1.2.1 Additional Information

Flexibility of the Curriculum: CBCS/Core/Elective option / Open options

The CBCS options and the Institutional provisions are as follows:

1. **M. Sc (Chemistry): Elective options = 04, Open Options = 27**
2. **M. Sc. (Biotechnology): Elective options = 02, Open Options = 27**
3. **M.Sc. (Physics): Elective options = 02, Open Options = 18**
4. **M.Sc. (Mathematics): Elective options = 04, Open Options = 15**
5. **M.Sc. Computer Science**
6. **M.A English**

The Core / Elective / CBS / Open options and the Institutional provisions (with Semester pattern) are as follows

5. **B. Sc: Core Subject Combinations (Institutional Provisions):**
   - **Physics, Chemistry, Mathematics.**
   - **Physics, Mathematics, Electronics**
   - **Physics, Mathematics, Computer Science**
   - **Mathematics, Electronics, Computer Science**
   - **Chemistry, Botany, Zoology.**
   - **Chemistry, Botany, Biochemistry**
   - **Chemistry, Zoology, Biochemistry**
   - **Chemistry, Zoology, Biotechnology**
   - **Chemistry, Botany, Biotechnology**
   - **Chemistry, Biochemistry, Biotechnology**

6. **Compulsory English Language at Undergraduate First year level**

7. **Optional Languages (Institutional provisions) for B.A and B. Sc:**
   - **Marathi, Hindi, Supplementary English**
8. **Optional Subject Combinations (Institutional Provisions) for B.A:**
   - **Philosophy**
   - **Communicative English**
   - **Sociology / Political Science**
   - **History / Economics**
   - **English Literature / Marathi Literature / Hindi Literature**

Name of Programmes adopting CBCS/ Elective	Adopted in the year
M.SC. CHEMISTRY (CBCS)	2016-17
M.SC. BIOTECHNOLGY (CBCS)	2016-17
M.SC. PHYSICS (CBCS)	Course stared in this college -2019-20 [CBCS started in 2016-17]
M.SC. MATHS (CBCS)	Course stared in this college -2019-20 [CBCS started in 2016-17]
B.A. CBS/Elective	2016-17
B.SC. CBS/Elective	2014-15
BCA CBS/Elective	2015-16
BCCA-CBS/Elective	2016-17
MSc Comouter Science	2022-23

ST. FRANCIS DE SALES COLLEGE NAGPUR

OFFICIATING PRINCIPAL
ST. FRANCIS DE SALES COLLEGE
NAGPUR

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

NOTIFICATION

No. Acad/215. Date : 15th June, 2015

To,

The Principal
of all the affiliated Science Colleges
of Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur

Subject:- Direction No. 10 of 2015.

Sir/Madam,

I am forwarding herewith a copy of the Direction No. 10 of 2015 issued by the Hon'ble Vice-Chancellor under Section 14(8) of Maharashtra Universities Act, 1994 **"DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) "**along with the examination scheme and Syllabi to be implemented from Academic Session **2015-2016**.

You are requested to kindly bring it to the notice of all teachers and students of your college.

Thanking you,

Direction and Syllabi available on the Rashtrasant Tukadoji Maharaj Nagpur University.

(www.nagpur university. org.)

Yours faithfully,

Encl: As above.

Sd/-
(Puran Meshram)
Registrar,
Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur.

No. Acad/-- Nagpur dated the 15th June, 2015

Copy for information and necessary action along with the Direction , Examination Scheme and Syllabi as mentioned above to :-

1) The Dean Faculty of Science, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.
2) The Controller of Examinations, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
3) The Director, B.C.U.D., Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
4) The Deputy Registrar (Examinations) Rashtrasant Tukadoji Maharaj Nagpur University,
5) The Deputy Registrar (Coll. Sec.) Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
6) The Asstt. Registrar (Prof. Exam.), Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
7) The Asstt. Registrar (Conf.), Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.

8) The Asstt. Registrar (Exams & Enqury.), Rashtrasant Tukadoji Maharaj Nagpur University,
9) The Officer-in-Charge, Publication Section, R.T.M. Nagpur University, Nagpur.
10) The Asstt. Registrar, Ordinance Section, R.T.M. Nagpur University, Nagpur
11) The P. A. to the Hon'ble Vice-Chancellor, R.T.M. Nagpur University, Nagpur
12) The P. A. to the Hon'ble Pro-Vice-Chancellor, R.T.M. Nagpur University, Nagpur
13) The P. A. to the Registar, R.T.M. Nagpur University, Nagpur
14) Mrs. Veena Prakashe, Information Scientist, R.T.M. Nagpur University, Nagpur

Sd/-
(Manish Zodpey)
Deputy Registrar(Acad.
Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FACULTY OF SCIENCE
DIERCTION NO. _10 OF 2015

DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE)

(Issued under Section 14(8) of the Maharashtra Universities Act, 1994)

Whereas, Maharashtra Universities Act, 1994 (hereinafter referred to as Act) has come into force from 22nd July, 1994 and was amended from time to time,

AND

Whereas, the University Grants Commission, New Delhi vide letter No.D.O.No.F-1-1/2015 (CM) dated 8th January 2015 regarding reforms pertaining to the introduction of Choice Based Credit System at the earliest from the academic session 2015-16 to provide option to students and also seamless mobility across the institutions.

AND

Whereas, the Board of Studies in all the Science subjects in their meeting held during 24.4.2015 prepared the syllabi and scheme of examination for the M. Sc. and M. Sc. (Tech) Applied Geology course and recommended for starting of the Choice Based Credit System in Faculty of Science from the academic session 2015-16,

AND

Whereas, the faculty of Science in its meeting held on 20.5.2015 vide item No. 16 , has considered, accepted and recommended to Academic Council, the policy decision regarding introduction of Choice Based Credit System and the draft syllabi of M. Sc. Semester-I to IV (Semester I to VI for M. Sc. (Tech) Applied Geology) with draft direction and other details.

AND

Whereas, the Academic Council in its meeting held on _ _ _ _ _ _ _ _ _ vide item No. _ _ has considered, accepted and recommended to Management Council, for M.Sc. along with draft direction and other details.

AND

Whereas, the Management Council in its meeting held on _ _ _ _ _ _ vide item No. _ _ , has considered, accepted the draft direction and other details.

AND

Whereas, the new draft direction and scheme of examination as per semester pattern is to be implemented from the Academic Session 2015-16 for M.Sc. semester I and onwards which is to be regulated by this direction and as such there is no existence and framing of an Ordinance for the above examination is a time consuming process.

AND

Whereas, the admission of students in the Choice Based Credit System at M.Sc. Semester I and onwards are to be made in the Academic Session 2015-16.

AND

Whereas, ordinance making is a time consuming process, therefore, I, Dr. S. P. Kane, Vice Chancellor Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur in exercise of powers vested under Section 14(8) of the Act do hereby issue the following Direction.

1. This Direction may be called "Direction relating to examinations leading to the Degree of Master of Science, Semester Pattern (Choice Based Credit System) and Degree of Master of Science and Technology (Applied Geology), Semester Pattern, (Choice Based Credit System)
2. The direction shall come into force from the date of its issue by Hon'ble Vice Chancellor and shall remain in force till the relevant ordinance comes into being in accordance with the provisions of the Act.
3. The duration of the M. Sc. course shall be of two academic years consisting of four semesters with the University examinations at the end of each semester namely:

a) M. Sc. Semester I Exam
b) M. Sc. Semester II Exam
c) M. Sc. Semester III Exam
d) M. Sc. Semester IV Exam

4. The duration of the M. Sc. (Tech) Applied Geology course shall be of three academic years consisting of six semesters with the University examinations at the end of each semester namely:
   a) M. Sc. Semester I Exam
   b) M. Sc. Semester II Exam
   c) M. Sc. Semester III Exam
   d) M. Sc. Semester IV Exam
   e) M. Sc. Semester V Exam
   f) M. Sc. Semester VI Exam
5. The theory examination of Semester-I, II, III, IV, V and VI shall be conducted by the University and shall be held separately at the end of each semester at such places and dates as may be decided and notified by the University and shall be held as per the schedule given in Table below.

Sr. No.	Name of the examination	Main Examination	Supplementary Examination
1	Semester I, III & V	Winter	Summer
2	Semester II, IV&VI	Summer	Winter

ELIGIBILITY TO THE COURSE:

6. Subject to their compliance with the provisions of this direction and of other ordinances in force from time to time, the following applicant candidates shall be eligible for the admission to Master of Science and examinations theirof

A	For M. Sc. (Physics) Semester-I	For admission to the M. Sc. Semester I in Physics, a candidate shall have offered Physics as one of the subjects at the qualifying B.Sc. Examination.
B	For M. Sc. (Chemistry) Semester-I	For admission to the M. Sc. Semester I in Chemistry, a candidate shall have offered Chemistry / Industrial Chemistry as one of the subjects at the qualifying B.Sc. Examination.
C	For M. Sc. (Mathematics) Semester-I	For admission to the M. Sc. Semester I in Mathematics, a candidate shall have offered Mathematics as one of the subjects at the qualifying B.Sc. Examination.
D	For M. Sc. (Statistics) Semester-I	For admission to the M. Sc./M.A. Semester I in Statistics, a candidate shall have offered Statistics/Maths as one of the subjects at the qualifying B.Sc./B.A. Examination.
E	For M. Sc. (Computer Science) Semester-I	For admission to the M. Sc. Semester I in Computer Science, a candidate shall have offered Computer Science as one of the optional subjects of study and examination at B.Sc. degree or B.Sc./ B.E. examination with Post B.Sc. diploma course in Computer Science of RTM Nagpur University or any other statutory university and Application or B.Sc. with optional subjects Computer Maintenance / B.Sc. (Information Technology) / B.C.A.
F	For M. Sc. (Information Technology) Semester-I	For admission to the M. Sc. Semester I in Information Technology, a candidate must have Mathematics at 10+2 level and shall have passed B.Sc. (Computer Science) / B.Sc. (Information Technology) / B.Sc. (with Information Technology as the optional subject) / Bachelor of Computer Application (BCA)/ B.Sc. with optional subjects Mathematics, Computer Maintenance, Computer Science / B.Sc. with Electronics / Computer Maintenance as one of the subject .
G	For M. Sc. (Electronics) Semester-I	For admission to the M. Sc. Semester I in Electronics, a candidate shall have offered Electronics / Computer Maintenance as one of the subjects at the qualifying B.Sc. Examination.

H	For M. Sc. (Botany) Semester-I	For admission to the M. Sc. Semester I in Botany, a candidate shall have offered Botany as one of the subjects at the qualifying B.Sc. Examination / B.Sc. (Agriculture) with Botany is one of the subject.
I	For M. Sc. (Zoology) Semester-I	For admission to the M. Sc. Semester I in Zoology, a candidate shall have offered Zoology as one of the subjects at the qualifying B.Sc. Examination.
J	For M. Sc. (Microbiology) Semester-I	For admission to the M. Sc. Semester I in Microbiology, a candidate shall have offered Microbiology/ Biotechnology as a subject of study and examination at B.Sc. degree.
K	For M. Sc. (Biochemistry) Semester-I	For admission to the M. Sc. Semester I in Biochemistry, a candidate shall have offered Chemistry and Biochemistry as subjects of study and examination at B.Sc. degree.
L	For M. Sc. (Biotechnology) Semester-I	For admission to the M. Sc. Semester I in Biotechnology, a candidate shall be all Life Science graduates / Veterinary / Fishery Sciences / Pharmacy / Engineering Technology / Medicine (MBBS) / B.D.S. graduates / B.Sc. Agriculture.
M	For M. Sc. (Environmental Science) Semester-I	For admission to the M. Sc. Semester I in Environmental Science, a candidate shall have offered Environmental Science as one of the subjects at the qualifying B.Sc. Examination and B.Sc. Agriculture Science but having Environmental Science is one of the subject.
N	For M. Sc. (Molecular Biology and Genetic Engineering)	For admission to the M. Sc. Semester I in Molecular Biology and Genetic Engineering, the candidates who have passed the B.Sc. Examination in at least second division with any one or more subjects of life sciences / biological sciences / candidates who have passed B.Sc. with Biotechnology as one of the subjects in second division / candidates who have passed the B. Pharm. Examination in at least second division / candidates who have passed the graduation degree in agriculture / fisheries / veterinary sciences Examination in at least second division.
O	For M. Sc. (Geology) Semester-I	For admission to the M. Sc. Semester I in Geology, a candidate shall have offered Geology as one of the subjects at the qualifying B.Sc. Examination.
P	For M. Sc. (Tech) Applied Geology Semester-I	For admission to the M. Sc. (Tech) Semester I in Applied Geology, a candidate shall have offered Geology as one of the subjects at the qualifying B.Sc. Examination.
Q	For M. Sc. (Sericulture) Semester-I	For admission to the M. Sc. Semester I in Sericulture, a candidate shall have offered Sericulture / Zoology / Botany / Microbiology / Biochemistry as one of the subjects at the qualifying B.Sc. Examination / B.Sc. (Agriculture Science)

Candidates shall have passed any one of the above examinations from Rashtrasant Tukadoji Maharaj Nagpur University or any other statutory University of India or abroad, recognized by the UGC or any other concerned apex regulatory authority / body of India.

7) Semester Examinations

A	M. Sc. Semester I Examination	Students who have fulfilled the eligibility criteria as mentioned in Section 6 and have been admitted to this course in Semester I.
B	M. Sc. Semester II Examination	Students who have been admitted to this course in semester II.
C	M. Sc. Semester III Examination	Students who have been admitted to this course in semester III.
D	M. Sc. Semester IV Examination	i) Students who have been admitted to this course in semester IV. ii) Every student shall submit two copies of the project report (typed and properly bound) for the Fourth Semester to the Concerned Department at least one month prior to the commencement of the final practical examination through the Head of the Department / Centre / the Principal of the college concerned along

		with the certificate signed by the supervisor and declaration by the candidate towards original work which is not submitted to any university or organization for award of the degree. The scheme/ guidelines for the students and supervisors regarding Project Work Report are given in Appendix 04

(Note: Subject to the Rules of ATKT as mentioned in para 9 of this direction)

8) [M. Sc. (Tech) Applied Geology]

A	M. Sc. (Tech) Applied Geology] Semester I Examination	Students who have fulfilled the eligibility criteria as mentioned in Section 6 and have been admitted to this course in Semester I.
B	M. Sc. (Tech) Applied Geology] Semester II Examination	Students who have been admitted to this course in semester II.
C	M. Sc. (Tech) Applied Geology] Semester III Examination	Students who have been admitted to this course in semester III.
D	M. Sc. (Tech) Applied Geology] Semester IV Examination	Students who have been admitted to this course in semester IV.
E	M. Sc. (Tech) Applied Geology] Semester V Examination	Students who have been admitted to this course in semester V.
F	M. Sc. (Tech) Applied Geology] Semester VI Examination	Students who have been admitted to this course in semester VI.

(Note: Subject to the Rules of ATKT as mentioned in para 9 of this direction)

9) A) The ATKT rules for admission for the M. Sc. Course (Theory ,Practical and Seminar as separate passing head and on calculation fraction, if any, shall be ignored) shall be as given in the following table

Admission to Semester	Candidate should have passed in all the subjects of the following examination of R.T.M. Nagpur University	Candidate should have passed at least two third of the passing heads of the following examinations
Semester I	As provided in the para 6 of the direction	--------
Semester II	--------	--------
Semester III	--------	Semester I and II taken together
Semester IV	--------	--------

B) The ATKT rules for admission for the M. Sc. (Tech) Applied Geology Course (Theory ,Practical and Seminar as separate passing head and on calculation fraction, if any, shall be ignored) shall be as given in the following table-

Admission to Semester	Candidate should have passed in all the subjects of the following examination of R.T.M. Nagpur University	Candidate should have passed at least two third of the passing heads of the following examinations
Semester I	As provided in the para 6 of the direction	--------
Semester II	--------	--------
Semester III	--------	Semester I and II taken together
Semester IV	--------	-------
Semester V	Semester I and II	a) Passed Semester I and II examination And b) Two third of the passing heads of Semester III and IV taken together
Semester VI	--------	-------

10) Without prejudice to other provisions of Ordinance no. 6 relating to the examination in general, provisions of Para 5, 8, 9, 10, 26, 31 and 32 of the said ordinance shall apply to every student admitted to this course.
11) The fees for the tuition, examination, laboratory and other fees shall be as prescribed by the university from time to time.
12) (a) The scope of the subjects shall be as prescribed in the syllabus.
    (b) The medium of instruction and examination shall be English.
13) The number of papers and maximum marks assigned to each paper and minimum marks / grade, an examinee must obtain in order to pass the examination shall be as prescribed in appendices appended with this direction.
14) The examinee at each of the examination shall have option of not being declared successful at the examination in case he / she does not secure a minimum of grade equivalent to 55% marks at the examination. This option will have to be exercised every time the application is submitted to any of the examinations. Once this option is exercised, the option shall be binding on the examinee and it shall not be evoked in under any circumstances.
15) The classification of the examinee successful at the semester and examinations and at the end of final semester examination shall be as per the rules and regulations of Choice Based Credit System as prescribed in appendices, appended with this direction.
16) The provisions of direction no. 3 of 2007 for the award of grace marks for passing an examination, securing higher grade in subject(s) as updated from time to time shall apply to the examination under this direction.
17) The names of the successful examinee passing the examination as a whole in the minimum prescribed period and securing the grades equivalent to first and second division shall be arranged in order of merit as provided in ordinance 6 relating to examination in general.
18) Successful examinees at the end of M. Sc. Sem-IV Examination (Sem VI for M. Sc. (Tech) Applied Geology) who obtained CGPA above 7.51 shall be placed in First Division with distinction, those obtaining CGPA from 6.00 to 7.50 shall be placed in First Division, those obtaining CGPA from 4.50 to 5.99 shall be placed in Second Division and those obtaining CGPA from 4.00 to 4.49 shall be placed in Third Division.
19) No candidate shall be admitted to an examination under this direction, if he / she has already passed the same examination of this university or of any other university.
20) Successful examinees at the M. Sc. Sem I, II, III, & IV ((Sem I, II, III, IV, V & VI for M. Sc. (Tech) Applied Geology) Examinations shall be entitled to receive a Certificate signed by the Controller of Examination of University (COE) and successful examinees at the end of M. Sc. Sem IV (Sem VI for M. Sc. (Tech) Applied Geology) examination shall, on payment of prescribed fees, receive a Degree in the prescribed format, signed by the Vice-Chancellor.
21) This course is based on Choice Based Credit System and therefore, it will be also regulated by guidelines and regulation given in appendices which are part of this direction.
22) Absorption scheme for failure students of the credit based semester pattern:
    a) While switching over to Choice Based Credit System, the failure students of credit based semester pattern will be given **Five** chances to clear the examination.

b) The candidates who have cleared first and second semester of Part I of the Credit Based Semester Pattern examination in the concerned subject shall get admission to Third Semester of Part II of the Choice Based Credit System directly. However, candidates who are allowed to keep term will not be eligible for admission to Third Semester of Part II of the Choice Based Credit System unless they clear all the papers and practical of first and second semester of Part I of the Credit Based Semester Pattern examination.

c) The candidates who have cleared Third and Fourth semester of Part II of the Credit Based Semester Pattern examination in the concerned subject shall get admission to Fifth Semester of Part III of the Choice Based Credit System directly. However, candidates who are allowed to keep term will not be eligible for admission to Fifth Semester of Part III of the Choice Based Credit System unless they clear all the papers and practical of Third and Fourth semester of Part II of the Credit Based Semester Pattern examination.

23 Absorption scheme for failure students of annual pattern:

a. The candidates who have cleared first year of annual pattern shall get admission to Semester III of the Choice Based Credit System directly. However, candidates who are allowed to keep term will not be eligible for admission to Third Semester of the Choice Based Credit System unless they clear all the papers and practical of First year of the annual pattern examination.

b. For M. Sc. Tech Applied Geology course, the candidates who have cleared second year of annual pattern shall get admission to Semester V of the Choice Based Credit System directly. However, candidates who are allowed to keep term will not be eligible for admission to firth Semester of the Choice Based Credit System unless they clear all the papers and practical of First and Second year of the annual pattern examination.

24 With the issuance of this Direction No. _ _ of 2015, The Direction No 3 of 2015 (Credit based Semester Pattern) & Direction No. 14 of 2010 (M. Sc. Molecular Biology & Genetic Engineering) & Ordinance No. 49 (Annual Pattern) shall stand repealed.

Appendix-1

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in all subjects except Mathematics and M.Sc. (Tech) Applied Geology

Semester I for M.Sc. Program in all subjects except Mathematics and M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 1	Paper 1	4	-	4	4	3	80	20	100	40	
Core 2	Paper 2	4	-	4	4	3	80	20	100	40	
Core 3	Paper 3	4	-	4	4	3	80	20	100	40	
Core 4	Paper 4	4	-	4	4	3	80	20	100	40	
Pract. Core 1 & 2	Practical 1	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 3 & 4	Practical 2	-	8	8	4	3-8*	100**	-	100		40
Seminar 1	Seminar 1	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester II for M.Sc. Program in all subjects except Mathematics and M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 5	Paper 5	4	-	4	4	3	80	20	100	40	
Core 6	Paper 6	4	-	4	4	3	80	20	100	40	
Core 7	Paper 7	4	-	4	4	3	80	20	100	40	
Core 8	Paper 8	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6	Practical 3	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 7 & 8	Practical 4	-	8	8	4	3-8*	100**	-	100		40
Seminar 2	Seminar 2	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester III for M.Sc. Program in all subjects except Mathematics and M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 9	Paper 9	4	-	4	4	3	80	20	100	40	
Core 10	Paper 10	4	-	4	4	3	80	20	100	40	
Core Elective 1	Paper 11	4	-	4	4	3	80	20	100	40	
Foundation Course 1	Paper 12	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10	Practical 5	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 1	Practical 6	-	8	8	4	3-8*	100**	-	100		40
Seminar 3	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester IV for M.Sc. Program in all subjects except Mathematics and M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 11	Paper 13	4	-	4	4	3	80	20	100	40	
Core 12	Paper 14	4	-	4	4	3	80	20	100	40	
Core Elective 2	Paper 15	4	-	4	4	3	80	20	100	40	
Foundation Course 2	Paper 16	4	-	4	4	3	80	20	100	40	
Pract. Core 11, 12 & Elective 2	Practical 7	-	8	8	4	3-8*	100**	-	100		40
Project	Project		8	8	4		100**	-	100		40
Seminar 4	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Note: Th = Theory; Pr = Practical/lab, * = If required, for two days.
** = The Practical and Project shall be evaluated by both the External and Internal Examiner in the respective Department / Center / Affiliated College as per guidelines appended with this direction.

1. In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.
2. The student will have to carry out the project work (based on guidelines appended to this direction) in lieu of practical in the fourth semester in the department or depending on the availability of placement; he / she will be attached to any of the national / regional / private research institute / organization.
3. Internal Assessment Marks will be as per appendix attached in this direction.
4. **Foundation Course:** Student can choose this paper from any other subject other than his / her main subject for postgraduation.
5. One credit of 25 marks for theory / tutorial will be of one clock hour per week, running for 15 weeks.
6. One credit of 25 marks for practical / project / seminar will be of two clock hour per week, running for 15 weeks.

Appendix-2

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Mathematics

Semester I for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
							Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total		External Marks	Internal Ass		Th. External	Internal Ass.
Core 1	Paper 1	5	5	4	1	5	3	100	25	125	50	
Core 2	Paper 2	5	5	4	1	5	3	100	25	125	50	
Core 3	Paper 3	5	5	4	1	5	3	100	25	125	50	
Core 4	Paper 4	5	5	4	1	5	3	100	25	125	50	
Core 5	Paper 5	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

Semester II for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
							Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total		External Marks	Internal Ass		Th. External	Internal Ass.
Core 6	Paper 6	5	5	4	1	5	3	100	25	125	50	
Core 7	Paper 7	5	5	4	1	5	3	100	25	125	50	
Core 8	Paper 8	5	5	4	1	5	3	100	25	125	50	
Core 9	Paper 9	5	5	4	1	5	3	100	25	125	50	
Core 10	Paper 10	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

Semester III for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
								Max. Marks			Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total	Duration in hrs.	External Marks	Internal Ass	Total Marks	Th. External	Internal Ass.
Core 11	Paper 11	5	5	4	1	5	3	100	25	125	50	
Core 12	Paper 12	5	5	4	1	5	3	100	25	125	50	
Core 13	Paper 13	5	5	4	1	5	3	100	25	125	50	
Core Elective 1	Paper 14	5	5	4	1	5	3	100	25	125	50	
Foundation Course 1	Paper 15	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

Semester IV for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
								Max. Marks			Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total	Duration in hrs.	External Marks	Internal Ass	Total Marks	Th. External	Internal Ass.
Core 14	Paper 16	5	5	4	1	5	3	100	25	125	50	
Core 15	Paper 17	5	5	4	1	5	3	100	25	125	50	
Core 16	Paper 18	5	5	4	1	5	3	100	25	125	50	
Core Elective 2	Paper 19	5	5	4	1	5	3	100	25	125	50	
Foundation Course 2	Paper 20	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

*Internal Assessment: For the purpose of internal assessment the department will conduct three tests (with equal weight of marks). Best two scores of a student in these tests will be considered to obtain the internal assessment score of that student.

Foundation Course: Student can choose this paper from any other subject other than his / her main subject for postgraduation.

Appendix-3

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. (Tech) Applied Geology

Semester I for M.Sc. Program in M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 1	Paper 1	4	-	4	4	3	80	20	100	40	
Core 2	Paper 2	4	-	4	4	3	80	20	100	40	
Core 3	Paper 3	4	-	4	4	3	80	20	100	40	
Core 4	Paper 4	4	-	4	4	3	80	20	100	40	
Pract. Core 1 & 2	Practical 1	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 3 & 4	Practical 2	-	8	8	4	3-8*	100**	-	100		40
Seminar 1	Seminar 1	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester II for M.Sc. Program in M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 5	Paper 5	4	-	4	4	3	80	20	100	40	
Core 6	Paper 6	4	-	4	4	3	80	20	100	40	
Core 7	Paper 7	4	-	4	4	3	80	20	100	40	
Core 8	Paper 8	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6	Practical 3	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 7 & 8	Practical 4	-	8	8	4	3-8*	100**	-	100		40
Seminar 2	Seminar 2	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester III for M.Sc. Program in M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 9	Paper 9	4	-	4	4	3	80	20	100	40	
Core 10	Paper 10	4	-	4	4	3	80	20	100	40	
Core 11	Paper 11	4	-	4	4	3	80	20	100	40	
Core 12	Paper 12	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10	Practical 5	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 11 & 12	Practical 6	-	8	8	4	3-8*	100**	-	100		40
Seminar 3	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester IV for M.Sc. Program in M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 13	Paper 13	4	-	4	4	3	80	20	100	40	
Core 14	Paper 14	4	-	4	4	3	80	20	100	40	
Core 15	Paper 15	4	-	4	4	3	80	20	100	40	
Core 16	Paper 16	4	-	4	4	3	80	20	100	40	
Pract. Core 13 & 14	Practical 7	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 15 & 16	Practical 8	-	8	8	4	3-8*	100**	-	100		40
Seminar 4	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester V for M.Sc. Program in M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Houurs / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 17	Paper 17	4	-	4	4	3	80	20	100	40	
Core 18	Paper 18	4	-	4	4	3	80	20	100	40	
Core Elective 1	Paper 19	4	-	4	4	3	80	20	100	40	
Foundation Course 1	Paper 20	4	-	4	4	3	80	20	100	40	
Pract. Core 17 & 18	Practical 9	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 1	Practical 10	-	8	8	4	3-8*	100**	-	100		40
Seminar 5	Seminar 5	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Semester VI for M.Sc. Program in M.Sc. (Tech) Applied Geology											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 19	Paper 21	4	-	4	4	3	80	20	100	40	
Core 20	Paper 22	4	-	4	4	3	80	20	100	40	
Core Elective 2	Paper 23	4	-	4	4	3	80	20	100	40	
Foundation Course 2	Paper 24	4	-	4	4	3	80	20	100	40	
Pract. Core 19, 20	Practical 11	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 2	Practical 12	-	8	8	4	3-8*	100**	-	100		40
Seminar 6	Seminar 6	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Note: Th = Theory; Pr = Practical/lab, * = If required, for two days.

** = The Practical shall be evaluated by both the External and Internal Examiner in the respective Department / Center / Affiliated College as per guidelines appended with this direction.

1. In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.
2. Internal Assessment Marks will be as per appendix attached in this direction.
3. **Foundation Course:** Student can choose this paper from any other subject other than his / her main subject for postgraduation.
4. One credit of 25 marks for theory / tutorial will be of one clock hour per week, running for 15 weeks.
5. One credit of 25 marks for practical / project / seminar will be of two clock hour per week, running for 15 weeks.

Appendix-4

Project Work Scheme / Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out a project work in semester IV. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.

Experimental Project Work and Field Based Project Work:

Student can carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work / Field work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV or VI as applicable. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV or VI as applicable. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College

The supervisors for the Project Work shall be from the following.

A person shall be an approved faculty member in the relevant subject.

OR

Scientists of National Laboratories / Regional Research Laboratories who are approved by dint of their appointments in such facilities by the Union Government / the State Government / Nagpur University / Other Universities recognized by UGC.

The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.

The examiners will evaluate the Experimental Project Work taking into account the Coverage of subject matter, Arrangement and presentation, References, etc.

For written Project work	: 40 Marks – Evaluated jointly by External & Internal
Presentation	: 20 Marks – Evaluated jointly by External & Internal
For Viva-Voce	: 20 Marks – Evaluated by External examiner
Internal Assessment	: 20 Marks – Evaluated by Internal examiner
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Total	: 100 Marks

Appendix-5

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester (Except M. Sc. Mathematics), the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in two copies to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Appendix 6

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment shall be completed by the College / University at least 15 days prior to the final examination of each semester. The Marks shall be sent to the University immediately after the Assessment in the prescribed format.
3. For the purpose of internal assessment the University Department / College shall conduct one to three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
4. General guidelines for Internal Assessment are:
   a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
   b) There shall be one to three assignments (as described above) per Theory paper.
   c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the Internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
   d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
   e) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she propose to adopt and the scheme of marking for internal assessment.
   f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.
   g) Final submission of internal marks to the University shall be before the commencement of the University Theory / Practical examinations whichever is later.

Appendix 7

Practical Examination

1. Each practical carries 100 marks. For the examination, the distribution of the marks shall be as follows:
   a. Record / Journal / Internal assessment : 20 marks – Evaluated by Internal
   b. Practical Performance : 60 marks – Evaluated jointly by External & Internal
   c. Viva-voce : 20 marks - Evaluated by External

   NOTE: Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
2. Practical exam shall be of 3 to 8 hours duration for one or two days, depending on subject and number of students.
3. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department.

4. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.
5. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _
Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _ of M. Sc. _ _ _ _ _ _ _ _ _ _ _ _ _ _ Semester _ _ _ _ _ _ _ _ _ _ during the academic year _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments prescribed by Rashtrasant Tukdoji Maharaj Nagpur University for the subject _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee
1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Head of the Department

Appendix 8

Subject wise Core Elective Papers:

M. Sc. Subject	**Core elective paper to be opted in sem III (Sem V in case of M. Sc. (Tech) Applied Geology)**	**Core elective paper to be opted in sem IV (Sem VI in case of M. Sc. (Tech) Applied Geology)**
M. Sc. (Physics)	Materials Science I	Materials Science II
	X-ray I	X-ray II
	Nanoscience and Nanotechnology I	Nanoscience and Nanotechnology II
	Atomic and Molecular Physics I	Atomic and Molecular Physics II
	Applied Electronics I	Applied Electronics II
	Methods of Theoretical Physics I	Methods of Theoretical Physics II
	Nonlinear Dynamics I	Nonlinear Dynamics II
M. Sc. (Chemistry)	Applied Analytical Chemistry I	Applied Analytical Chemistry II
	Nuclear Chemistry I	Nuclear Chemistry II
	Environmental Chemistry I	Environmental Chemistry II
	Polymer Chemistry I	Polymer Chemistry II
	Medicinal Chemistry I	Medicinal Chemistry II
M. Sc. (Mathematics)	Fluid Dynamics I	Fluid Dynamics II
	General Relativity	Cosmology
	Operations Research I	Operations Research II
M. Sc. (Statistics)	Mathematical Programming	Operations Research
	Industrial Process and Quality Control	Industrial Statistics
	Demography	Actuarial Statistics
	Survival Analysis	Biostatistics
	Statistical Ecology	Reliability Theory
	Computer Programming	Data Mining
M. Sc. (Computer Science)	Neural Network	Design and Analysis of Algorithm
	Mobile Computing	Embedded System
	Multimedia Technologies	Pattern Recognition
	ASP.NET	Parallel Computing
	Digital & Cyber Forensics	Mobile & Cyber Forensics
M. Sc. (Information Technology)	Soft Computing	Design and Analysis of Algorithm
	Distributed Databases	Cloud Computing

	Object Oriented Analysis and Design using UML	Mobile Computing
	CORBA	Enterprise Computing
	Digital & Cyber Forensics	Mobile & Cyber Forensics
M. Sc. (Electronics)	Digital signal Processing	Microwave and Optical Communication
	Mechatronics	Mobile and Satellite Communication
M. Sc. (Botany)	Molecular Biology and Plant Biotechnology I	Molecular Biology and Plant Biotechnology II
	Reproductive Biology of Angiosperms- I	Reproductive Biology of Angiosperms- II
	Advanced Phycology and Hydrobiology I	Advanced Phycology and Hydrobiology II
	Mycology and Plant pathology I	Mycology and Plant pathology II
	Palaeobotany I	Palaeobotany II
	Palynology I	Palynology II
	Plant Physiology I	Plant Physiology II
M. Sc. (Zoology)	Entomology II	Entomology IV
	Fish & Fisheries II	Fish & Fisheries IV
	Mammalian Reproductive Physiology (MRP) II	Mammalian Reproductive Physiology (MRP) IV
	Animal Physiology II	Animal Physiology IV
	Cell Biology II	Cell Biology IV
	Fresh Water Zoology II	Fresh Water Zoology IV
	Aquaculture II	Aquaculture IV
	Environmental Biology II	Environmental Biology IV
	Sericulture II	Sericulture IV
M. Sc. (Microbiology)	Microbial Diversity, Evolution and Ecology (MDEE)	Microbial Diversity, Evolution and Ecology (MDEE)
	Bioinformatics (BIF)	Bioinformatics (BIF)
	Drungs, Vaccines and Delivery Systems (DVD)	Drungs, Vaccines and Delivery Systems (DVD)
M. Sc. (Biochemistry)	Biochemical & Environmental Toxicology	Clinical Research
	Nutritional Biochemistry	Applied Nutritional Biochemistry
M. Sc. (Biotechnology)	Industrial Biotechnology I	Industrial Biotechnology II
	Environmental Biotechnology I	Environmental Biotechnology II
M. Sc. (Environmental Science)	Biological processes in waste water treatment	Environmental Impact assessment and Legislation
	Water supply and resources	Environmental Management
M. Sc. (Molecular Biology and Genetic Engineering)	Molecular Diagnostics Methods	Molecular Diagnostics
	Plant Genetic Engineering I	Plant Genetic Engineering II
	Bioinformatics I	Bioinformatics II
M. Sc. (Geology)	Fuel Geology (Coal, Petroleum & Nuclear)	Mining Geology & Mineral Exploration
	Environmental Geology and Engineering Geology	Exploration Geochemistry
	Petroleum Exploration	Applied & Industrial Micropalentology
	Quaternary Geology & Limnogeology	Basin Analysis & Sequence Stratigraphy
		Marine Geology & Oceanography
M. Sc. (Tech) Applied Geology	Exploration Geochemistry	Environmental Geology & Geohazards

	Quaternary Geology & Limnogeology	Petroleum Exploration
	Marine Geology & Oceanography	Basin Analysis & Sequence Stratigraphy
M. Sc. (Sericulture)	Genetics & Breeding of Mulberry Silk Work	Economics of Sericulture and Trading of Silk
	Genetics & Breeding of Silk Worm & Host Plant	Extension, Management & Product Analysis

Appendix 9

Foundation Course

Candidate can opt for any one foundation course paper as shown below in the semester III and IV (Semester V & VI in case of M. Sc. (Tech) Applied Geology). However, Student shall opt for this paper from any other subject other than his / her main subject for postgraduarion.

List of foundation courses available:

M. Sc. Subject	**Foundation Course I in semester III (Sem V in case of M. Sc. (Tech) Applied Geology)**	**Foundation Course II in Semester IV (Sem VI in case of M. Sc. (Tech) Applied Geology)**
M. Sc. (Physics)	Fundamentals of Spectroscopy	Spectroscopic applications
	Fundamentals of Nanoscience and Nanotechnology	Optics and Optical Instruments
M. Sc. (Chemistry)	Instrumental Methods of Analysis-I	Instrumental Methods of Analysis-II
M. Sc. (Mathematics)	Elementary Mathematics	Elementary Discrete Mathematics
	Elementary Mathematical Methods	Fuzzy Mathematics II
	Elementary Numerical Methods	Linear Programming
	Fuzzy Mathematics I	
M. Sc. (Statistics)	Foundation course in Statistics I	Foundation course in Statistics II (Applied Statistics)
	Biostatistics I	Biostatistics II
M. Sc. (Computer Science)	Operating system concepts	Advances in information technology
	Principles of Management	Enterprise Resource Planning
	Managerial Economics	Supply Chain Management
	Retail & Services Marketing	Total Quality Management
	Financial Services Management	Banking Operations And Services
	E-Business	Information Security And Cyber Law
M. Sc. (Information Technology)	Operating system concepts	Advances in information technology
	Principles of Management	Enterprise Resource Planning
	Managerial Economics	Supply Chain Management
	Retail & Services Marketing	Total Quality Management
	Financial Services Management	Banking Operations And Services
	E-Business	Information Security And Cyber Law
M. Sc. (Electronics)	Basic Electronics	PC and PC Interfacing
M. Sc. (Botany)	General Botany	Applied Botany
M. Sc. (Zoology)	Elementary Zoology	Applied Zoology
	Basic Entomology	Applied & Industrial Entomology
	Fresh Water Fisheries	Applied Fresh Water Fisheries
	Human Physiology	Applied Human Physiology
M. Sc. (Microbiology)	General Microbiology	Advanced Microbiology
M. Sc. (Biochemistry)	Biomolecules and Basic Metabolism	Enzyme Technology
M. Sc. (Biotechnology)	Introductory Biotechnology	Molecular Biotechnology
M. Sc. (Environmental Science)	Fundamentals of Environmental Science-I	Fundamentals of Environmental Science -II
M. Sc.	Molecular Biology	Recombinant DNA Technology and

(Molecular Biology and Genetic Engineering)		Plant Genetic Engineering
M. Sc. (Geology)	Introduction to Geology	Paleobiology
M. Sc. (Tech) Applied Geology	Introduction to Geology	Paleobiology
M. Sc. (Sericulture)	Sericulture, Commercial insect conservation & Management	Insect Cell Culture & Molecular Informatics Technology

Appendix-10

General Rules and Regulations regarding pattern of question paper, absorption scheme and choice based credit system:

A) Pattern of Question Paper

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 80 (In M. Sc. Mathematics, each paper will be of 100 marks)
3. Question paper will consist of five questions, each of 16 marks (In M. Sc. Mathematics, each question will be of 20).
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

B) Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

M. Sc. Program shall consist of four semesters, wherein the student has to complete certain number of credits as indicated in Table 1. Each subject (or course) has fixed number of credits. The types of subject subheads are: Core, Core Pract, Core Elective, Core Elective Pract, Foundation Course, Seminar and Project / Review writing.

Among the 100 credits (Applied Geology 150) which candidate needs to complete and clear for M. Sc. in any concerned subjects, at least 92 credits (Maths 90 / Appl. Geo 146) must be taken from the parent department where he / she is registered for M. Sc. Course. The remaining 08 credits (Maths 10 / Appl. Geo 8) can be taken from any other department of university or affiliated colleges offering foundation courses of PG programs. Similar is the case with Mathematics and Geology program with the exception of difference (given in parentheses) in number of credits.

Table 1: Credit Requirements for Post Graduate Studies

PG	Semester	Core	Pract Core	Core Elective	Pract Core Elective	Foundation Course	Project / Review Writing	Seminar	Total Credits
M. Sc. Maths	I	25							100
	II	25							
	III	15		5		5			
	IV	15		5		5			
Total		**80**		**10**		**10**			**100**
M. Sc. (Tech) Applied Geology	I	16	8					1	150
	II	16	8					1	
	III	16	8					1	
	IV	16	8					1	
	V	8	4	4	4	4		1	
	VI	8	4	4		4	4	1	
Total		**80**	**40**	**8**	**4**	**8**	**4**	**6**	**150**
All other M. Sc.	I	16	8					1	100
	II	16	8					1	
	III	8	4	4	4	4		1	
	IV	8	4	4		4	4	1	
Total		**48**	**24**	**8**	**4**	**8**	**4**	**4**	**100**

Explanatory terms:

1. **Core:** Major theory papers in the concerned subject.
2. **Core Elective:** These papers will be specialization in the concerned subject. Ex. Zoology – MRP, AP, Fisheries, Entomology etc.
3. **Foundation Course:** Student can choose this paper from any other subject other than his main subject for postgraduation. For Ex. An M. Sc. Biochemistry student can take such a foundation course paper from Zoology or Mathematics or Computer Science or Political Science subject.
4. **Project / Review writing:** Project / Review writing is in semester IV (Sem VI in Geology).
5. **Seminar:** The seminar in each semester shall be presented by the candidate in his / her parent department only.

Credits:

It is a unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work / field work per week.

For example a subject with 6-2-6 (L-T-P) means it has 3 Lectures, 1 Tutorial and 6 Practical in a week. This subject will have ten credits (6x1 + 2x½ + 6x½ = 10). If a student is declared pass in a subject, then he/she gets the credits associated with that subject. Depending on the marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Letter Grade	O	A+	A	B+	B	C	P	F	Ab
Grade Point	10	09	08	07	06	05	04	0	0

A student obtaining Grade F shall be considered failed and will be required to reappear for the examination.

Valuation pattern:

Every credit is for 25 marks and valuation and grade points will be given as per following pattern.

Marks obtained in Theory / Practical of 100 marks	Marks obtained in Theory / Practical of 50 marks	Letter Grade	Grade point
91-100	46-50	O	10
81-90	41-45	A+	09
71-80	36-40	A	08
61-70	31-35	B+	07
51-60	26-30	B	06
41-50	21-25	C	05
= 40	=20	P	04
<40	<20	F	0
Ab	Ab	Ab	0

Computation of SGPA and CGPA

Following is the procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (Si) = Σ(Ci x Gi) / Σ Ci

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for SGPA

Code	Theory / Practical	Credits	Marks Obtained	Out of	Grade Point	Grade Letter	Credit Point (Credit x Grade Point)
Core 1	Paper 1	4	91	100	10	O	4x10=40
Core 2	Paper 2	4	89	100	9	A+	4x9=36
Core 3	Paper 3	4	50	100	5	C	4x5=20
Core 4	Paper 4	4	78	100	8	A	4x8=32
Pract. Core 1 & 1	Practical 1	4	89	100	9	A+	4x9=36
Pract. Core 3 & 4	Practical 2	4	85	100	9	A+	4x9=36
Seminar 1	Seminar 1	2	46	50	10	O	2x10=20
	Total	**26**					**220**
Thus, **SGPA =220/26 = 8.4615384 = 8.46**							

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

CGPA = Σ (Ci x Si) / Σ Ci

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Illustration for CGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 26 SGPA: 8.46	Credit : 26 SGPA: 7.83	Credit : 26 SGPA: 5.69	Credit : 26 SGPA: 6.31

Thus,

$$\textbf{CGPA} = \frac{26 \times 8.46 + 26 \times 7.83 + 26 \times 5.69 + 2\,6 \times 6.31}{104}$$

$$= \frac{219.96 + 203.58 + 147.94 + 164.06}{104} = \frac{735.54}{104} = \textbf{7.0725} \qquad \textbf{i.e. 7.07}$$

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. Ex. 7.0765 = 7.08 or 6.5168 = 6.52 etc.

Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the HEIs may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

Sd/-

Nagpur: **Dr. S.P. Kane**

Dated : 15.6.2015 **Vice-Chancellor**

SYLLABUS for M. Sc. BIOTECHNOLOGY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.
The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Biotechnology

M. Sc. Biotechnology Semester I												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks		
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract	
Core 1 **(1T1)**	Paper 1: **Cell Biology and Enzymology**	4	-	4	4	3	80	20	100	40		
Core 2 **(1T2)**	Paper 2: **Molecular Biology**	4	-	4	4	3	80	20	100	40		
Core 3 **(1T3)**	Paper 3: **Biomolecules**	4	-	4	4	3	80	20	100	40		
Core 4 **(1T4)**	Paper 4: **Biophysical Techniques**	4	-	4	4	3	80	20	100	40		
Pract. Core 1 & 2 **(1P1)**	Practical 1: **Cell Biology and Enzymology**	-	8	8	4	3-8*	100**	-	100		40	
Pract. Core 3 & 4 **(1P2)**	Practical 2: **Macromolecules & Analytical Techniques**	-	8	8	4	3-8*	100**	-	100		40	
Seminar 1 **(1S1)**	Seminar 1	2	-	2	1			25	25	10		
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**	

M. Sc. Biotechnology Semester II											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 5 **(2T1)**	Paper 5: **Microbiology**	4	-	4	4	3	80	20	100	40	
Core 6 **(2T2)**	Paper 6: **Immunology**	4	-	4	4	3	80	20	100	40	
Core 7 **(2T3)**	Paper 7: **Fundamentals of Genetic Engineering**	4	-	4	4	3	80	20	100	40	
Core 8 **(2T4)**	Paper 8: **Applied Molecular Biology**	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6 **(2P1)**	Practical 3: **Microbiology & Immunology**	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 7 & 8 **(2P2)**	Practical 4: **Genetic Engineering & Applied Molecular Biology**	-	8	8	4	3-8*	100**	-	100		40
Seminar 2 **(2S1)**	Seminar 2	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Biotechnology Semester III											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 9 **(3T1)**	Paper 9: **Genetic Engineering & its Applications**	4	-	4	4	3	80	20	100	40	
Core 10 **(3T2)**	Paper 10: **Plant Biotechnology**	4	-	4	4	3	80	20	100	40	
Core Elective 1 **(3T3)**	**Paper 11: A) Industrial Biotechnology I (3T3A) OR B) Environmental Biotechnology I (3T3B)**	4	-	4	4	3	80	20	100	40	
Foundation Course 1 / Core Subject Centric 1 **(3T4)**	Paper 12: **Introductory Biotechnology (3T4A) / Diagnostic Medical Biotechnology (3T4B)**	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10 **(3P1)**	Practical 5: **Genetic Engineering & Plant Biotechnology**	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 1 **(3P2)**	**Practical 6: A) Industrial Biotechnology OR B) Environmental Biotechnology**	-	8	8	4	3-8*	100**	-	100		40
Seminar 3 **(3S1)**	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Biotechnology Semester IV											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 11 **(4T1)**	Paper 13: **Animal Biotechnology**	4	-	4	4	3	80	20	100	40	
Core 12 **(4T2)**	Paper 14: **Biostatistics, Bioinformatics, Ethics & Patenting**	4	-	4	4	3	80	20	100	40	
Core Elective 2 **(4T3)**	**Paper 15: A) Industrial Biotechnology II (4T3A) OR B) Environnemental Biotechnology II (4T3B)**	4	-	4	4	3	80	20	100	40	
Foundation Course 2 / Core Subject Centric 2 **(4T4)**	Paper 16: **Basic rDNA Technology (4T4A)/ Therapeutic Medical Biotechnology (4T4B)**	4	-	4	4	3	80	20	100	40	
Pract. Core 11, 12 & Elective 2 **(4P1)**	**Practical 7: Animal Biotechnology, Biostatistics, Bioinformatics, Ethics & Patenting And A) Industrial Biotechnology II OR B) Environmental Biotechnology**	-	8	8	4	3-8*	100**	-	100		40
Project **(4PROJ 1)**	Project	-	8	8	4	3-8*	100**	-	100		40
Seminar 4 **(4S1)**	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Note: Th = Theory; Pr = Practical/lab, * = If required, for two days.

** = The Practical and Project shall be evaluated by both the External and Internal Examiner in the respective Department / Center / Affiliated College.

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SYLLABUS for M. Sc. BIOTECHNOLOGY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

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M. Sc. BIOTECHNOLOGY
Semester I
Paper – I (Code: 1T1)
Cell Biology and Enzymology

UNIT I:
Structure and function of cell organelles:
Plasma membrane: transport of nutrients, ions and macromolecules.
Cell walls: Archaea, Bacteria, plant cells.
Mitochondria: Electron Transport Chain and Oxidative Phosphorylation.
Chloroplasts: Chlorophyll, carotenoids and photosynthesis.
Golgi complex: Endoplasmic reticulum, lysosomes, peroxisomes (functions).

UNIT II:
Cell cycle: Molecular events in S. cerevisiae.
Cell signaling: Signal transduction in animal and plant cells (tyrosine kinase, light induced signaling)

UNIT III:
Basic Enzymology
Basics: Enzyme nomenclature, classification and specificity. Concept of coenzymes.
Mechanism of enzyme action: Models, catalysis by proximity effect, acid-base catalysis, electrostatic interaction, metal ion catalysis, nucleophilic and electrophilic catalysis,
Concept of multienzyme complexes: fatty acid synthase and pyruvate dehydrogenase complexes.
Concept of enzyme regulation: Allosteric (example ATCase), chemical modification and calmodulin mediated regulation.

UNIT IV:
Basic aspects of enzyme kinetics: Michaelis-Menten equation (derivation, significance and transformation). Two substrate kinetics. Modifying factors of enzyme kinetics, enzyme inhibition and types of inhibitors.
Enzyme Engineering
Immobilization of Enzymes

M. Sc. BIOTECHNOLOGY
Semester I
Paper – II (Code: 1T2)
Molecular Biology

UNIT I:
DNA Replication: Prokaryotic and Eukaryotic DNA replication, mechanisms of DNA replication, fidelity of replication, enzymes and accessory proteins involved in DNA replication.
Gene mutations: Types of mutations. Suppression. Ames' test.
DNA Repair: Direct repair, Ada protein, NER, BER, MMR, SOS repair, Transcription-repair coupling, repair of double-strand breaks.

UNIT II:
Prokaryotic Transcription: RNA Polymerase holoenzyme and apoenzyme, different sigma factors, details of initiation, elongation, termination.
Eukaryotic Transcription: Three types of RNA polymerases. Promoter of RNA polymerase II. Enhancers. General and inducible transcription factors.
Modifications of RNA: 5' cap formation, polyadenylation, splicing of nuclear pre-mRNA, mRNA stability.

UNIT III

Genetic code: characteristics, deciphering the code.
Protein biosynthesis: Prokaryotic and eukaryotic translation, the translational machinery, mechanism of initiation, elongation and termination.

UNIT IV
Regulation of expression in prokaryotes: lac operon, ara operon, trp operon, negative autogenous control.
Regulation of expression in eukaryotes: Britten-Davidson model. DNA binding and activation domains of transcription factors. Packaging of chromosomes and its relation to transcription regulation. Regulation of translation by 3' and 5' UTR motifs.

M. Sc. BIOTECHNOLOGY
Semester I
Paper – III (Code: 1T3)
Biomolecules

UNIT I:
Chemistry of Carbohydrates: Energy storage molecules – starch, glycogen. Building blocks – cellulose, hemicellulose, and chitin. Cell surface molecules – glycolipids, proteoglycans.

UNIT II:
Chemistry of Lipids: Triglycerides, phospholipids, glycolipids, sphingolipids, sterols, terpenes, lipoproteins (LDL, VLDL, HDL, IDL). Lipid micelles, Liposomes.

UNIT III:
Proteins: Amino acids and peptides. Primary, secondary, and tertiary structures. Protein sequencing, protease mapping. Ramachandran plot. Collagen structure. Domain structure, models of protein folding, methods of study of protein folding, roles of chaperones and chaperonins.

UNIT IV:
Nucleic acids: Structure of DNA and RNA: A, B, and Z forms of DNA. Novel structures. DNA bending and bendability. Denaturation and renaturation studies and their applications, nucleic acid hybridization. Topological structure of DNA.

M. Sc. BIOTECHNOLOGY
Semester I
Paper – IV (Code: 1T4)
Biophysical Techniques

UNIT I:
Spectrophotometry: UV-Visible spectrophotometry, fluorescence spectrophotometry, absorption and emission spectrophotometry, IR, NMR, Lumionometry.
Basic introduction to Raman and Mass spectrophotometry.

UNIT II:
Chromatography: Basic principles and techniques of partition, adsorption, gel filtration, affinity, and ion exchange chromatography. Concept of GLC and HPLC.

UNIT III:
Electrophoresis: Gel electrophoresis (Agarose, PAGE, SDS PAGE), Disc gel electrophoresis, Gradient electrophoresis, Pulsed field gel electrophoresis, capillary electrophoresis.
Viscosity: Determination of conformational changes through viscosity.

UNIT IV:
Centrifugation
Basic principles, Mathematics & theory (RCF, Sedimentation coefficient etc)
Types of centrifuge: microcentrifuge, high speed & ultracentrifuges.

Differential & density gradient centrifugation, Isolation of cell components using centrifugation technique.
Radioactivity
Radioactive & stable isotopes, Pattern and rate of radioactive decay, Units of radioactivity.
Measurement of radioactivity: Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique),
Applications of isotopes in Biotechnology: Principles of tracer techniques, Its advantages and limitations, Distribution studies, Isotope dilution technique, Metabolic studies, Clinical application. Radioimmunoassay.

M. Sc. BIOTECHNOLOGY
Semester I
LAB I (Code: 1P1)
Cell Biology and Enzymology

1. Determination of activity of calcium ATPase of plasma membrane.
2. Subcellular fractionation and assay of marker enzymes.
3. Assay of activity of LDH.
4. Cell motility and flagellar staining.
5. Cell types of plants- maceration of various tissue explant and identification of xylem, trachied, stomata, root hair, etc.
6. Determination of activity of sodium/potassium ATPase of plasma membrane.
7. Isolation of neutrophils and demonstration of phagocytosis.
8. Determination of osmotic fragility of RBC membrane.
9. Assay of activity of beta-galactosidase
10. Assay of activity of acid phosphatase,
11. Enzyme purification by crystallization - urease.
12. Immobilization of enzymes (Invertase/ Protease/ Amylase.) by Na alginate method.
13. Whole cell immobilization (Yeast) by Na Alginate and the estimation of alcohol produced.
14. Effect of NaCl on amylase activity
15. Inhibition of alkaline phosphatase activity by EDTA
16. Estimation of lipase activity by titrimetric method
17. Effect of Temperature on activity of Amylase / Alkaline phosphatase and determination of optimum temperature.
18. Effect of Substrate concentration on activity of Amylase / Alkaline phosphatase and determination of optimum substrate concentration.
19. Effect of pH on activity of Amylase / Alkaline phosphatase and determination of optimum pH
20. Isolation of chlorophyll and xanthophyll from spinach leaves.
21. Effect of inhibitors on respiratory chain.
22. Study of Mitosis and Meiosis
23. Study of mutations by Ames Test.
24. Assay of Activity of SGOT & SGPT.
25. Isolation, Purity determination and quantitation of DNA by UV method.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester I
LAB II (Code: 1P2)
Macromolecules & Analytical Techniques

1. Separation of proteins / lipids by ion exchange chromatography
2. Separation of lipids / amino acids by thin layer chromatography
3. Polyacrylamide gel electrophoresis: a) native enzyme preparation, b) SDS-PAGE of proteins.
4. Introduction to measurements: balance and pipetting, preparation of solutions of given molarity and normality.
5. Measurement of pH: buffering capacity, to determine pKa value and hence the dissociation constant of a given acid using pH meter.

6. Colorimetry: To determine the dissociation constant of a given indicator colorimetrically and to prepare buffer solutions in the pH range 2.2 to 8.0
7. Colorimetry: Assay of DNA by diphenylamine method.
8. Colorimetry: Assay of RNA by orcinol method.
9. Potentiometry: To determine redox potential of Fe++ and Fe+++.
10. Conductometry: to determine cell constant of 0.1 M KCl.
11. Conductometry: Titration of strong acid vs strong base, to find out equivalent conductance of salt formed.
12. Viscometry: Effect of temperature on the viscosity of DNA using Ostwald's viscometer.
13. Viscometry: To determine molecular weight of protein and DNA.
14. Viscometry: To determine changes in the conformation of bovine serum albumin by viscosity measurements, effect of pH on conformation of BSA.
15. Spectrophotometry: To study the absorption spectrum of hemoglobin and NADH
16. Determination of Tm of nucleic acid
17. The validity of beers law for colorimetric estimation of creatinine.
18. The ultraviolet absorption of proteins and amino acids.
19. Estimation of proteins by Lowry"s and Bradford method.
20. Estimation of protein by E280/E260 method.
21. Fractionation of proteins: Salt precipitation, solvent precipitation, isoelectric precipitation, dialysis, centrifugation.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. Sem I
Seminar (Code: 1S1)

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M. Sc. BIOTECHNOLOGY
Semester II
Paper – I (Code: 2T1)
Microbiology

UNIT I:
Eukaryae and Viruses

- Algae: General characteristics, Applications in biotechnology.
- Fungi and slime moulds: General characteristics, applications in biotechnology.
- Viruses: Nature, symmetry, capsid structure, nucleic acid.
- Quantification of viruses
- Life cycles: T4 and lambda.
- Viroids and prions.

UNIT II:
General Microbiology and Taxonomy

- Prokaryotes: bacterial structure and morphology, endospore forming bacteria, pseudomonas, mycobacteria, archaebacteria.
- Microbial classification: 16s rRNA sequence and bacterial phylogeny.
- Bacterial genetic system: recombination (transformation, conjugation, transduction and transposition) Plasmids, salient features of the E. coli genetic map.

UNIT III:
Microbial Physiology

- Nutrition: nutritional classification, behavior, cultivation, isolation, media and their types, maintenance of culture.
- Growth: Measurement of growth, growth curve, continuous and synchronous culture, factors affecting microbial growth.

UNIT IV:
Microbial Control

- Microbial control: methods and dynamics of sterilization, mechanisms of control, biocontrol and preservation.
- Concept of chemotherapy, chemotherapeutic agents, mechanisms of action.
- Drug resistance, MDR, assessment and management of drug resistance.

M. Sc. BIOTECHNOLOGY
Semester II
Paper – II (Code: 2T2)
Immunology

UNIT I:
Immunology- fundamental concepts and anatomy of the immune system
Components of innate and acquired immunity; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system;; Mucosal and Cutaneous associated Lymphoid tissue.(MALT&CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, HLA typing, flow cytometry, Microarrays.

UNIT II:
Immune responses generated by B and T lymphocytes
Immunoglobulins-basic structure, classes & subclasses of immunoglobulins, antigenic determinants;Basis of self —non-self discrimination; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Cell-mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses, Hapten-carrier system

UNIT III:
Vaccinology

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.

UNIT IV:

Clinical Immunology

Hypersensitivity — Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; immunosuppressive therapy; Cancer immunotherapy. Apoptosis, transgenic mice, Gene knock outs.

M. Sc. BIOTECHNOLOGY
Semester II
Paper – III (Code: 2T3)
Fundamentals of Genetic Engineering

UNIT I:

- Restriction endonucleases and modification methylases
- Other enzymes needed in genetic engineering: exonucleases and endonucleases, ligases, polymerases, DNA modification enzymes and topoisomerases.
- Gene isolation and purification: general methods (shotgun method for producing gene library, cloning specific genes by hybridization and reverse transcriptase methods, direct selection of a gene)

UNIT II:

- Insertion of DNA and ligation: Berg's terminal transferase method (dA:dT joints); Boyer-Cohen-Chang experiment (cohesive ends), Butt joints (T4 DNA ligase); current ligation techniques (blunt-end ligation, complementary end ligation, linkers, adaptors, homopolymer tailing.

UNIT III:

Construction of Genomic DNA library and its applications

- Construction of cDNA Library: Method, problems to be addressed, advantages and disadvantages compared to the genomic DNA library, uses
- Screening of recombinants: Screening by complementation, southern hybridization, northern hybridization, colony lift, western blotting, immunoprecipitation, south-western screening. Synthesis and labeling of probes.
- DNA sequencing: Sanger-Coulson dideoxynucleotide method, Maxam-Gilbert chemical cleavage method, multiplex DNA sequencing, automated DNA sequencing. Basic idea of oligonucleotide synthesis.

UNIT IV:

Cloning vectors

- Plasmids as vectors, general characteristics of plasmids, bacterial vector plasmids, yeast vector plasmids,
- yeast artificial chromosomes
- Phage Vectors (lambda, M13).
- Cosmid vectors.
- Animal virus derived vectors – SV 40 and retroviral vectors

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M. Sc. BIOTECHNOLOGY
Semester II
Paper – IV (Code: 2T4)
Applied Molecular Biology

UNIT I:

Recombination and Genome Mapping,

- Homologous recombination: Holiday junction, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.
- Molecular mapping of genome: Genetic and physical maps, choice of mapping population, southern and fluorescence in situ hybridization for genome analysis, RFLP, RAPD, and AFLP analysis, molecular

markers linked to disease resistance genes, application of molecular markers in forensic, disease prognosis, genetic counseling, pedigree etc.

UNIT II:

Antisense, Ribozymes and Epigenetics

- Antisense and ribozyme technology: Molecular mechanism of antisense molecule, biochemistry of ribozyme, hammerhead ribozymes, applications of antisense and ribozyme technologies.
- Epigenetics: chromatin marking systems, Direct chemical modification of DNA, Basic concepts of RNAi.

UNIT III:

Cancer Biology

- Methods to study cancer: Animal models. Role of tissue culture in study of cancer. Combination of tissue culture and animal models.
- DNA Viruses and cancer: Polyoma virus, SV40, adenovirus
- Genetics of Cancer: Oncogenes (ras, myc), suppressor genes (p53, Rb).

UNIT IV:

- Angiogenesis: Brief idea of healthy vasculature, definition of angiogenesis, basic process of tumor induced angiogenesis, Hypoxia induced factor (HIF), basics of pro- and anti- angiogenic factors, positive and negative factors affecting angiogenesis.
- Metastatsis: Stages of metastatic progression, prerequisites for metastasis (properties a cell must acquire for metastasis), epithelial-mesenchymal transition, biochemical parameters acquired by metastatic cells.
- Basic idea of Cancer stem cells.

M. Sc. BIOTECHNOLOGY
Semester II
LAB I (Code: 2P1)
Microbiology & Immunology

1. Production of microbial products in bioreactors/fermentors.
2. Immobilization of cells/enzymes.
3. Cleanliness, media preparation, sterilization, culturing methods, dilution techniques.
4. Staining techniques in microbiology; simple staining, gram staining, spore staining capsule staining, flagella staining.
5. Isolation of pure culture by different techniques.
6. Replica plating technique.
7. Propagation of viruses.
8. Assay of viruses.
9. Purification of immunoglobulins, qualitative assessment.
10. Demonstration of immunochemical reactions (blood group, Widal, VDRL, pregnancy, ELISA)
11. Blood film preparation and identification of cells.
12. Ouchterlony immunodiffusion,
13. Determination of albumin by radial immunodiffusion.
14. Biochemical tests for identification of Bacteria – Oxidase, catalase, IMViC test, etc.
15. Isolation of antibiotic resistant bacteria from waste / sewage water.
16. Motility of bacteria by hanging drop method.
17. Assay of antibiotics by disc diffusion method.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester II
LAB II (Code: 2P2)
Genetic Engineering & Applied Molecular Biology

1. Induction of β-galactosidase in strains of E. coli (I+ and I-).
2. Southern blotting.
3. Isolation of genomic DNA.
4. Western blotting.
5. Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.
6. Isolation of RNA.
7. Restriction fragment length polymorphism.
8. Ames test.
9. Isolation of plasmid DNA (miniprep and alkaline bulk method)
10. Isolation of RNA
11. Isolation of polyA RNA using oligodT columns
12. Estimation of RNA by Orcinol method
13. Estimation of DNA by diphenylamine method
14. Estimation of DNA by E260 method
15. Isolation of Lambda phage DNA.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. Sem II
Seminar (Code: 2S1)

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M. Sc. BIOTECHNOLOGY
Semester III
Paper – I (Code: 3T1)
Genetic Engineering & its Applications

UNIT I:

- Transformation: DNA uptake by bacterial cells.
- Transfection: Chemical and physical methods, Viral vectors. Polyethylene glycol, DEAE-dextran, calcium phosphate coprecipitation, dimethyl sulfoxide, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection
- Amplification of DNA: Polymerase chain reaction.

UNIT II:

Plant transformation technology: Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, use of scaffold attachment regions, methods of nuclear transformation, viral vectors and their application, Biological and physical transformation methods. Chloroplast transformation.

UNIT III:

- Expression of heterologous genes: expression of eukaryotic genes in bacteria, expression of heterologous genes in yeast, insect and mammalian cells.
- Salient features of expression vectors.
- Processing of recombinant proteins: Refolding and stabilization.
- Industrial Products of Protein engineering

UNIT IV:

- Phage Display: Production of monoclonal bodies by phage display technique using filamentous phage vectors.
- Gene Therapy: somatic and germline, gene replacement, in vivo and ex vivo gene delivery, retrovirus gene transfer system, advantages and disadvantages of adenovirus, adeno-associated virus, herpes virus vectors, gene correction, replacement/augmentation, editing, regulation and silencing. Gene therapy of human diseases

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M. Sc. BIOTECHNOLOGY
Semester III
Paper – II (Code: 3T2)
Plant Biotechnology

UNIT I:

- Conventional plant breeding (introductory).
- Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids.
- Tissue culture media (composition and preparation)
- Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.
- Organogenesis. Embryogenesis; transfer and establishment of whole plants in soil.

UNIT II:

- Shoot tip culture: rapid clonal propagation and production of virus free plants.
- Embryo culture and embryo rescue.
- Hybrid plants: protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid, cybrid.
- Production of haploid plants: anther, pollen and ovary cultures for production of haploid plants and homozygous lines.

- Germplasm conservation: cryopreservation, slow growth cultures and DNA banking for germplasm conservation.

UNIT III:

- Applications of plant transformation for productivity and performance
- Herbicide resistance, phosphoinothricine glyphosate, sulfonyl urea, atrazin, insect resistance, Bt genes, non-Bt-like protease inhibitor, virus resistance, coat protein mediated nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP,
- antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress, post harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase.

UNIT IV:

- Plant metabolic engineering and industrial products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology.
- Molecular marker aided breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellite, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism), QTL, map based cloning, molecular marker assisted selection.
- Green House Technology

M. Sc. BIOTECHNOLOGY
Semester III
(NOTE: Candidates can choose any one elective paper from Core elective A or B)

Paper – III (Core Elective A) (Code: 3T3A)
Industrial Biotechnology I

UNIT I:
Bioreactors:

- Bioreactor function, utility, types of bioreactor. Modes of bioreactor operations. Main components of the bioreactor and their functions.
- Bioreactors
  a) Design/configuration of a basic fermentor; individual parts and probes for on-line monitoring of process.
  b) Concept of Batch and Continuous process, fed-batch semi-continuous systems; aerobic and anaerobic fermentors
  c) Submerged/liquid state and solid state fermentations

UNIT II
Types of Bioreactors:

- Continuous stirred tank and plug flow reactors
- Packed bed and fluidized bed reactors
- Trickle bed, immobilized bed, air lift, rotary disc reactors. Reactors with cell recycle.

UNIT III:
Immobilized reactor systems:

- Immobilization techniques for cells (physical adsorption, ionic binding, covalent binding, lattice entrapment, membrane entrapment, micro encapsulation) and enzymes (covalent binding, entrapment, micro encapsulation, cross-linking, adsorption, ionic binding, affinity binding, chelation, disulfide bonds)
- Immobilized enzyme kinetics
- Types of immobilized reactors

UNIT IV:
Scope of Downstream Processing:

- Importance of Down Stream Processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Role of DSP methods in bioprocess economics. Cell Disruption

Methods: Various cell disruption methods, need for cell disruption for (Homogenizer, French press & Dynomill) intracellular products, cell disruption equipment. Applications in bio-processing. Flocculation: Principles of flocculation various flocculating agents, applications in bio-processing. Coagulation: Principles of coagulations and its applications in bio-processing

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M. Sc. BIOTECHNOLOGY
Semester III
(NOTE: Candidates can choose any one elective paper from Core elective A or B)

Paper – III (Core Elective B) (Code: 3T3B)
Environmental Biotechnology I
Environmental Science & Bioresources

UNIT I:
Introduction to environmental Science: Environmental ethics: Environmentalism, Environment & Religion, Environmental education, Need for environmental education. Environmental Pollution: Classification of pollutants, Air pollution and their properties, Gaseous pollutants, water pollutants and their properties. Noise pollution, Soil pollution, thermal pollution, marine pollution, solid water pollution.

UNIT II:
Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes. Biotechnological processes: Bioconversion, Bioaccumulation, Bioconcentration, Biomagnification, Biodegradation.

UNIT III:
Energy & Biofuels: Non conventional or renewable sources of energy, Energy from Biomass, Biofertilizers, Biosensors and biochips, Biofilters, Biofuel cells,

UNIT IV:
Biofertilizers, Biopestisides and Integrated pest management: Bacterial biofertilizers, algal biofertilizers, Aquatic ferns as biofertilizers, Fungi as biofertilizers, earthworm as biofertilizers, biopestisides, Integrated pest management.

M. Sc. BIOTECHNOLOGY
Semester III
(NOTE: Candidates of other M. Sc. Subjects can choose this paper from Biotechnology subject)
Paper – IV (Foundation Paper I) (Code: 3T4A)
Introductory Biotechnology

UNIT I:
Basics of Proteins

- Amino acids: Structures of amino acids found in proteins, classification, peptide bond structure; Protein Structure:
- Primary (basic idea of sequencing and amino acid composition), secondary (alpha and beta structures), tertiary and quaternary structures

UNIT II:
Nucleic acids

- Nucleoside, Nucleotides, Bases; Basic Structure of DNA (Watson Crick structure) and RNA.

UNIT III:
Genes and chromosomes

- Gene definition, prokaryotic and eukaryotic gene structure; Structure of chromatin (nucleosome, 30 nm fiber, solenoid structure); basic understanding of chromosome structure; centromeres, telomeres, Unique genes and gene families

UNIT IV:

Enzymes

- Overview, Enzyme classification with specific examples. Characteristics of enzymes, Concept of active centre, binding sites, stereospecificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Enzyme activity, international units, specific activity
- Introduction to Enzymes used in biotechnology: Restriction enzymes, exonucleases and endonucleases, ligases, polymerases, DNA modification enzymes and topoisomerases

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M.Sc. Biotechnology (CBCS)
Semester-III
(Candidate can opt for this paper in their main subject of postgraduation ONLY).
Paper-IV: (Core Subject Centric I) (Code: 3T4B)
Diagnostic Medical Biotechnology

Molecular and Nanomolecular Diagnostics

Unit I

Host pathogen interactions in disease process (Bacterial: Tuberculosis and Staphylococcal Diseases & Viral: Influenza and HIV/AIDS); Disease pathology and clinical spectrum; Clinical diagnosis of diseases; Molecular Genetics of the host and the pathogen. Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis.

Unit II

Concept of Genomics, Human disease genes; DNA polymorphism including those involved in disease (Ex: Hemoglobin and the anemias); Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information: SSCP. Single nucleotide polymorphism and disease association; High throughput DNA sequencing and diagnosis; and Array based techniques in diagnosis.

Unit III

Outline of a typical proteomics experiment, clinical proteomics and disease biomarkers. Isolation of proteins and other molecules associated with disease; 2D analysis of such proteins by sequencing individual spots by Mass Spectrometry; Protein Microarray; Present methods for diagnosis of Specific diseases like Tuberculosis and AIDS; Ethics in Molecular Diagnosis

Unit IV

Nanomolecular diagnostics and Biosensor: Introduction to Nanodiagnostics, Nanoarrays for diagnostics, detection of single DNA, self-assembled protein nanoarrays, protein nanobiochip nanoparticles for molecular diagnostics, DNA nanomachines, Nanobiosensor, CNT biosensor, DNA nanosensor, Nanowire biosensor, application of nanodiagnostics.

Texts/References

1. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1st Edition, Academic Press, 2005.
2. Willey J. Prescott, Harley, and Klein's Microbiology-7th international ed./Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. New York: McGraw-Hill Higher Education; 2008.
3. Lela Buchingham and Maribeth L Flawsm, Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 1st Edition, F A Davis Company, Philadelphia, USA, 2007.
4. Campbell, M.A and Heyer L.J., Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2007.
5. Andrew Read and Dian Donnai, New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK, 2007.
6. Challa S.S.R. Kumar, Nanomaterials for medical diagnosis and therapy, Viley-VCH, 2007.
7. Dr.Parag Diwan and Ashish Bharadwaj (Eds), Nano Medicines, Pentagon Press, 2006.

M. Sc. BIOTECHNOLOGY
Semester III
LAB I (Code: 3P1)
Genetic Engineering & Plant Biotechnology

1. Recombinant DNA technology: in vitro DNA ligation and transformation of E. coli.
2. Recombinant DNA technology: characterization of transformants.
3. Northern blotting
4. Agarose gel electrophoresis and restriction mapping of DNA.
5. Construction of restriction map of plasmid DNA
6. Cloning in plasmid/phagemid vectors.
7. DNA sequencing.
8. Gene expression in E coli and analysis of gene product
9. Demonstration of technique of PCR
10. Demonstration of technique of RT-PCR
11. Replica plating technique.
12. Propagation of viruses.
13. Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.
14. Restriction fragment length polymorphism.
15. Ames test.
16. Quantitation of DNA by various methods.
17. Preparation of plant tissue culture media.
18. Surface sterilization.
19. Organ culture.
20. Callus propagation, organogenesis, transfer of plants to soil.
21. Protoplast isolation and culture.
22. Anther culture: production of haploids.
23. Cytological examination of regenerated plants.
24. Micropropagation of banana, citrus Papaya, Sugarcane etc.
25. Effect of various growth hormones on cell divisions and cell proliferation
26. Isolation, purification and culture of protoplast
27. Artificial seed preparation
28. Cytological examination of regenerated plants
29. Agrobacterium culture and selection of transformants.
30. Hardening of tissue culture raised plants.
31. Transfer of plants to soil.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester III
LAB II (Core Elective A) (Code: 3P2)
Industrial Biotechnology

1. Immobilization of cells/enzymes
2. Determination of rheological constant.
3. Determination of oxygen transfer rate, volumetric transfer coefficient.
4. Microbial production of Alcohol
5. Microbial production of antibiotics
6. Production of microbial products in fermentors / bioreactors
7. Preparation and formulation of microbial biopestisides / biofertilizers.
8. Study of patenting procedure
9. Preparation of proposal for patenting.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester III
LAB II (Core Elective B) (Code: 3P2)
Environmental Biotechnology

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of total dissolved solids of water
3. Determination of Hardness and alkalinity of water sample.
4. Determination of dissolved oxygen concentration of water sample
5. Determination of biological oxygen demand of sewage sample
6. Determination of chemical oxygen demand (COD) of sewage sample.
7. Analysis of oligodynamic action.
8. Determine the efficiency of removal of air pollutant using fibrous air filter.
9. Preparation and formulation of microbial biopesticide (bacteria, fungi and viruses
10. Production of microbial fertilizers (Rhizobium, Azotobacter and AMF).

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. Sem III
Seminar (Code: 3S1)

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M. Sc. BIOTECHNOLOGY
Semester IV
Paper – I (Code: 4T1)
Animal Biotechnology

UNIT I:

- Animal Cell Culture: Equipments and materials for animal cell culture technology. Various systems of tissue culture, their distinguishing features, advantages and limitations.
- Culture medium: natural media, synthetic media, sera. Introduction to balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon di oxide, serum and supplements.
- Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors.

UNIT II:

- Primary Culture: Behavior of cells, properties, utility. Explant culture; suspension culture.
- Established cell line cultures: Definition of cell lines, maintenance and management; cell adaptation.
- Measurement of viability and cytotoxicity. Cell cloning, cell synchronization and cell manipulation. Various methods of separation of cell types, advantages and limitations; flow cytometry.

UNIT III:

- Scaling up of animal cell culture. Cell transformation.
- Stem cell cultures, embryonic stem cells and their applications. Somatic cell genetics.
- Apoptosis: Measurement of cell death. Apoptosis (death domain, role of cytochrome C)

UNIT IV:

- Commercial applications of cell culture: Tissue culture as a screening system; cytotoxicity and diagnostic tests. Mass production of biologically important compounds (e.g. Vaccines). Harvesting of products, purification, and assays.
- Three dimensional cultures and tissue engineering.

M. Sc. BIOTECHNOLOGY
Semester IV
Paper – II (Code: 4T2)
Biostatistics, Bioinformatics, Ethics & Patenting

UNIT I:

Biostatistics

- Measures of central tendency: mean, mode, and median.
- Measures of dispersion: range, mean deviation, standard deviation.
- Methods of sampling, sampling error, non-sampling errors, standard error.
- Chi-square test, meaning of correlation and regression.
- Cluster analysis: phylogenetic clustering by simple matching coefficients.
- Presentation of statistical data: tabulation (simple tables, frequency distribution table); charts and diagrams (bar charts, histograms, pie charts, dendrogram).
- Research designs with basic principles and field layout.

UNIT II:

Bioinformatics

- Computer concept: computer organization, hardware, software, operating system (windows, unix, brief list of computer languages).
- Concept of networking: internet, internet concepts, web browsing, public domain resources in biology.
- Concept of database management: brief idea of data types, data structures, searching, sorting, designing a database, genomic, proteomic, and metabolic pathways databases.

- Computer analysis of genetic sequences: general concepts of sequence analysis, identification of functional sequences, homology, brief idea of BLAST, ENTREZ, and PuBMed.
- Proteomics: basic issues and concepts, protein sequences and alignment, protein structure prediction.
- Bioinformatics tools in drug design.

UNIT III:

Ethics:

- Benefits of biotechnology, ELSI of biotechnology, recombinant therapeutic products for human health care, genetic modifications and food consumption, release of genetically engineered organisms, applications of human genetic rDNA research, human embryonic stem cell research.

UNIT IV:

Patenting

- Patent and Trademark, Biotechnology products and processes, Intellectual property rights, Plant breeders rights, biotechnology in developing countries. Biosafty and its implementation, Quality control in Biotechnology.

M. Sc. BIOTECHNOLOGY

Semester IV

(NOTE: Depending on the Core elective subject chosen in Semester III, Candidates shall pursue the same core elective subject in semester IV)

Paper – III (Core Elective A) (Code: 4T3A)

Industrial Biotechnology II

UNIT I:

Bioprocess Engineering Concepts:

- Mass transfer, heat transfer, mixing, rheology of fermentation fluids, residence time distribution, substrate utilization and yield-coefficients, oxygen transfer and oxygen sag.

UNIT II:

Process Optimization and Control:

- Optimization parameters, medium formulation, process optimization techniques:classical, Plackett-Burman design, ANOVA, central; composite design, response surface methodology with example.; medium formulation: classical, experimental design technique, fractional factorial design with egs.
- Concept of control: turbidostatic and chemostatic control, open loop and feedback control
- Advanced control policies: model predictive control, cascade control, PID control, programmed control

UNIT III:

Scale up & Biosensor Technology:

- basic principles of scale-up
- bases of scale up, scale down
- Biosensors

UNIT VI:

Production of Primary & Secondary Metabolite:

1. Primary Metabolites:

- A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc); amino acids (glutamic acid, phenyalanine, aspartic acid etc.) and alcohols (ethanol, butanol etc.)

2. Secondary Metabolites:

- Brief Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin), aminoglycosides (streptomycin) macrolides (erythromycin), vitamins and steroids.

M. Sc. BIOTECHNOLOGY

Semester IV

(NOTE: Depending on the Core elective subject chosen in Semester III, Candidates shall pursue the same core elective subject in semester IV)

Paper – III (Core Elective B) (Code: 4T3B)

Environmental Biotechnology II
Applied Environmental Biotechnology

UNIT I:
Bioremediation & Phytoremediation: Biofeasibility, applications of bioremediation, Bioreduction, Phytoremediation.
Solid waste pollution and its management: Current practice of solid waste management, composting systems, vermicomposting, sewage treatment.

UNIT II:
Bioabsorption and Bioleaching of heavy metals: Cadmium, Lead, Mercury, Metal binding targets and organisms, Bioabsorption, Metal microbial interaction, Biomethylation of elements (Methylation of mercury and arsenic), Commercial biosorbants, bioleaching, metal precipitation, advantages and disadvantages of bioleaching.

UNIT III:
Waste water Treatment: Biological treatment system (Oxidative ponds, aerobic and anaerobic ponds, facultative ponds, aerated ponds), Biological waste treatment, activated sludge treatment, microbial pollution in activated sludge, percolating filters, waste water treatment by biofilms. Treatment scheme of Dairy, Distillery, Tannery, Sugar, Fertilizers, Refinery, Chemical and Antibiotic waste.

UNIT IV:
Xenobitics in environment: Biodegradation of Hydrocarbons, Substituted hydrocarbons, Surfactant, Pesticides, Lignin, Tannin, Synthetic dyes, Biotransformation: Oxidation reactions: Cytochrome P450 monooxygenase system, Alcohol and aldehyde dehydrogenases, Peroxidases. Reduction reactions: Cytochrome P450 and flavin dependent reactions. Hydrolysis reactions: Carboxyl esterases. Conjugation reactions: Gluthione S transferases. Regulation of biotransformation.

M. Sc. BIOTECHNOLOGY
Semester IV
(NOTE: Candidates of other M. Sc. Subjects can choose this paper from Biotechnology subject)
Paper – IV (Foundation Paper II) (Code: 4T4A)
Basic rDNA Technology

UNIT I:
History of Gene cloning

- Boyer-Cohen-Chang experiment. Patenting of the recombinant DNA technique; Berg's role in gene cloning history, Change in medicinal science after discovery of recombinant DNA technology (brief mention of how we produce human insulin today, somatostatin and other therapeutic products, very brief overview of how we may treat diseases through gene therapy)
- Why do we clone genes? (amplification and/or heterologous gene expression). Basic steps of gene cloning:
- Agarose gel electrophoresis; 2D Electrophoresis; Pulsed field gel electrophoresis; SDS PAGE; 16S rDNA sequencing for bacterial identification; ITS region sequencing for fungal identification; RFLP; RAPD

Unit II:
Basic process of recombinant DNA technology

- Cutting and joining of DNA. Vectors: concept, types of vectors (plasmids, phage, virus), Essential qualities that a vector must possess
- Types of vectors: pBR322, cosmids, lambda phage

Unit III:
Basic process of recombinant DNA technology

- Transformation and Transfection – basic techniques. Selectable markers (antibiotic resistance, lacZ), Selection process, Screening.

Unit IV:

Applications of gene cloning

- Insulin, Somatostatin, BT Cotton, production of human proteins and drugs, recombinant vaccines, agricultural applications, production of transgenic animals, human gene therapy

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M.Sc. Biotechnology (CBCS)
Semester-IV
(Candidate can opt for this paper in their main subject of postgraduation ONLY).
Paper-IV: (Core Subject Centric II) (Code: 4T4B)
Therapeutic Medical Biotechnology

Molecular Therapeutics and Drug Discovery

Unit I

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery. Gene silencing technology; siRNA- Concept, delivery and therapeutic applications in treatment of influenza and HIV/AIDS; Tissue and organ transplantation; Transgenics and their uses; Cloning; Ethical issues

Unit II

Proteomics and drug discovery: High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharamacogenetics and drug development; Toxicogenomics; Metagenomics.

Unit III

Nanobiotechnology for drug discovery, protein and peptide based compounds for cancer and diabetes, drug delivery - nanoparticle based drug delivery, lipid nanoparticles, vaccination, cell therapy, Gene therapy. Ethical, safety and regulatory issues of nanomedicine. Physicochemical characteristics of nanomaterials, Nanoparticle interaction with biological membrane, Neurotoxicology.

Unit IV

Drug Discovery & Clinical research

Introduction and importance of clinical research, Drug Development and phases of Clinical trials, Designing clinical Trials, Protocol designing, Ethical issues in clinical research, ICH-GCP Guidelines, Informed consent process, Role of CRC and CRA in clinical trials, Pharmacovigilance, Standard operating procedures, Guidelines to undertake clinical trials in India schedule Y.

Texts/References:

1. Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.
2. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer, 2008.
3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
4. H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press, 2006.
5. Robert A. Freitas Jr., Nanomedicine, Volume I: Basic Capabilities, Landes Bioscience, Georgetown, TX, 1999.
6. Robert A. Freitas Jr., Nanomedicine, Volume IIA: Biocompatibility, Landes Bioscience, Georgetown, TX, 2003.
7. Kewal K. Jain, The Hand book of Nanomedicine, Humana Press, Springer 2008.
8. Nancy A. Monteiro – Riviere and C. Lang Tran, Nanotoxicology: Characterization, Dosing and Health Effects, Informa Healthcare. 2007.
9. Kumar, Challa S. S. R. (ed.) Nanomaterials - Toxicity, Health and Environmental Issues, Wiley-VCH, Weinheim, 2006.
10. Norris, Deborrah. Clinical Research Coordinator Handbook. Plexus Pub, 2009.
11. Portney, Leslie Gross, and Mary P. Watkins. Foundations of clinical research: applications to practice. Vol. 2. Upper Saddle River, NJ: Prentice Hall, 2000.
12. Stone, Judy. Conducting clinical research: A practical guide for physicians, nurses, study coordinators, and investigators. Mountainside MD Press, 2006.
13. Glasser, Stephen P., and P. Glasser. Essentials of clinical research. Springer, 2008.

Semester IV
LAB I (Code: 4P1)
Animal Biotechnology, Biostastics, Bioinformatics, Ethics & Patenting
And Industrial Biotechnology II or Environmental Biotechnology

Section I: Animal Biotechnology, Biostastics, Bioinformatics, Ethics & Patenting

1. Development of primary cell lines/maintenance of established cell lines
2. Preparation of animal cell culture media.
3. Filter sterilization and sterility test.
4. Media storage, serum inactivation.
5. Cell fusion.
6. Cell transformation by viruses.
7. Lyophilization of local germplasma.
8. Calculation of mean, mode, and median
9. Calculation of standard deviation and standard error
10. Using computer in single user and multiple user environment
11. Designing and management of databases
12. Computer aided statistical analysis
13. Computer presentation of statistical data, charts and diagrams
14. Computer aided visualization of amino acid sequence of protein and its 3D structure.
15. Retrieving metabolic pathway using internet
16. Homology searching using BLAST
17. Base sequence analysis of gene / protein sequence
18. Computer aided survey of scientific literature
19. Field layout based on statistical research designs
20. Determination of rheological constant

Section II: Section A) Industrial Biotechnology OR Section B) Environmental Biotechnology
A) Industrial Biotechnology

1. Demonstration of various bioreactor configuration, parts and integrated process control system.
2. Demonstration of addition of inoculation and sampling in CSTR
3. Determination fo volumetric mass transfer coefficient (KLa) by dynamic method and sulphite oxidation method
4. Preparation of wine from grapes.
5. Preparation and characterization of immobilized cells system
6. To perform cell disruption by ultrasonication
7. To study the settling velocity of solid particles under batch sedimentation

OR

B) Environmental Biotechnology

1. Test for the degradation of a aromatic hydrocarbons by bacteria
2. Survey of degradative plasmids in microbes growing in polluted environment
3. Effect of Sulphur dioxide on crop plants
4. Estimation of heavy metals in water/soil by Atomic absorption spectrophotometry,
5. Estimation of nitrate in drinking water.
6. Role of microorganisms in elevation of heavy metal induced stress in plants.
7. Isolation of xenobiotic degrading bacteria by selective enrichment technique
8. In vitro evaluation of medicinal plants against pathogenic microbes.
9. Effect of mycorrhizal fungi on growth promotion of plants.
10. Study of patenting procedure
11. Preparation of proposal for patenting.
12. Study of RFLP, VNTRs, SNPs

Note: At least 6 practical must be conducted within the semester.

M. Sc. Part II, Sem IV
Project (Code: 4PROJ1)

M. Sc. Part II, Sem IV
Seminar (Code: 4S1)

SYLLABUS for M. Sc. CHEMISTRY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.

The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

Scheme of teaching and examination under semester pattern Choice Based Credit System **(**CBCS**)** for M.Sc. Program in Chemistry

M. Sc. Chemistry Semester I												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
		Th	Pract	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
							External Marks	Internal Ass		Th	Pract
(1T1**)**	Paper 1: Inorganic Chemistry	4	-	4	4	3	80	20	100	40	
(1T2**)**	Paper 2: Organic Chemistry	4	-	4	4	3	80	20	100	40	
(1T3**)**	Paper 3: Physical Chemistry	4	-	4	4	3	80	20	100	40	
(1T4**)**	Paper 4: Analytical Chemistry	4	-	4	4	3	80	20	100	40	
Pract. **(**1P1**)**	Practical 1: Inorganic Chemistry	-	8	8	4	3-8*	100**	-	100		40
Pract. **(**1P3**)**	Practical 2: Physical Chemistry	-	8	8	4	3-8*	100**	-	100		40
Seminar 1 **(**1S1**)**	Seminar 1	2	-	2	1			25	25	10	
	TOTAL	18	16	34	25		520	105	625	170	80

M. Sc. Chemistry Semester II												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks		
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract	
(2T1)	Paper 5: Inorganic Chemistry	4	-	4	4	3	80	20	100	40		
(2T2)	Paper 6: Organic Chemistry	4	-	4	4	3	80	20	100	40		
(2T3)	Paper 7: Physical Chemistry	4	-	4	4	3	80	20	100	40		
(2T4)	Paper 8: Analytical Chemistry	4	-	4	4	3	80	20	100	40		
Pract. (2P2)	Practical 3: Organic Chemistry	-	8	8	4	3-8*	100**	-	100		40	
Pract. (2P4)	Practical 4: Analytical Chemistry	-	8	8	4	3-8*	100**	-	100		40	
Seminar 2 (2S1)	Seminar 2	2	-	2	1			25	25	10		
	TOTAL	18	16	34	25		520	105	625	170	80	

M. Sc. Chemistry Semester III												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
		Th	Pract	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
							External Marks	Internal Ass		Th	Pract
(3T1)	Paper 9: Special – I (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
(3T2)	Paper 10: Special – II (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
Elective 1 (3T3)	Paper 11: A) NuclearChemistry I (3T3A) ORB) Environmental Chemistry I (3T3B) ORC) Polymer Chemistry I(3T3C) ORD) Medicinal Chemisrty I(3T3D)	4	-	4	4	3	80	20	100	40	
Foundation Course 1 / Core Subject Centric 1 (3T4)	Paper 12: Applied AnalyticalChemistry-I / Spectroscopy I	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10 (3P1)	Practical 5: Special (Inorganic/ Organic / Physical / Analytical) Chemistry	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 1 (3P3)	Practical 6: A) Nuclear Chemistry I ORB) Environmental Chemistry I ORC) Polymer Chemistry I ORD) Medicinal Chemisrty I	-	8	8	4	3-8*	100**	-	100		40
Seminar 3 (3S1)	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	18	16	34	25		520	105	625	170	80

M. Sc. Chemistry Semester IV				
Code	Theory / Practical	Teaching scheme	Credits	Examination Scheme

		(Hours / Week)									
		Th	Pract	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
							External Marks	Internal Ass		Th	Pract
(4T1)	Paper 13: Special – I (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
(4T2)	Paper 14: Special – II (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
Elective 2 (4T3)	Paper 15: A) Nuclear Chemistry II ORB) Environmental Chemistry II ORC) Polymer Chemistry II ORD) Medicinal Chemisrty II	4	-	4	4	3	80	20	100	40	
Foundation Course 2 / Subject Centric 2 (4T4)	Paper 16: Applied Analytical Chemistry II / Spectroscopy II	4	-	4	4	3	80	20	100	40	
Pract. (4P1)	Practical 7: Special (Inorganic/ Organic / Physical / Analytical) Chemistry	-	8	8	4	3-8*	100**	-	100		40
Project (4PROJ1)	Project	-	8	8	4	3-8*	100**	-	100		40
Seminar 4 (4S1)	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	18	16	34	25		520	105	625	170	80

NOTE Sem III & IV:

Foundation Course: Candidate can opt for any one foundation course paper in the semester III and IV. However, Student shall opt for this paper from any other subject other than his / her main subject for postgraduation. If the candidate decides to opt for foundation course papers then he/she shall not be eligible to opt for Core (Subject Centric) papers in their respective subjects.

Core (Subject Centric): Candidate can opt for this paper as shown in the semester III and IV in their main subject of postgraduation only. If the candidate decides to opt for Core (Subject Centric) papers in their main subject of

postgraduation then he**/**she shall not be eligible to opt for foundation course papers neither in their own subject nor in any other subject**).**

- General Scheme for Distribution of Marks in Practical Examination in Chemistry
  Time:8-9h (One day Examination) Marks:100

Exercise-1	- 30 Marks	- Evaluated jointly by Internal and External Examiner
Exercise-2	- 30 Marks	- Evaluated jointly by Internal and External Examiner
Record	-20 Marks	- Evaluated by Internal
Viva-Voce	-20 Marks	- Evaluated by External
Total	**-** 100 Marks	

- General Scheme for Distribution of Marks in Project Examination in Chemisrty
  The project work will carry total 100 marks and will be evaluated by both external and internal examiners in the respective Department / Center/ Affiliated College.
  The examiners will evaluate the experimental project work taking into account the coverage of subject matter, presentation, references etc.

For written Project work	- 40 Marks	-	Evaluated jointly by External and Internal
For Presentation	- 20 Marks	-	Evaluated jointly by External and Internal
ForViva-Voce	- 20 Marks	-	Evaluated by External Examiner
Internal Assessment	- 20 Marks	-	Evaluated by Internal Examiner
Total	**-** 100 Marks		

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SYLLABUS for M. Sc. CHEMISTRY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2015-2016

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Semester I
Paper – I (Code: 1T1)
Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 5h

A) Stereochemistry and Bonding in Main Group Compound:VSEPER-Shape of simple inorganic molecules and ions containing lone pairs, various stereo chemical rules and resultant geometry of the compounds of non-transitional elements, short coming of VSEPR model. Bent's rule and energetics of hybridization.

B) Metal – Ligand Bonding: 10h

Crystal Field Theory: Splitting of d-orbital in tetragonal, square planar and trigonal bipyramidcomplexes. John teller effect, spectrochemical series, nephelauxetic effect. Limitaion of crystal field theory. M.O.Theory for octahedral, tetrahedral & square planar complexes with and without π-bonding.

Unit-II

A) Metal – Ligand Equilibria in Solution: 5h

Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodyanamic origin. Determination of formation constant by :

(1) spectrophotometric method (Job's and Mole ratio method)

(2) Potentiometric method (Irving-Rossotti Method)

B) Reaction Mechanism of Transition metal complexes: 10h

Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution: Acid hydrolysis, factors affecting acid hydrolysis, Stereochmistry of intermidiates in SN^1& SN^2 , Base hydrolysis, Conjugate base mechanism, Direct and indirect evidences in favour of conjugate mechanism, Annation reaction, reaction without metal-ligand bond breaking.

Unit-III: Cluster- I 15h

Boron hydrides: Classification, nomenclature, structure, bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for higher boranes and their utilities. Chemistry of diboranes: Study of Metalloboranes, Carboranes and Metallocarboranes with reference to preparations and structures.

Unit – IV: Cluster-2

A) Metal-Metal bonds: 10h

Occurrence of metal-metal bond, Classification of metal clusters, Binuclear, trinuclear, tetranuclear, pentanuclear and hexanuclear with reference to halide, oxide, alkoxide and acetate clusters.

B) Isopoly, Heteropoly acids and their anions. 5h

List of Books

1) S. F. A. Kettle, J. N. Murral and S. T. Teddler: Valency Theory
2) C. A. Coulson: Valency

3) J. E. Huheey :Inorganic Chemistry
4) F .A. Cottonand G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5thand 6th Editions.
5) A. F. Willims: Theoretical Approach in inorganic chemistry.
6) A. Mannas Chanda: Atomic Structure and chemical Bonding
7) L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
8) J. J. Logowski: Modern Inorganic Chemistry
9) B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
10) J. C. Bailar: Chemistry of coordination compounds.
11) W. L. Jolly: Modern Inorganic Chemistry
12) R. S. Drago: Physical methods in inorganic chemistry.
13) Waddington: Nonaqueous solvents.
14) Sisler: Chemistry of nonaqueous solvents.
15) A. K. Barnard: Therotical Inorganic Chemistry
16) Emeleus and Sharpe: Modern Aspect of Inorganic Chemistry.
17) F. A. Cotton: Chemical Applications of Group theory.
18) Jones: Elementary Coordination chemistry.
19) B. N. Figgis: Introduction to Ligand field.
20) S. F. A. Kettle: Coordination chemistry.
21) M.C.Day and J.Selbin: Theoretical Inorganic Chemistry.
22) J. Lewin and Wilkins: Modern Coordination Chemistry.
23) Gowarikar, Vishwanathan and Sheedar: Polymer science.
24) H. H. Jattey and M. Orchin: Symmetry in chemistry.
25) D. Schonaland: Molecular Symmetry in chemistry.
26) L. H. Hall: Group theory and Symmetry in chemistry
27) H. H. Jattey and M. Orchin: Symmetry in chemistry
28) R.L.Dutta and A.Symal: Elements of magneto chemistry
29) Inorganic Chemistry 4th Edition, P.Atkins, Oxford University Press.
30) Essential Trends in Inorganic Chemistry, D.M.P.Mingos, Oxford University Press.

Semester I

Paper II (Code: 1T2)

Organic Chemistry

60 h (4 h per week): 15 h per unit — 80 Marks

Unit-I: 15 h

A] Nature and Bonding in Organic Molecule**:**Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyper-conjugation, bonding in fullerenes. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons Huckel's rule, energy level of π-molecules orbitals, annulenes, antiaromaticity, homo-aromoaticity. Aromatic character and chemistry of cyclopentadienyl anion, tropylium cation, tropone and tropolone. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes

B] Reactive Intermediates**:** Generation, structure, stability and chemical reactions involving carbocations, carbanions, free radical, carbenes, and nitrenes

Unit-II: 15 h

Streochemistry**:** Conformational analysis of cycloalkanes **(**5**-**8 membered rings**)**, substituted cyclohexanes, mono substituted, disubstituted and trisubstituted cyclohexanes, decalines, effect of conformation on reactivity, Cahn**-**Ingold**-**Prelog System to describe configuration at chiral centers**.** Elements of symmetry, chirality, molecules with more than one chiral center, meso compounds, threo and erythro isomers, method of resolution, optical purity, enantiotopic and distereotopic atoms, groups and faces, prochirality, addition**-**elimination reactions, stereospecific and

steroselective synthesis**.** Asymmetrical synthesis, optical activity in absence of chiral carbon **(**biphenyl and allenes**)**

Unit**-**III**:** 15 h

A**]** Reaction mechanism**:** Structure and Reactivity**:** Types of mechanism, Types of reaction, thermodynamics and kinetics requirements, kinetic and thermodynamic control, Hammond**'**s postulate, Curtin**-**Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects, Hard and soft acids and bases**.**

B**]** Aliphatic nucleophilic substitution**:** The SN^1, SN^2, mixed SN^1, SN^2 and SET and SN_i mechanisms**.** Nucleophilicty, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, phase transfer catalysis

C**]** Concept of neighboring group participation Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen**.** Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migartory aptitude, carbocation rearrangements and related rearrangements in neighboring group participation**.**

Unit IV**:** 15h

A**]** Aromatic Nucleophilic Substitution

A general introduction to different mechanisms of aromatic nucleophilic substitution S_NAr, SN^1, benzyne and $S_{RN}1$ mechanisms, arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter, Sommlet-Hauser and Smiles rearrangements.

B**]** Aromatic electrophilic substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituents, orientation in other ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Reimer-Tieman reaction, Diazonium coupling.

C**]** Effect of Structure on reactivity**:** Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft Equation.

List of books

1] Advanced Organic Chemistry –Reaction mechanism and structure. Jerry March, John Wiley
2] Advanced Organic Chemistry- F.A. Carey and R. J. Sunberg, Plenum
3] A Guidebook to Mechanism in Organic Chemistry-Peter Skyes, Longman
4] Structure and Mechanism in Organic Chemistry-C.K. Gold, Cornell University Press
5] Organic Chemistry, R.T. Morrison Boyd. Prentice Hall
6] Modern Organic Chemistry-H.O. House, Benjamin
7] Principal of Organic Chemistry-R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional
8] Reaction Mechanism in Organic Chemistry-S.M. Mukharji and S.P. Singh, Macmilan
9] Stereochemistry of Organic Compounds- D. Nasipuri, New Age International
10] Stereochemistry of Organic Compounds- P. S. Kalsi, New Age International
11] Frontier Orbitals and Organic Chemical Reactions-I. Fleming
12] Orbital Symmetry – R. E. Lehr and A. P. Marchand
13] Reactive Intermediate in Organic Chemistry-N. S. Isaacs
14] Stereochemistry of Carbon Compounds- E. L. Eliel
15] Physical Organic Chemistry-J. Hine
16] Name Reaction in Organic chemistry –Surrey
17] Advanced Organic Chemistry – L. F. Fieser and M. Fieser.
18] Organic Chemistry Vol. I and II - I. L. Finar
19] Modern Organic Chemistry- J.D. Roberts and M. C. Caserio
20] The Search for Organic Reaction Pathways (Longmann), Peter Skyes

21] Organic Chemistry 5th Edition (McGraw Hill), S. H. Pine
22] Organic Chemistry (Willard Grant Press Botcon), John Mcmurry
23] A Textbook of Organic Chemistry- R. K. Bansal New Age International
24] New Trends in Green Chemistry –V. K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
25] Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford University Press
26] Organic Chemistry, 4th Edition, G Marc Loudon, Oxford University Press

Semester I
Paper III (Code: 1T3)
Physical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT I: CLASSICAL THEMODYNAMICS 15h

A] Recapitulation of Laws of thermodynamics, Exact and inexact differentials, condition of exactness, Ptaff differential expression and equations, Applications of Ptaff differential equations to first and second law of thermodynamics, Carathéodory's principle and its equivalence to the Kelvin Plank and Clausius statement of the Second law of Thermodynamics, Homogeneous functions of degree 0 and 1, extensive and intensive properties, derivation of thermodynamic equations of state, Maxwell's relations.

B] Third law of thermodynamics, Nernst Heat Theorem, unattainability of absolute zero, calculation of entropy based on third law of thermodynamics, residual entropy and its application. Virial equation of state.

UNIT II: GIBBS FUNCTION AND PHASE EQUILIBRIA 15h

A] Partial molar quantities: Determination of partial molar quantities, chemical potential, partial molar volume, Gibbs Duhem equation, Gibbs Duhem Mergules equation, Extent of advancement of reaction (ξ), thermodynamic criteria of chemical equilibrium.

B] Gibbs Phase rule and its derivation, calculation of degrees of freedom, reduced phase rule, construction of phase diagram, one component systems (Helium, carbon), 1st and 2nd order phase transition, lambda line, two component systems forming solid solutions having congruent and incongruent melting point, partially miscible solid phase, three component systems, graphical presentation, influence of temperature, systems with 1, 2, 3 pairs of partially miscible liquids, transition points.

UNIT III: SURFACE PHENOMENA AND MACROMOLECULES 15h

A] Recapitulation of Surface tension, Adsorption: Freundlich adsorption isotherm, Langmuir theory, Gibbs adsorption isotherm, BET theory and estimation of surface area, enthalpy and entropy of adsorption. Surface film on liquids and catalytic activity, Electro-kinetic phenomena, Surface active agents, hydrophobic interactions, micellization, Critical Micelle Concentration (CMC), mass action model and phase separation model of micelle formation, shape and structure of micelles, factors affecting CMC, micro-emulsion and reverse micelles.

B] Macromolecules: Definitions, Number and mass average molecular weights, molecular mass determination by Osmometry, Viscometry, Sedimentation, Diffusion, light scattering method, Numerical.

UNIT IV: CHEMICAL KINETICS 15h

A] Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations, Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates.

B] Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions: Lindeman-Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation.

List of books

1. R. P. Rastogi and R. R. Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010.
2. P. W. Atkins and D. Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010.
3. E. N. Yenemin, Fundamentals of Chemical Thermodynamics, MIR, Publications.
4. G. K. Vemulapalli, Physical Chemistry, Prentice – Hall of India, 1997.
5. S. Glasstone andDe Van No Strand, Thermodynamics for Chemists, 1965.
6. S. M. Blinder, Advanced Physical Chemistry,
7. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
8. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
9. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
10. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
11. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
12. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York.
13. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan IndianLtd., New Delhi (1993)
14. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 1., Elsevier Publications, New York, 1969.
15. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 2., Elsevier Publications, New York, 1969.
16. S. Glasstone, K. J. Laidler and H. Eyring, The Theory of Rate Processes, Mc-Graw Hill, New York, 1941.
17. A. Findley, The Phase Rule and its Applications, Longmans Green and Co., Mumbai.
18. K. S. Birdi, Surface Chemistry Essentials, CRC Press, New York, 2014.
19. Eric Keightley Rideal, An Introduction to Surface Chemistry, Cambridge University Press, 1926.
20. D. M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, NewYork, 1984.
21. A. W. Adamson, A. P. Gasi, Physical Chemistry of Surfaces, Wiley, 2007.
22. P. C. Hiemenz and R. Rajagopalan, Principles of Colloid and Surface Chemistry, CRC Taylor and Fransis, 2007.
23. P. D. Hede and S. P. Beier, Inorganic and Applied Chemistry, e-Book, 2007.
24. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
25. E.M. Mc Cash, *Surface Chemistry*, Oxford University Press, Oxford (2001).
26. G. K. Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill, 1990.
27. N. B. Singh, N. S. Gajbhiye, S. S. Das, Comprehensive Physical Chemistry, New Age International, 2014.
28. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

Semester I

Paper IV (Code: 1T4)

Analytical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Introduction and statistical analysis 15h

Introduction to analytical chemistry: Types of analysis-qualitative and quantitative. Classification of analytical methods- classical and instrumental, basis of their classification with examples.

Statistical analysis and validation: Errors in chemical analysis. Classification of errors-systematic and random, additive and proportional, absolute and relative. Accuracy and precision. Mean, median, average deviation and standard deviation. Significant figures and rules to determine significant figures. Calculations involving significant figures. Confidence limit, correlation coefficient and regression analysis. Comparison of methods: F-test and T-test. Rejection of data based on Q-test. Least squares method for deriving calibration graph. Application of Microsoft

Excel in statistical analysis (statistical functions and spreadsheets in MS-Excel). Validation of newly developed analytical method. Certified reference materials (CRMs). Numerical problems.

Unit II: Separation techniques 15h

*Chromatography:*Definition and Classification. Techniques used in Paper, Thin Layer and Column chromatography. Applications in qualitative and quantitative analysis.

*Ion exchange:*Principle and technique. Types of ion exchangers. Ion exchange equilibria. Ion exchange capacity. Effect of complexing ions. Zeolites as ion-exchangers. Applications.

*Solvent extraction:*Principle and techniques. Distribution ratio and distribution coefficient. Factors affecting extraction efficiency: Ion association complexes, chelation, synergistic extraction, pH. Numericals based on multiple extractions. Role of chelating ligands, crown ethers, calixarenes and cryptands in solvent extraction. Introduction to Solid phase extraction (SPE) and Microwave assisted extraction (MAE), Applications.

Unit III: Classical methods of analysis 15h

Volumetric analysis: General principle. Criteria for reactions used in titrations. Primary standards and secondary standards. Theory of indicators. Types of titrations with examples- Acid-base, precipitation, redox and complexometric. Titration curves for monoprotic and polyprotic acids and bases. Indicators used in various types of titrations. Masking and demasking agents.

Gravimetric analysis: General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibria. Steps involved in gravimetric analysis. Purity of precipitate: Co-precipitation and post-precipitation. Fractional precipitation. Precipitation from homogeneous solution. Particle size, crystal growth, colloidal state, aging and peptization phenomena. Ignition of precipitates.

Unit IV: Electrochemical methods of analysis-I 15h

Conductometry: Concepts of electrical resistance, conductance, resistivity and conductivity. Specific, molar and equivalent conductance and effect of dilution on them. Measurement of conductance. Kohlrausch's law, Applications of conductometry in determination of dissociation constant, solubility product. Conductometric titrations. High frequency titrations. Numerical problems.

Potentiometry: Circuit diagram of simple potentiometer. Indicator electrodes: hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode. Reference electrodes: Calomel electrode and Ag/AgCl electrode. Theory of potentiometric titrations. Acid-base, redox, precipitation and complexometric titrations. Nernst equation, standard electrode potential, Determination of cell potential, n, K_f and K_{sp}. pH titrations. Buffers and buffer capacity. pH of buffer mixtures based on Henderson-Hasselbalch equation.

List of books:

1. Quantitative analysis: Day and Underwood (Prentice-Hall of India)
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry: Gary D. Christian (Wiley, India).
4. Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
6. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
7. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
8. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
9. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
10. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
11. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
12. Fundamentals of Analytical Chemistry: S. A. Skoog and D. W. West
13. Instrumental Methods of Chemical Analysis: G. W. Ewing

Semester I
Practical-I (Code: 1P1)

Inorganic Chemistry

12 h /week Marks:100

I. Preparation of Inorganic Complexes and their characterization by:

Elemental analysis and physico-chemical methods (Electronic and IR Spectra, magnetic susceptibility measurements, Thermal analysis and Molar conductance studies).

1. K_3 [Al $(C_2O_4)_3$]$(H_2O)_3$ 2. [VO (acac) $_2$] 3. Na [Cr $(NH_3)_2(SCN)_4$]
4. $K_3[Cr(SCN)_6]$. 5. [Mn (acac) $_3$] 6. K_3 [Fe $(C_2O_4)_3$]
7. Hg [Co (SCN) $_4$] 8. [Co (Py) $_2$ Cl_2] 9. [Cu_2 $(CH_3COO)_4(H_2O)_2$]
10. [Ni (DMG) $_2$] 11.$[Ni(NH_3)_6]Cl_2$ 12. $[Cu(NH_3)_4(H_2O)_2]SO_4$

II. Quantitative Analysis:

Separation and determination of two metal ions from the following alloys involving:
Volumetric, Gravimetric and Spectrophotometric methods

i) Copper (II) and Nickel (II)
ii) Copper (II) and Zinc (II)
iii) Nickel (II)—Zinc (II) and
iv) Copper (II)—Iron (III)

III. Qualitative analysis of radicals:

Semi-micro Analysis of inorganic mixture containing four cations out of which two will be rare metal ions such as W, Mo,Se,Ti,Zr,Ce,Th,V and U.(Spot Test for individual cations should be performed)

Semester I

Practical-II (Code: 1P3)

Physical Chemistry

12 h /week Marks: 100

It is expected to perform minimum 14 experiments in a semester.

1. To study the variation of volume contraction with mole fraction of alcohol in alcohol -water system
2. To determine the activation parameters of viscous flow for a given liquid.
3. To Determine the critical micelle concentration (CMC) of a given surfactant / soap / shampoo by surface tension measurements.
4. Determination of molecular mass of a polymer by viscometry method.
5. To determine integral heat of KNO_3, at two different conc. and calculation of heat of dilution.
6. Effect of 1% NaCl, 1% succinic acid, 0.5% naphthalene on CST in phenol-water systems.
7. Distribution of succinic acid in H_2O- benzene, H_2O-ether and comparison of distribution coefficient.
8. To construct the phase diagrams of two components system (phenol- urea, diphenyl aminebenzophenone; a-naphtyl amine-phenol) forming compounds with congruent melting points.
9. To study the mutual solubility of glycerol-m-toluidine and to determine congruent points.
10. To study kinetics of hydrolysis of an ester by NaOH reaction.
11. To determine equilibrium constant of the equation $KI+I_2=KI_3$ by distribution method.
12. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
13. Determination of order of reaction of oxidation of ethyl alcohol by acid dichromate.
14. To titrate conductometrically monobasic and dibasic acids with NaOH and determine the strength of given acid.
15. To determine equivalent conductance of weak electrolyte at infinite dilution by kaulrausch's method.
16. Determination of heat of reaction, entropy change and equilibrium constant of the reaction between metallic zinc and Cu^{+2} ions in solution.
17. Determination of thermodynamic constants G, H, S for $Zn^{+2}+H_2SO_4 \rightarrow ZnSO_4+ 2H^+$ by emf measurement.

18. Titration of Ferrous Ammonium Sulphate against ceric sulphate and hence the formal redox potential of $Fe^{2+} \rightleftharpoons Fe^{3+}$ and $Ce^{3+} \rightleftharpoons Ce^{4+}$ systems.
19. To determine the pH of a buffer solutions using a quinhydrone electrode
20. Complexometric titrations (EDTA based)

List of Books

1. Vogel A,IIIrd Edition : A Textbook Of Quantitative Inorganic Analysis, Longman
2. J. B. Yadav, Practical Physical Chemistry
3. Das and Behra, Practical Physical Chemistry
4. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
5. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
6. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
7. Day And Underwood :Quantitative Analysis
8. Merits And Thomas:Advanced Analytical Chemistry
9. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
10. Drago, R.S:Physical Methoods In Inorganic Chemistry
11. Christain G.D:Analytical Chemistry
12. Khopkar S.M.:Basic Concept of Analytical Chemistry
13. Koltath And Ligane:Polorography
14. Braun:Instrumental Methods of Chemical Analysis
15. Willard, Merritt And Dean: Instrumental Methods of Chemical Analysis ,Van Nostrand
16. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
17. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
18. Dilts R.V.: Analytiacl Chemistry
19. Jahgirdar D.V :Experiments In Chemistry
20. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
21. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
22. Akjmetov, N :General And Inorganic Chemistry

Semester I

Seminar-I (Code: 1S1)

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25marks (1credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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M.Sc. Chemistry
Semester II
Paper V (Code: 2T1)
Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

A) Electronic spectra of Transition Metal complexes 10h

Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule, Hole Formulation, Derivation of the term symbol for a d^2 configuration, Electronic spectra of transition metal complexes – Laporte 'orbital' selection rule,spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10Dq, B, β parameters.Tanabe- Sugano Diagrams of octahedral complexes with d^2& d^8 configuration.

B) Magnetic Properties of Transition Metal complexes 5h

Abnormal magnetic properties, orbital contributions and quenching of orbital angular momentum, spin-orbit coupling. Magnetic moment, electronic spectra and structure of tetrahalocobalt(II) complexes, tetrahedral and octahedral Ni(II) complexes. High spin-low spins crossover.

Unit – II 15h

Reaction mechanism of Transition Metal Complexres-II: Substitution reaction in square planer complexes: the trans effect, cis effect, steric effect, solvent effect, effect of leaving group, effect of charge, effect of nucleophile, effect oftemperature. Trans effect theories, uses of trans-effect, mechanism of substitution reactions in Pt(II) complexes.Electron transfer reactions. Types of electron transferreactions, conditions of electron transfer, and mechanism of one-electron transfer reactions, outer sphere and inner sphere mechanisms, two electron transfer reactions complimentary and non-complimentary reactions. Tunneling effect, cross-reaction, Marcus-Hush theory, bridged activated mechanism.

Unit-III: Metal pi-Complexes - I 15h

Metal carbonyls: Structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls.Metal carbonyl clusters with reference to classification, EAN rule, synthesis and structures.

Unit – IV: Metal pi-Complexes – II 15h

Metal nitrosyls: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structureelucidation, important reactions of transition metal nitrosyls, structure and bonding. Dinitrogen and dioxygen complexes. Wilkinson's catalyst and Vaska's compound.

List of Books

1. J.E.Huheey :Inorganic Chemistry
2. F.A.Cottonand G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th and 6th Editions.
3. A.F. Willims: Theoretical Approach in inorganic chemistry.
4. Mannas Chanda: Atomic Structure and chemical Bonding
5. L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
6. J. J. Logowski: Modern Inorganic Chemistry
7. B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
8. J C. Bailar: Chemistry of coordination compounds.
9. W. L. Jolly: Modern Inorganic ChemistryJones: Elementry Coordination chemistry.
10. B. N. Figgis: Introduction to Ligand field.
11. M.C.Day and J.Selbin: Therotical Inorganic Chemistry.
12. J. Lewin and Wilkins: Modern Co-ordination chemistry.
13. Purcell and Kotz: Inorganic Chemistry.

14. D. Banerjea: Co-ordination chemistry, Tata Mc. Graw. Pub.
15. A.F. Wells: Structural inorganic chemistry, 5th Edition, Oxford.
16. S. G. Davies: Organotransition metal chemistry applications to organic synthesis.
17. R. C. Mehrotra: Organometallic chemistry Tata McGraw Hill. Pub.
18. G. S. Manku: Thereotical priciples of inorganic chemistry
19. A. B. P. Lever: Inorganic electronic spectroscopy.
20. R.C.Maurya:Synthesis and charecterisation of novel nitrosyls compounds, Pioneer Pub. Jabalpur2000.
21. R.H.Crabtree:The Organometalic chemistry of Transition metals, John Wiley.
22. D.N.Styanaryan:Electronic Absorption Spectroscopy and related techniques, University Press.
23. R. S. Drago: Physical methods in inorganic chemistry
24. F.Basolo andG.Pearson: Inorganic Reaction Mechanism
25. Organometallics II and I complexes with transition metal- carbon bonds: Manfred Bochmann- Oxford Press.
26. Advanced Inorganic Chemistry Vol I and II – Satyaprakash, Tuli, Bassu and Madan- S Chand.
27. M.Tsusui,M.Nlevy,M.Ichikwa and K.Mori:Introduction to metal pi-complexe chemistry,Plenum press,NY
28. A.E.Martel;Coordination Chemistry-VolIandII,VNR.

Semester II

Paper VI (Code: 2T2)

Organic Chemistry

2T2

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 15 h

A] Addition to carbon-carbon multiple bond: Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry, Addition to cyclopropanes, Hydrogenation of double bond and triple bonds. Hydrogenation of aromatic rings, hydroboration, Michael reaction, Robinson annulation

B] Addition to carbon-hetero atom multiple bond: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles, Addition of Grignard reagents, organozinc and organolithium reagents to carbonyls and unsaturated carbonyl compounds, Wittig reaction, Mechanisms of condensation reactions involving enolates- Aldol, Knoevengel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction, Hydrolysis of esters and amide.

Unit-II 15 h

A] Mechanism of molecular rearrangement: Classification and General mechanistic treatment of electrophilic, nucleophilic and free radical moleculer rearrangement. Mechanism of the following rearrangement –Wagner-Meerwin, Pinacol-Pinacolone, Tiffenev –Demjnov ring expansion, benzil-benzilic acid, Favorski, Wolff, Arndt-Eistert synthesis, Curtius Lossen, Beckman, Hoffman, Schmidt rearrangement.

B] Elimination reactions: The E_1, E_2 and E_1CB mechanisms and orientation of the double bond, Saytzeff and Hoffman's rule, Effect of substrate structure, attacking base, leaving group and medium, Mechanism and orientation in pyrolytic elimination

UNIT-III

Free radical reactions: Generation of free radicals, Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, aliphatic substrate, reactivity at a bridgehead position. Neighbouring group assistance, reactivity for aliphatic and aromatic substrates, reactivity in attacking radicals, effect of solvent on reactivity.Halogenation at an alkyl carbon, allylic carbon (NBS), hydroxylation at an aromatic carbon by means of Fenton's reagent. Auto-oxidation,

chlorosulphonation (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Free radical rearrangement, Hunsdiecker reaction, iododecarboxylation, Barton reaction, Hoffmann-Loefler-Freytag reaction

Unit IV: Green chemistry 15 h

Green chemistry: Basic principles of green chemistry, calculation of atom economy of rearrangements, addition, substitution and elimination reaction with suitable examples, Case study of Bhopal gas tragedy and Seveso disaster, Synthesis involving basic principles of green chemistry-paracetamol, Ibuprofen, hydroquinone, adipic acid, ε-caprolactum, styrene, urethanes, Free radical bromination, Multi-component reactions (Biginelli, Ugi and Passerini reaction), Prevention or minimization of hazardous products, choice of solvents. Sonochemistry, microvave induced reactions, polymer supported reagents, reactions in aqueous medium, zeolites and ionic liquid supported reaction, Solvent free reactions, electrochemical reactions, Biocatalysts in Organic synthesis.

List of books

1] Books as Suggested in Semester I for Organic Chemistry
2] A Textbook of organic chemistry- R.K. Bansal
3] New trends in green chemistry –V.K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
4] Heterocyclic Chemistry, John Joule, Oxford University Press
5] Books as Suggested in Semester I for Organic Chemistry
6] A Textbook of organic chemistry- R.K. Bansal
7] New trends in green chemistry –V.K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
8] Heterocyclic Chemistry, John Joule, Oxford University Press

Semester II

Paper VII (Code: 2T3)

Physical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT I: FORMULATION OF QUANTUM MECHANICS

15h

A] Introduction of Quantum Mechanics, Wave Function, Acceptability of Wave Functions, Normalized and Orthogonal Wave Functions, Operators, Operator Algebra, Eigen Functions and Eigen Values of Quantum Mechanical Properties (e.g. Linear, Angular momentum, etc.), Hermitian Operators, Orbital and generalized Angular Momentum, Postulates of Quantum Mechanics, Problems on Operator algebra, Eigen Values and Average Values of quantities.

B] Application of Schrödinger Wave Equation to Simple Systems: Degeneracy in 3-Dimensional Box, Rigid Rotor, Potential Well of Finite Depth (Tunneling Effect), Simple Harmonic Oscillator, The Hydrogen Atom.

UNIT II: THERMODYNAMICS

15h

A] Ideal and Non-ideal Systems: Concept of fugacity, determination of fugacity, excess functions for non ideal solutions, Entropy of mixing, Enthalpy of mixing, Activity and activity coefficients, Concept of ion atmosphere and electrophoretic effect, Debye Hückel theory for activity coefficients of electrolytic solutions, determination of activity and activity coefficients, ionic strength and dependence of activity coefficients on ionic strength, numericals.

B] Nonequilibrium Thermodynamics: Conservation of mass and energy in time dependent closed and open systems, Thermodynamic criteria of irreversibility, rate of entropy production and entropy exchange in irreversible processes. The generation of the concept of Chemical Affinity and the

extent of advancement of chemical reactions, Thermodynamic constraints on the signs of chemical affinity and the velocity of chemical reaction, application to any one coupled reaction.

UNIT III: SOLID STATE CHEMISTRY 15h

A] Introduction to crystals, Unit Cell and lattice parameters, Symmetry elements in crystals, Absence of fivefold axis, Space groups, The Bravais Lattices, Miller Indices, Bragg's Equation, seven crystal system, Packing in crystals, Hexagonal Closest Packing (HCP) Cubic Closest Packing (CCP), Voids, packing fraction, Numericals.

B] Crystal Defects and Non-stiochiometry: Perfect and imperfect crystals, point defects, line and plane defects. Thermodynamics of Schottky and Frenkel defect formation, colour centers, non-stiochiometry and defects.

UNIT IV: STATISTICAL THERMODYNAMICS AND NUCLEAR CHEMISTRY 15h

A] Statistical thermodynamics: Lagrange's Method of Undetermined Multipliers (Conditional Maximization), Stirling Approximation, Concept of Distribution, Thermodynamic Probability and most probable distribution, Maxwell Boltzmann, Bose Einestein, Fermi Dirac statistics, comparison between three statistics.

B] Nuclear Chemistry: Introduction, radioactive decay and equilibrium, thermonuclear reactions, photonuclear reactions, Radiometric titration, isotopic dilution analysis, NAA. Counters: Proportional counter, GM counter, Scintillation counter, Ionization chamber counter.

List of books

1. Ira .N. Levine, Quantum Chemistry, 5th edition(2000), Pearson educ., Inc.New Delhi
2. A.K.Chandra, Introductory Quantum Chemistry, 4th edition (1994), Tata Mcgraw Hill, New Delhi.
3. M.W.Hanna, " Quantum Mechanics in Chemistry", Benjamin
4. L. Pualing and E. B. Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York (1935).
5. R. K. Prasad, Quantum Chemistry, New Age International, Delhi.
6. R. K. Prasad, Quantum Chemistry through problems and solutions, New Age International, New Delhi, 2009.
7. B. C. Reed, Quantum Mechanics, Jones and Bartlett, New Delhi, 2010.
8. R. P. Rastogi and R. R. Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010.
9. P. W. Atkins'and D. Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010.
10. G. K. Vemulapalli, Physical Chemistry, Prentice – Hall of India, 1997.
11. S. Glasstone, An Introduction to Electrochemistry, East-West Press Pvt. Ltd., New Delhi, 2004.
12. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
13. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
14. N. B. Hanny, Treaties in Solid State Chemistry,
15. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
16. I Prigogine and R. Defay, Chemical Thermodynamics, Longmans, London, 1954.
17. S. R. DeGroot and P. Mazoor, Non-Equilibrium Thermodynamics, North-Holland Co., Amsterdam, 1969.
18. G. Lebon, D. Jou and Casa Vazquez, Understanding Non-equilibrium Thermodynamics, Springer, 2008.
19. I.Prigoggine, "An Introduction to Thermodynamics of Irreversible Processes," Wiley-Interscience.
20. R. P. Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.
21. G. A. Somorjai, Introduction to Surface Chemistry and Catalysis, Wiley, 2010.
22. M. C. Gupta, Statistical Thermodynamics, New Age International.
23. K. Huang, Statistical Mechanics, Wiley, New Delhi, 2003.
24. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
25. C.N.Rao. Nuclear Chemistry

26. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
27. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.
28. C.Kittel, " Introduction to solid state Physics",Wiley
29. L.V.Azaroff, " Introduction to solids", McGraw Hill
30. L. E. Smart and E. A. Moore, Solid State Chemistry-An Introduction, CRC Tylor and Fransis, 2005.
31. D. D. Sood, A. V. R. Reddy, Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, 2007.
32. C. N. R. Rao and Gopalakrishnan, "New Directions in Solid State Chemistry " Second Edition, Cambridge University Press.
33. Anthony R. West, "Solid State Chemistry and its Applications" Wiley India Edition.
34. C. Kalidas and M. V. Sangaranarayana, Non-Equilibrium Thermodynamics.
35. D. K. Chakravorty, Solid State, New Age International.

Semester II

Paper VIII (Code: 2T4)

Analytical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Sampling and quantification 15h

A] *Sampling and sample treatment*: Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals.Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples.

B] *Detection and quantification*: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques.Units in chemical analysis and their interconversion.

C] *Stoichiometry:* Stoichiometric and sub-stoichiometric reactions and calculations.

Unit-II: Modern separation techniques 15h

A] *Gas Chromatography*: Principle including concept of theoretical plates and van-Deemter equation. Instrumental set up- carrier gas, sampling system, column and detector. Types of columns, their advantages and limitations. Detectors in GC analysis. Temperature programmed GC. Factors affecting retention, peak resolution and peak broadening.

B] *Liquid chromatography*: Principle, Instrumentation, Advantages and applications of HPLC. Types of columns and detectors. Principle and applications of size exclusion, gel permeation, ion retardation, normal phase and reverse phase chromatography.

C] *Supercritical fluid chromatography*: Introduction and applications.

Unit III: Optical methods of analysis-I 15h

A] Spectrophotometry and Colorimetry: Principle of colorimetry. Beer's law, its verification and deviations. Instrumentation in colorimetry and spectrophotometry (single and double beam). Sensitivity and analytical significance of molar extinction coefficient and λ_{max}. Comparison method, calibration curve method and standard addition method for quantitative estimation. Role of organic ligands in spectrophotometric analysis of metal ions. Ringbom plot and Sandell's sensitivity. Photometric titrations. Determination of pK value of indicator. Simultaneous determination. Composition and stability constant of complex by Job's and mole ratio methods. Derivative spectrophotometry. Numerical problems.

B] Flame photometry: Principle. Instrumentation and types of burners. Factors affecting flame photometric determination. Limitations of flame photometry. Interferences in flame photometry. Applications.

Unit-IV: Electrochemical methods of analysis-II 15h

A] *Polarography*: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.

B] Amperometric titrations**:** Principle, types and applications in analytical chemistry.

List of books**:**

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley India**).**
4. Instrumental Methods of Analysis**:** Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Sample Pre-treatment and Separation: R. Anderson (John Wiley and Sons)
6. Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)
7. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
10. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
11. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
12. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
13. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
14. Fundamental of Analytical Chemistry: S. A. Skoog and D. W. West
15. Instrumental Methods of Chemical Analysis: G. W. Ewing
16. Polarography: Koltoff and Ligane
17. Electroanalytical Chemistry: Sane and Joshi (Quest Publications)

Semester II
Practical**-**III **(**Code**:** 2P2**)**
Organic Chemistry

12 h /week Marks: 100

[A**]** Qualitative Analysis**:** Separation, purification and identification of the mixture of two organic compounds (binary mixture with two solid, one solid one liquid and two liquids) using chemical methods or physical techniques.
Minimum 8-10 mixtures to be analyzed.
Purification of the compounds by crystallization, TLC and chromatographic techniques.

[B**]** Organic preparations**:**Student is expected to carry out minimum of 5-6 two stage organic preparation and 5-6 single stage preparation from the following lists.

[1] Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
[2] Benzophenone → benzhydrol
[3] Aldol condensation: Dibenzal acetone from benzaldehyde.
[4] Sandmeyer reaction: *p*- chlorotoluene from *p*-toluidine
[5] Cannizzaro reaction
[6] Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
[7] Benzil → 2,4,5-triphenyl imidizole

[8] Sucrose → Oxalic acid
[9] Methyl acetoacetate → 5-methyl-isoxazol-3-ol
[10] Ethyl acetoacetate →4-aryl-6-methyl-3,4-dihydro-2(1*H*)-pyrimidinone ester
[11] Ethyl acetoacetate → Diethyl 1,4-dihydro-2,6-dimethyl-4-phenylpyridine-3,-5dicarboxylate
[12] Dye prepartion : Sulphanilic acid → Methyl orange
[13] Dye prepartion : p-nitroaniline → p-red
[14] Acetanilide →*p*-nitroacetanilide →*p*-nitroaniline
[15] Aniline → 2,4,6-tribromo aniline → 2,4,6-tribromoacetanilide
[16] Nitrobenzene →*m*-dinitrobenzene →*m*-nitroaniline
[17] toluene →p-nitrotoluene →*p*-nitrobenzoic acid
[18] Glycine → Benzoyl glycine → 4-benzilidene-2-phenyl oxazole

Semester II

Practical-IV (Code: 2P4)

Analytical Chemistry

12 h /week Marks: 100

Section (A): Classical methods and separation techniques: Calibration, validation and computers

1. Calibration of pipette and burette.
2. Statistical analysis of data.
3. Use of MS-Excel in statistical analysis of data and curve fitting.

Volumetry

1. Determination of Na_2CO_3 in washing soda.
2. Determination of NaOH and Na_2CO_3 in a mixture.
3. Estimation of nickel in given solution by direct complexometric titration with EDTA using bromopyrogallol red.
4. Estimation of nickel in given solution by complexometric back-titration with EDTA.
5. Estimation of chloride in given solution by Mohr's titration.
6. Estimation of chloride in given solution by Volhard's titration.
7. Determination of volume strength of commercial hydrogen peroxide by redox titration with $KMnO_4$.
8. Estimation of phenol/ aniline by bromination method.
9. Estimation of glucose.
10. Estimation of acetone.
11. Estimation of formaldehyde.
12. Estimation of Mn in the presence of Fe using masking phenomenon (ferromanganese alloy).

Gravimetry

1. Estimation of barium as barium sulphate.
2. Estimation of calcium as calcium oxalate/ calcium carbonate/ calcium oxide.

Separation techniques

1. Qualitative separation of metal ions by paper chromatography for 2/3 components.
2. Determination of ion-exchange capacity of resin.
3. Separation of ions by ion exchange.

Section (B): Instrumental techniques: Electroanalytical techniques

1. Analysis of commercial vinegar by conductometric titration.
2. Estimation of phenol by conductometric titration with NaOH.
3. Determination of strength of HCl and CH_3COOH in a mixture conductometrically.

4. Determination of strength of HCl and oxalic acid in a mixture conductometrically.
5. Determination of strength of oxalic acid and CH_3COOH in a mixture conductometrically.
6. Determination of degree of dissociation and dissociation constant of acetic acid conductometrically.
7. Estimation of phenol in dilute solution by conductometric titration with NaOH.
8. Determination of strength of HCl and CH_3COOH individually and in a mixture potentiometrically.
9. Determination of Fe(II) by potentiometric titration with $K_2Cr_2O_7$.
10. Determination of three dissociation constants of H_3PO_4 by pH-metric/ potentiometric titration.

Optical methods

1. Determination of pK of indicator by colorimetry.
2. To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.
3. To study the complex formation between Fe(III) and salicylic acid and find the formula and stability constant of the complex colorimetrically (Job's method).
4. To determine the dissociation constant of phenolphthalein colorimetrically.
5. Estimation of iron in wastewater sample using 1,10-phenanthroline.

Note: One experiment from each section should be performed in the examination.

Semester II

Seminar-II (Code: 2S1)

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 Credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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M.Sc. Chemistry
Semester III
INORGANIC CHEMISTRY SPECILIZATION
Paper IX (Code: 3T1)
Special I-Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I 15h

A) Essential and trace metals in biological systems: Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and difficiency of V, Cr, Mn, Fe, Co, Cu,& Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.

B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na^+ /K^+ pump. Role of Ca in transport and regulation in living cells.

C) Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics & related compounds. Metal used for dignosis and chemotherapy with particular reference to anti cancer drugs.

Unit-II 15h

A) Bio-energetics and ATP cycle: DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

B) Electron transfer in Biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit-III

15h

Transport & Storage of Dioxygen: Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins & hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoningand treatment. Vanadium storage and transport.

Unit-IV 15h

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals ini) Zn-enzyme:- Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme:-Catalase Peroxidase & Cytochrome P-450 iii) Cu-enzyme:-Super Oxide dismutase iv) Molybdenum:-Oxatransferase enzymes, Xanthine oxidase,Co-enzyme Vit.B12, Structure of vitamin B12 Co-C bond cleavage, Mutaseactivity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetc model of enzyme action, stability and ageing of enzyme.

List of Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford

8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

Semester III

Paper X (Code: 3T2)

Special II-Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 15 h

Crystal Structure of Some Simple Compounds:

i) Ionic Crystals &Their structures, radius ratio rule, effect of polarization on crystals.
ii) Covalent structure type- Sphalerite & Wurtzite.
iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs, reasons for preference for a particular structure in above AB type of compounds.
iv) AB_2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O,,$CdCl_2$, CdI_2 structures.
v) Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

Unit-II 15h

A) AB_2O_4 type- compounds: Normal & inverse,2-3 and 4-2 spinel,packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen,application of charge neutrality principles, site preferences in spinel, distorted spinel.Hausmannite(Jahn-Teller distortions),Factors causing distortion in spinel.

B) Lattice Defects: Per fect &Imperfect crystals, point defects, Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronicproperties of Non-stoichiometric oxides.

Unit-III 15h

Glasses, Ceramics and composite:Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and GlassModifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengtheried and particlereinforced, fibre reinforced Composites, microscopic composites, nanocrystaline phase, preparation procedure, special properties and applications.

Unit-IV

15 h

Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotrpic, planer & schlieren textures twisted nematics, chiral nematics, molecular arrngement insmectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants. Lyotropic phases & their description of ordering in liquid crystals.

List of Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).

5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford
8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).
10. Peter J. Collings, Liquid Crystals-Nature's delicate Phase of Matter, New Age International.
11. S. Chandrasekhar, Liquid Crystals, Cambidge University Press.

Semester III

Practical-V (Code: 3P1)

Inorganic Chemistry Special

12 h /week Marks: 100

A INSTRUMENTAL METHODS

I pH METRY:

1. Stepwise proton ligand and metal ligand constant of complexes by Irving Rossetti method

II COLORIMETRY AND SPECTROPHOTOMETRY

1. simultaneous determination of manganese (KMnO$_4$) and chromium ($K_2Cr_2O_7$)
2. simultaneous determination of cobalt (II) and nickel(II)
3. Determination of composition and stability constant of complexes by Job's method of continuous variation , mole ratio method and slope ratio method

III POTENTIOMETRY

1. Estimation of halide in a mixture by potentiometry
2. Determination of stepwise stability constant of silver thiosulphate complex by potentiometrically

IV CONDUCTOMETRY

1. Estimation of amount of acid in a mixture by conductometric titration

B INORGANIC REACTION MECHANISM

Kinetics and mechanism of following reactions:

1. Substitution reactions in octahedral complexes (acid/base hydrolysis)
2. Redox reactions in octahedral complexes
3. Isomerization reaction of octahedral complexes

C BIOINORGANIC CHEMISTRY (CHLOROPHYLL

1. Extraction and absorption spectral study of chlorophyll from green leaves of student choice
2. separation of chlorophyll and their electronic spectral studies
3. Complexation study of metal ions with biologically important amino acids

List of Books

1. Day And Underwood :Quantitative Analysis
2. Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman
3. Flaschka : Edta Titration
4. Merits And Thomas:Advanced Analytical Chemistry
5. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
6. Drago, R.S:Physical Methoods In Inorganic Chemistry
7. Christain G.D:Analytical Chemistry
8. Khopkar S.M.:Basic Concept Of Analytical Chemistry
9. Koltath And Ligane:Polorography

10. Braun:Instrumental Methods Of Chemical Analysis
11. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
12. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
13. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
14. Dilts R.V.: Analytiacl Chemistry
15. Jahgirdar D.V :Experiments In Chemistry
16. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
17. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
18. Ramesh Rand Anbu M , Chemical Methods For Envirnmental Analysis : Watewr And Sedient , Macmillion India
19. Akjmetov, N :General And Inorganic Chemistry
20. Aylett, B. And Smith , B. :Problems In Inorganic Chemistry
21. Charlot, G. And Bezier, D.: Quantitative Inorganic Analysis (John Wilry)
22. Douglas, B. E. Mcdanirl, D. H. Et Al : Concept Amd Models Of Inorganic Chemistry (4th Ed) J Wiley
23. Dutt P. K.:General And Inorganic Chemistry (Sarat Book House)
24. Fenton, David E.:Biocoordination Chemistry, Oxford
25. Jolly, W. L. :Inorganic Chemistryu (4 Th Ed) Addison-Wesley
26. Bertini, Et Al:Bioinorganic Chemistry (Viva)
27. Katakis, D. And Gordon, G :Mechanism Of Inorganic Reactions (J. Wiley)

Semester III

ORGANIC CHEMISTRY SPECIALIZATION

Paper IX (Code: 3T1)

Special I-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

UnitI: Photochemistry 15 h

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation additon and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, di-pi methane rearrangement, Photo theory reaction of anilides, photochemistry of vision, Applications of photochemical methods in synthesis: Isocomene, Cedrene, Hirsutene

Unit II: Pericyclic Reactions 15 h

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Perturbation of Molecular Orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, Cycloaddition reaction with more emphasis on [2+2] and [4+2], Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolar cycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial, and antarafacial shift involving carbon moieties, retention and inversion of configuration, [3,3] and [3,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction.

Unit III 15 h

A] Oxidation: Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and $PhI(OAc)_2$, Oxidation with SeO_2, Epoxidation of olefins, Synthetic

application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis

a) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS and $(CH_3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer oxidation
b) Oxidation of aldehydes and ketones, Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation , Chemistry and synthetic applications of $Pb(OAc)_4$, Dess-Martin periiodinane, IBX

B**]** Reduction**:** Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.

a) Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis
b) Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and $NaBH_4$, stereochemical aspects of hydride addition, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction with Bu_3SnH., Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes

Unit IV**:** Chemistry of P, S, Si,and Boron compounds 15 h

a) Phosphours and sulphur ylide: Preperation and their synthetic application along with stereochemistry
b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride based generation of acyl anion
c) Organoboranes- preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexyl borane, cyclohexyl borane, $ICPBH_2$, IPC_2BH, Hydrboration-mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC_2BH. Allyl boranes- synthesis, mechanism and uses
d) Organo silicon compounds in organic synthesis, Me_3SiCl, Me_3SiH and Paterson synthesis

List of books

1] Books as suggested in Semester I for organic chemistry
2] Organic Synthesis, The disconnection approach-S. Warren
3] Designing Organic Synthesis-S. Warren
4] Some Modern Methods of Organic Synthesis-W. Carruthers
5] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
6] Protective Group in Organic Synthesis-T. W. Greene and PGM
7] The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren
8] Organo Silicon Compound-C. Eabon
9] Organic Synthesis via Boranes-H. C. Brown
10] Organo Borane Chemistry-T. P. Onak
11] Organic Chemistry of Boron-W. Gerrard
12] Fundamentals of Photochemistry-K. K. Rohatgi-Mukharji, Wiley Eastern Limited
13] Photochemistry-Cundau and Gilbert
14] Aspects of Organic Photochemistry-W. M. Horspoot
15] Photochemistry-J. D. Calvert
16] Photochemistry-R. P. Wayne

Semester III
Paper X (Code: 3T2)
SpecialII-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit – I

15 h

A] Terpenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Geraniol, α-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A Genesis of biological isoprene unit, Biosynthesis (ONLY) of the following tepenoids: myrecene, linalool, geraniol, α-terpeneol, limonene, camphor, α-pinene, β-pinene, farnesol, β-bisabolene and squelene

B] Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll

Unit II 15 h

A] Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants Structure, stereochemistry, and synthesis of the following: Ephedrine, (+)-coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine,
Biosynthesis (ONLY) of the followings: hygrine, tropinone, nicotine, pelletierine, conine

B] Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE_2 and $PGF_{2\alpha}$

Unit-III 15 h

A] Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone.
Biosynthesis of steroids (lanosterol)

B] Plant Pigments: Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin.
Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway

Unit IV: 15 h

A] Carbohydrate: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, Chemistry of starch and cellulose.

B] Amino acids, protein and peptides: Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, Solid phase peptide synthesis, end group analysis.

List of books

1] Chemistry of Alkloids-S. W. Pelletier
2] Chemistry of Steroids-L. F. Fisher and M. Fisher
3] The Molecules of Nature-J. B. Hendricsion
4] Biogenesis of Natural Compound - Benfield
5] Natural Product Chemistry and Biological Significance- J. Mann, R. S Devison, J. B. Hobbs, D. V. Banthripde and J. B. Horborne
6] Introduction to Flavonoids-B. A. Bohm, Harwood
7] Chemistry of Naturally Occurring Quinines-R. H. Thomson
8] The Systematic Identification of Flavonoids- Marby, Markham, and Thomos

9] Text Book of Organic Medicinal Chemistry-Wilson, Geswold
10] Medicinal Chemistry Vol I and II-Burger
11] Synthetic Organic Chemistry -Gurudeep Chatwal.
12] Organic Chemistry of Natural Products Vol I and II-O. P. Agrawal
13] Organic Chemistry of Natural Products -Gurudeep Chatwal
14] A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh
15] Synthetic Dyes Series -Venkatraman
16] Chemistry Process Industries-Shreve and Brink
17] Principal of Modern Heterocyclic Chemistry-L. A. Paquelte
18] Heterocyclic Chemistry-J. Joule and G. Smith
19] Heterocyclic Chemistry-Morton
20] An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson
21] Introduction to Medicinal Chemistry-A. Gringuadge
22] Wilson and Gisvold Text Book of Organic Medicinal and Pharmaceutical Chemistry-Ed. Robert F Dorge
23] An Introduction to Drug Design-S. S. Pandey and J. R. Demmock
24] Polymer Science-V. Govarikar
25] Principle of Polymer Chemistry-P. J. Flory
26] An Outline of Polymer Chemistry-James Q. Allen
27] Organic Polymer Chemistry-K. J. Saunders

Semester III

Practical-V (Code: 3P1)
Organic Chemistry Special)

12 h /week Marks: 100

[A**]** Quantitative Analysis

Student is expected to carry out following estimations (minimum 6 estimations.)

1. Estimation of Vitamin "C" Iodometry.
2. Estimation of Phenol by $KBrO_3$-KBr.
3. Estimation of Amine by Bromate/ Bromide solution.
4. Estimation of Formaldyde by Iodometry.
5. Estimation of Glucose by Benedict's solution.
6. Estimation of given carbonyl compound by hydrazone formation.
7. Estimation of Aldehyde by Oxidation method.
8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

[B**]** Isolation of Organic Compounds from Natural Source **(**Any six**)**

a) Isolation of caffeine from tea leaves.
b) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
c) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)
d) Isolation of nicotine dipicrate from tobacco
e) Isolation of cinchonine from cinchona bark
f) Isolation of piperine from black pepper
g) Isolation of lycopene from tomatoes
h) Isolation of β-carotene from carrots
i) Isolation of cysteine from hair
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid
k) Isolation of eugenol from cloves

l) Isolation of (+) limonine from citrus rinds

[C**]** QUALITATIVE ANALYSIS

Separation of the components of a mixture of three organic compounds (three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two components using chemical methods or physical techniques. Minimum 10-12 mixtures to be analyzed.

Semester III

PHYSICAL CHEMISTRY SPECIALIZATION

Paper IX **(**Code**:** 3T1**)**

Special I**-**Physical Chemistry

60h *(*4h/week*)* 15h/unit 80 Marks

UNIT I **:** STATISTICAL THERMODYNAMICS 15h

A**]** Statistical thermodynamics**:** Atomic and Molecular quantum levels, Significance of Boltzmann Distribution law, partition Functions and ensembles, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical and micro canonical ensembles, corresponding distribution laws using Lagranges method of undetermined multipliers*. Ortho and para hydrogen, principle of equipartition of energy, calculation of average energy*

B**]** Partition function, Translational partition function, Rotational partition function, Vibrational partition function, Electronic partition function, Applications of partition functions, Numericals**.**

UNIT II**:** ELECTROCHEMISTRY OF INTERFACES 15h

A**]** Electrode Interfaces**:** Quantum aspects of charge transfer at electrode**-**solution interfaces, quantization of charge transfer, tunneling**.** Semiconductor interfaces**:** Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces, effect of light at semiconductor solution interface**.**

B**]** Electro catalysis**:** Comparison of electro catalytic activity, importance of oxygen reduction and hydrogen evolution reactions, and their mechanism, volcanoes**.**

C**]** Bio**-**electrochemistry**:** Threshold membrane phenomena, Nernst Plank equation, Hodges Huxley equations, core conductor models, electrocardiography**.**

UNIT III**:** CHEMICAL DYNAMICS **-** I 15h

A**]** Dynamics of complex reactions**:** reversible, parallel, consecutive, concurrent and branching reactions, free radical and chain reactions, reaction between Hydrogen **–** Bromine and Hydrogen **–** Chlorine **(**thermal and photochemical**)**, decomposition of ethane, acetaldehyde, N_2O_5, Rice Herzfeld mechanism, Oscillatory autocatalytic and Belousov**-**Zhabotinsky reactions**.**

B**]** Fast Reactions**:** relaxation methods, flow methods, flash photolysis, magnetic resonance method, relaxation time and numericals**.**

UNIT IV**:** PHOTOCHEMISTRY 15h

A**]** Photophysical phenomenon**:** Introduction, photo and photochemical excitation and de**-**excitation, fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching**:** concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems**.** Stern**-**Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern**-**Volmer equation**.**

B**]** Photochemical reactions**:** photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosenitisation, chemiluminescence, photochemistry of environment**:** Green house effect**.**

List of books:

1. G. M. Panchenkov and V. P. Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, "Chemical Kinetics and Kinetics of Solutions", Academic
3. K. J. Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J. Raja Ram and J. C. Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
5. J.G. Calvert and J.N. Pitts, Jr., *Photochemistry,* John Wiley and Sons, New York (1966).
6. K. K. Rohtagi-Mukherjee, *Fundamentals of Photochemistry,* New Age International, New Delhi(1986).
7. R. P. Wayne, *Principles and Applications of Photochemistry,* Oxford University Press, Oxford(1988).
8. N. J. Turro, *Modern Molecular Photochemistry,* Univ. Science Books, Sansalito (1991).
9. J. F. L. Lakowicz, *Principles of Fluorescence Spectroscopy,* 2nd Edition (1999), PlenumPublishers, NewYork.
10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics".AddisonWesley
11. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
12. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
13. N. J. Turro, V. Ramamurthy and J. C. Scaiano, Principles of Photochemistry – An Introduction, Viva Books, New Delhi, 2015.
14. G. A. Somorjai, Introduction to Surface Chemistry and Catalysis, Wiley, 2010.
15. M. C. Gupta, Statistical Thermodynamics, New Age International.
16. K. Huang, Statistical Mechanics, Wiley, New Delhi, 2003.
17. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
18. B. K. Agarwal and M. Eisner, *Statistical Mechanics*, Wiley Eastern, New Delhi (1988).
19. D. A. McQuarrie, *Statistical mechanics*, Harper and Row Publishers, New York (1976).
20. J.O.M.Bokris and A.K.N.Reddy, "Modern Elcrtrochemistry". Wiley
21. S. Glasstone, "Introduction to Electrochemistry" Affilisated East West Press, New Delhi.
22. D. R. Crow, " The Principle of electrochemistry", Chapman Hall
23. G. K. Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill Pvt., Ltd. 1990
24. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

Semester III

Paper X (Code: 3T2)

Special II-Physical Chemistry

60h *(4h/week)* 15h/unit 80 Marks

UNIT-I: QUANTUM MECHANICS - II 15h

A] Applications of Quantum Mechanics: Approximate methods, variation principle, its application in Linear and non-linear functions, MO theory applied to H_2^+ molecule and H_2 molecule (calculation of energy), perturbation theory, application of perturbation theory to helium atom, generation of the concept of resonance.

B] Electronic structure of atoms: Russel Sanders terms and coupling schemes, Slater determinents, term separation energies of the p^n configuration, term separation energies for d^n configuration, magnetic effects: spin orbit coupling and Zeeman splitting.

C] Hybridization, hybrid orbitals in terms of wave functions of s and p orbitals, sp and sp^2 hybridizations, Simple Hückel theory applied to: ethylene, butadiene, cyclobutadiene, cyclopropenyl radical.

Unit II: SOLID STATE REACTIONS AND NANOPARTICLES 15h

A] Solid State Reactions: General principle, types of reactions: Additive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the solid state reactions. photographic process.

B] Nanoparticles and Nanostructural materials: Introduction, methods of preparation, physical properties, and chemical properties, sol-gel chemistry of metal alkoxide, application of Nanoparticles, Charecterization of Nanoparticles by SEM and TEM. Nanoporous Materials: Introduction, Zeolites and molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation and applications.

UNIT-III: ELECTROCHEMISTRY OF SOLUTION 15h

A] Metal/Electrolyte interface: OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer : Helmholtz-Perrin, Gouy Chapman model, Stern region, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models.

B] Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot

C] Electrical double lever, theories of double layer, electro-capillary phenomena, electro-capillary curve. Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential.

UNIT IV: IRREVERSIBLE THERMODYNAMICS 15h

A] Microscopic reversibility and Onsager reciprocity relation, phenomenological equations, Transformation of generalized fluxes and forces. The cyclic version of Clausius' inequality and its integrated form and their correspondence with time's arrow and irreversibility, Clausius' uncompensated heat. Derivation of the differential form of Clausius' inequality.

B] Rate of entropy production and the concept of Chemical affinity and its application to the cases of chemical reactions, coupled reactions, electrochemical reactions. Derivation of Gibbs relation and its DeDonderian version (time rate form) for spatially uniform chemically reacting closed systems, entropy production in spatially non-uniform systems like heat flow, Electrokinetic effect – Saxen relation.

List of books:

1. Ira .N. Levine, Quantum Chemistry, 5th edition(2000), Pearson educ., Inc.New Delhi
2. A.K.Chandra, Introductory Quantum Chemistry, 4th edition (1994), Tata Mcgraw Hill, New Delhi.
3. M.W.Hanna, " Quantum Mechanics in Chemistry", Benjamin
4. L. Pualing and E. B. Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York (1935).
5. R. K. Prasad, Quantum Chemistry, New Age International, Delhi.
6. R. K. Prasad, Quantum Chemistry through problems and solutions, New Age International, New Delhi, 2009.
7. B. C. Reed, Quantum Mechanics, Jones and Bartlett, New Delhi, 2010.
8. S. Glasstone, An Introduction to Electrochemistry, East-West Press Pvt. Ltd., New Delhi, 2004.
9. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
10. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
11. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
12. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
13. I Prigogine and R. Defay, Chemical Thermodynamics, Longmans, London, 1954.
14. S. R. DeGroot and P. Mazoor, Non-Equilibrium Thermodynamics, North-Holland Co., Amsterdam, 1969.
15. G. Lebon, D. Jou and Casa Vazquez, Understanding Non-equilibrium Thermodynamics, Springer, 2008.
16. I.Prigoggine, "An Introduction to Thermodynamics of Irreversible Processes," Wiley-Interscience.
17. R. P. Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.
18. J.O.M.Bokris and A.K.N.Reddy, "Modern Elcrtrochemistry". Wiley
19. S. Glasstone, "Introduction to Electrochemistry" Affilisated East West Press, New Delhi.
20. D. R. Crow, " The Principle of electrochemistry", Chapman Hall

21. C.Kittel, " Introduction to solid state Physics",Wiley
22. L.V.Azaroff, " Introduction to solids", McGraw Hill
23. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
24. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
25. N. B. Hanny, Solids,
26. Sulbha Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing House, 2011.
27. T. Pradeep, Nano: The Essentials, Tata Mc-Graw Hill, 2012
28. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.
29. N. B. Hanny, "Solid State Chemistry"
30. C. N. R. Rao and Gopalakrishnan, "New Directions in Solid State Chemistry " Second Edition, Cambridge University Press.
31. Anthony R. West, "Solid State Chemistry and its Applications" Wiley India Edition.

Semester III

Practical-V (Code: 3P1)

Physical Chemistry Special

12 h /week Marks: 100

Thermodynamics:

1. Determination of partial molar volume of solute and solvent (ethanol-water, methanol-water, KCl-water mixture)

Solutions:

2. Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients.
3. Determination of temp. dependence of the solubility of a compound in two solvents having similar intermolecular interactions(benzoic acid in water and DMSO – water mixture) and calculation of the partial molar heat of solution.

Phase equilibrium:

4. To study the effect of addition of an electrolyte such as NaCl, KCl,Na_2SO_4,K_2SO_4 etc. on the solubility of an organic acid(benzoic acid or salicylic acid).
5. To determine the heat of crystallization of $CuSO_4$,$5H_2O$
6. To determine the heat of reaction involving precipitation of a salt $BaSO_4$
7. To determine transition temperature of $CaCl_2$ by thermometric method and to determine transition temperature of $CaCl_2$, sodium bromide by solubility method

Kinetics:

8. To determine the activation energy of hydrolysis of an ester by acid.
9. Kinetics of reaction between sodium thiosulphate and KI. Determination of rate constant; study of influence of ionic strength
10. Kinetics of decomposition of H_2O_2 catalysed by iodide ion. Also determination of activation energy of reaction.

Conductometry:

11. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.
12. Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl, KNO_3) at several concentration and hence verify Onsager's equation.
13. Carry out the following precipitation titration conductometrically. a. 50 ml.0.02N $AgNO_3$ with 1N HCl; b.50 ml.0.02N $AgNO_3$ with 1N KCl; c. 50 ml 0.004 N $MgSO_4$ with 0.1 N Ba$(OH)_2$; d. 50 ml 0.002 N $BaCl_2$ with 1 N Li_2SO_4; e. 50 ml.0.02 N $BaCl_2$ with 1N K_2SO_4

Potentiometry:

14. To prepare calomel electrode and to determine the potential of calomel electrode by potentiometry.

15. To determine stability constant of Fe^{3+} with potassium dichromate in presence of dilute sulphuric acid by redox titration.
16. To determine solubility product of Silver chloride by potentiometric method.
17. Determination of redox potential of the couples(**Fe^{2+}/Fe^{3+}**,Co^{3+}/Co^{2+}**,Cr^{3+}/Cr^{2+}**,MnO_4^-/Mn2+(**any two**)** and equilibrium constant.
18. Study of complex formation by potentiometry e.g.Ag^+-$S_2O_3^{-2}$, Fe^{3+}-SCN^-,Ag^+-NH_3(any two) and calculation of stability constant.

Spectrophotometry:

19. To verify Beers law for solution of potassium permanganate and to find molar extinction coefficient.
20. To determine the indicator constant (**pK_{In}**) of methyl orange/red spectrophotometrically.

Polarography:

1. Determination of the half-wave potential of the cadmium ion in 1M potassium chloride solution.
2. Investigation of the influence of dissolved oxygen.
3. Determination of cadmium in solution.
4. Determination of lead and copper in steel.

List of Books

1. Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
5. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood :Quantitative Analysis
7. Merits And Thomas:Advanced Analytical Chemistry
8. Ewing, G. W. : Instrumental Methods of Chemical Analysis, Mcgraw-Hill
9. Drago, R.S:Physical Methoods In Inorganic Chemistry
10. Christain G.D:Analytical Chemistry
11. Khopkar S.M.:Basic Concept Of Analytical Chemistry
12. Koltath And Ligane:Polorography
13. Braun:Instrumental Methods Of Chemical Analysis
14. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
15. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
16. Skoog S.A. And West D. W.:Fundamental of Analytical Chemistry
17. Dilts R.V.: Analytiacl Chemistry
18. Jahgirdar D.V :Experiments In Chemistry
19. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
20. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed

Semester III

ANALYTICAL CHEMISTRY SPECIALIZATION

Paper IX(Code: 3T1)

Special I-Analytical Chemistry

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-I 15h

Radioactivity-Radiation-Units-Curie, Becquerel, Gray, Rad, Sievert, RBE, REM, Half life, mixed half life, branching decay, different types of radiations and their interactions with matter, radioactive

equilibrium, Elementary principles of GM and proportional counters, Gamma Ray Spectrometer, Ionization chamber, HPGe detector, NaI(Tl) detector, calibration using standard sources, resolution, numericals.

Unit-II:Optical methods of analysis-III 15h

Atomic absorption spectroscopy: Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapour and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.

Unit-III: Electrochemical methods of analysis-III 15h

Stripping Voltammetry: Principle and technique in anodic and cathodic stripping voltammetry, applications to metal ion analysis, limitations.

Adsorptive stripping voltammetry: Principle, technique, applications to metal ions and organic analysis. Advantages over anodic stripping voltammetry. Catalytic effects in voltammetry.

Working electrodes: Mercury electrodes, carbon electrodes, film electrodes.

Cyclic voltammetry: Principle and technique. Randles-Sevcik equation. Interpretation of voltammogram- reversible, irreversible and quasi-reversible systems. Applications of cyclic voltammetry in study of reaction mechanism and adsorption processes.

Electrochemical sensors (Chemically modified electrodes): Biosensors, catalytic sensors and gas sensors.Comparison of voltammetry with AAS and ICP-AES.

Unit-IV: Miscellaneous techniques-I 15h

Fluorometry and phosphorimetry: Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications.

Nephelometry and turbidimetry: Principle, instrumentation and applications.

*Photoacoustic spectroscopy:*Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS.

Electrogravimery: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Characteristics of deposits and completion of deposition. Instrumentation. Application in separation of metals.

Semester III

Paper X(Code: 3T2)

Special II-Analytical Chemistry

60h *(4h/week)* 15h/unit 80 Marks

Unit-I: Organoanalytical Chemistry 15h

Elemental analysis: Outline of macro, semi-micro, micro and ultra-micro analysis, semi-micro determination of carbon, hydrogen, halogen, sulphur, nitrogen, phosphorous, arsenic, boron and metals in organic compounds.

Functional group analysis: Semi-micro determination of the following functional groups in organic compounds- hydroxyl, amino, nitro, nitroso, azo, N-acetyl, O-acetyl, methyl, aldehydes, ketones, thio, disulphide, sulphonamide, unsaturation and active hydrogen.

KF reagent: Karl Fischer reagent and its use in analysis of water in organic compounds.

Unit-II: Analysis of ores and cement

15h

Ores: Composition and analysis of the followings ores- Bauxite, Pyrolusite, Dolomite, Chromite.
Portland cement: Composition, raw material, manufacturing processes, characteristics, analysis.

Unit III: 15h

Water pollution and analysis: Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation. Water treatment plants: Sand filters and other types of filters.

Unit-IV: Air pollution and analysis 15h

Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO_2, NO_2, CO, CO_2, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Green house effect, Heat Islands, Acid Rain.

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
4. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
5. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
6. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
7. Vogel's Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Atomic Absorption Spectroscopy: Robinson (Marcol Dekker)
10. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
11. Analysis of Water: Rodier
12. Laboratory manual of water analysis: Moghe and Ramteke (NEERI)
13. Electroanalytical chemistry: Joseph Wang
14. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)
15. Trace analysis: S. Lahiri (Narosa Publishing House)
16. Electroanalytical Chemistry: Bard (Marcel-Dekker)
17. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)

Semester III

Practical-V (Code: 3P1)

Analytical Chemistry Special

12 h /week Marks: 100

pH-metry

1. Determination of percent Na_2CO_3 in soda ash by pH-metric titration.
2. Determination of isoelectric point of amino acid.
3. Determination of three dissociation constants of phosphoric acid.

Conductometry

1. Displacement titration of CH_3COONa with HCl.
2. Precipitation titration of $MgSO_4$ and $BaCl_2$.

3. Titration of mixture of CH_3COOH, H_2SO_4 and $CuSO_4$ with NaOH.

Potentiometry

1. Estimation of Cl^-, Br^- and I^- in a mixture.
2. Determination of percent purity of phenol by potentiometric titration with NaOH.
3. Estimation of acids in mixtures.

Coulometry

1. Estimation of nickel and cobalt by coulometric analysis at controlled potential.
2. Analysis of antimony (III) with I_3^- .

Polarography

1. Determination of $E_{1/2}$ of Cd^{2+} and Zn^{2+} at DME.
2. Estimation of Cd^{2+} and Zn^{2+} in respective solutions by calibration curve and standard addition methods.
3. Determination of composition /stability constant of complex.

Cyclic voltammetry

1. Study of cyclic voltammograms of $K_3[Fe(CN)_6]$.

Electrogravimetry

1. Estimation of nickel and copper individually as well as in mixture.

Polarimetry

1. Inversion of cane sugar in the presence of HCl.
2. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in mixture.

Colorimetry**/**spectrophotometry

1. Simultaneous determination of chromium and manganese in given mixture.
2. Simultaneous determination of two dyes in a mixture.
3. Estimation of Mn in steel.
4. Estimation of Cu/Ni in alloys.
5. Estimation of iron in water sample using 1,10-phenanthroline.
6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

Flame photometry

1. Estimation of Li, Na, K, Ca in rock/ soil / water samples.

Turbidimetry and nephelometry

1. To determine molecular weight of polymer.
2. Estimation of sulphate in water sample by turbidimetry.
3. Estimation of phosphate by nephelometry.

Radioanalytical techniques

1. GM-counter: Plateau, nuclear statistics, half thickness of aluminium absorbers, dead time.
2. Gamma ray spectrometer: Calibration using standard sources, determination of half life (Mn-56, I-128, In-116)
3. Experiments based on radiation chemistry: G-value-$G(NO_2^-)$.

Demonstrations

1. UV-spectrophotometry

Semester III

Paper XI **(**Code**:** 3T3**)**

Elective**-** Nuclear Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit**-I:** Radioactive decay 15h

Various modes of decay, natural radioactivity, successive radioactive decay and growth kinetics, radioactive equilibrium, half life, half life of mixed radioisotopes, decay schemes, its determination by experimental methods, statistical nature of nuclear radiation, treatment of nuclear data and calculation of standard deviation, probability

Unit-II: Nuclear structure 15h

mass-energy relationship, nuclear binding energy, semi-empirical mass formula, nuclear stability rules, nuclear properties, mass size, spin and parity, nature of nuclear forces, liquid drop model, shell model, its evidence and advantages, comparison of the two models, calculations based on above.Energetics of nuclear reaction, cross reaction, comparison with chemical reactions, various types of nuclear reactions, photonuclear, spallation and thermonuclear reaction

Unit-III: Interaction of radiations with matter,detectors 15h

Interaction with matter and detection of gamma rays with matter by photoelectric, Compton and pai production, interaction of beta particles, neutrons and heavy charged particles, various methods of detecting nuclear radiations, gas filled counters, ionization chamber, proportional and GM counters, scintillation detector and solid state detectors- Ge(Li), Si(Li) and HPGe.

Unit-IV: Nuclear fission and Fusion 15h

Probability, mass and charge distribution, release of energy and neutrons, spontaneous fission, nuclear reactors and their uses for power production, brief idea about thermal and fast breeder reactors, reprocessing of nuclear fuel, PUREX process, heavy water- manufacturing and use in reactors. accelerators, nuclear fusion. Production of isotopes by nuclear reactions, production of new elements, radioactive waste management and disposal

Semester III

Practical VI–Elective (Code: 3P3)

Nuclear Chemistry Practical

12 h per week Marks-100

1. Working of GM counter, plateau, statistics, geometry effects, dead time, energy of beta particle, back scattering
2. Working of gas flow proportional counter, plateau, statistics, geometry effects, dead time, energy of beta particle
3. Working with scintillation counter, gamma ray spectra, energy calibration and resolution, half life determination of single and composite nuclei.
4. Radiochemical separation of ^{234}Th from natural uranium salt and its half life determination
5. Experiment on Neutron Activation Analysis by non-destructive method
6. Dose measurement by Fricke and other chemical dosimeters
7. Radiolysis of potassium nitrate, methyl iodide, carbon tetrachloride-iodine systems
8. Szilard-Chalmers reactions with inorganic and organic systems, potassium permanganate and methyl iodide
9. Some trace experiments like partition coefficient, solubility product, isotopic exchange, isotope dilution analysis, radiochromatography, ion exchange.

List of books:

1. H. J. Arnikar - Essentials of Nuclear Chemistry (Willey Eastern Ltd)
2. G. Friendlander, J. W. Kennedy,E. S. Macias and J. M. Miller-Nuclear and Radiochemistry (Wiley Intersciences, New York)
3. G. R. Choppin and J. Rydberg- Nuclear Chemistry-Principles and Applications(Pergamon press, London)
4. B. G. Harvey-Introduction to Nuclear Physics and Chemistry(Prentice Hall of India)
A. N. Nesmeyanov - Radiochemistry- (Mir Publications)
5. M. N. Sastry-Introduction to Nuclear Science, Affiliated East-West Press, New Delhi
6. G. Hughes- Radiation Chemistry- Oxford University Press, London

7. V. Verschinskii and A. K. Pikeav-Introduction to Radiation Chemistry, Israel Publication, Jerusalem-Robinson (Marcol Dekker)
8. Farhat Aziz and M. A. J. Radgers-Radiation Chemistry-Principles and Applications, VCH Publishers FRC.
9. M. Hassinsky-Nuclear Chemistry and its application, Addison Wesley

Semester III

Paper XI (Code: 3T3)

Elective- Environmental Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I: Concept and scope of Environmental Chemistry 15 h

Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification,types of ecosystems. Biogeochemical cycles- carbon, nitrogen, phosphorous, oxygen, hydrogen, sulphur, iron, sodium, potassium, magnesium, cobalt, mercury, lead, zinc and cadmium.
Thermal pollution—sources, harmful effects and prevention of thermal pollution.
Noise pollution --- sources, effects and control of noise pollution.

Unit-II: Water 15 h

Origin, physico-chemical properties of water, sources of water, hydrological cycle, criteria ofwater quality, Water management- water shed management, rain water harvesting, waterpollution-sources, consequences and harmful effects of water pollution, strategies for waterpollution control.

Unit-III: Air 15 h

Major regions of the atmosphere, composition of the atmosphere, temperature inversionand air pollution episodes, photochemistry of the atmosphere, depletion of the stratosphericozone, green house effect, green house gases, remedial measures for reversion of green house effect, acid rain, photochemical smog, particulate matter.

Unit-IV: 15 h

Soil: Chemical and mineralogical composition of soil, classification of soil, types of soil- saline and alkaline, physical properties – texture, bulk density, permeability, chemical properties—Ion exchange capacity, soil pH and micro and macro nutrient availability. Soil management—Management of saline and alkaline soil, soil indicator plants,
Radioactive Pollution: Introduction to radiation chemistry, sources of radioactive pollution, effects of radioactivepollution, nuclear disasters in the two decades, protection from radiation, control of radiation.

Semester III

Practical VI–Elective (Code: 3P3)

Environmental Chemistry Practical

12h per week Marks-100

WATER ANALYSIS

1 Sampling of water-tap water, overhead storage tank water, pond water and lake water
2 Physico –chemical and organoleptic characteristics of the above water sample
3 Statistical evolution of the data obtained for optimization of result
4 Determination of total solids, total dissolved solids and total suspended solids and its significance
5 Determination and comparison of chlorine content in tap water, storage tank and swimming pool
6 Determination of acidity and alkalinity in water samples
7 Determination of total, permanent and temporary hardness of water sample
8 Determination of DO, COD, and BOD of water sample

9 Analysis of chemicals used in water and waste water treatment-alum, bleaching powder, activated carbon
10 Analysis iron and manganese in water sample by visual titrimetry
11 Analysis of copper and nickel in water sample by Spectrophotometry
12 Analysis of phenol in water sample by Spectrophotometry
13 Analysis of nitrite in water sample by Spectrophotometry
14 Analysis of chromium in water sample
15 Analysis of chloride in water sample
16 Analysis of sulphate in water sample
17 Determination of turbidity of a given water sample
18 Estimation of Na, K, by flame photometry in given water

AIR ANALYSIS

1 Determination of SOx and NOx and TSPM **(**total suspended particulate matter**)** and RSPM in ambient air

SOIL ANALYSIS

1 Analysis of different types of soil like pH, conductivity, alkalinity etc**.**
2 Determination of N,K, P of soil by flame photometry
3 Analysis of nutrients**-**nitrogen **(**total, ammonia, nitrite & nitrate **)**, phosphate total
4 Determination of macro &micro nutrients in soil

List of books

1. Water analysis : J. Rodier
2. A Text book of Inorganic Analysis : A.I.Vogel
3. Colorimetric Determination of metals : E.B.Sandell
4. Environmental Chemistry : Moore J W and Moore E A. Academic Press, New York, 1976.
5. Environment and Man Vol VII: The Chemical Environment Edited by J Lenihar and W Fleecher Vlackie Publication, 1977.
6. The Chemistry of Environment: R A Horne, Wiley Interscience Publication 1978.
7. Fundamentals of Air Pollution: A C Stern
8. Instrumental Methods of Analysis: Willard,Merrit and Dean
9. Analytical Chemistry: Meites and Thomas
10. Standard Methods for Examination of water and waste water: A E Greenberg, A D Eaton, APHA, AWWA,WEF
11. Chemistry for Environmental Engineering and Science: C N Sawyer, P L McCarty and G F Parkin
12. Laboratory Manual for the Examination of Water, waste water and soil: H H Rupa and H Krist, V C H Publication
13. Manual on Water and Waste water analysis: D S Ramteke and C A Moghe, NEERI
14. Environmental Chemistry: B K Sharma and H Kaur
15. Environmental Chemistry: A K De
16. Environmental Pollution- Management and control for sustainable Development: R K Khatoliya
17. Environmental Chemistry: A K Bhagi and G R Chatwal

Semester III

Paper XI **(**Code**:** 3T3**)**

Elective**-** Polymer Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Introduction to polymers 15h

Nomenclature and classification of polymers, Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization and their mechanisms, Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers.Stereoregular polymers- atactic, syndiotactic and isotactic.

Unit-II: Molar mass and its determination 15h

Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase), light scattering, gel permeation chromatography, sedimentation and ultracentrifuge, viscosity method and end-group analysis.

Unit III: Physical characteristics of polymers 15h

Morphology and order in crystalline polymers. Configuration of polymer chains, crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. The glass transition temperature (Tg), relationship between T_g and T_T, Effect of molecular weight, dilments, chemical structure, chain topology, branching and cross linking. Methods of determination of glass transition and crystallinity of polymers.

Unit IV: Commercial polymers 15h

A) Organic polymers: Commercial polymers, synthesis and and application of polyethylene, Cellulose Acetate, PMMA, polyaimdes, polyesters, Urea resins and eposy resins.

B) Functional polymers: Fire retarding polymers and conducting polymers, biomedical polymers.

Semester III

Practical VI – Elective (Code: 3P3)

Polymer Chemistry Practical

12h per week Marks-100

1. Synthesis of polymers:
   a) Synthesis of Thiokol rubber (condensation)
   b) Urea-formaldehyde (condensation)
   c) Glyptal resin: glycerine phthalic acid (crosslinked Polymer Chemistry)
   d) Polyacryonitril (bulk polymerization)
   e) Polyacryonitril (emulsion polymerization)
   f) Polymethylomethacrylate (emulsion of suspension Polymer Chemistry)
   g) Nylon-66 (interfacial polycondensation)
   h) Coordination polymers
   i) Conducting polymer (electro- or peroxodisulphate oxidation)
2. Characterization of polymers:
   a) End-group analysis
   b) Viscosity and molecular mass
   c) Density of polymer by flotation methods
   d) IR spectra.
3. Purification and fractionation of polymer, polystyrene, Nylon 66, PMMA.
4. Magnetic and electrical properties of polymers, magnetic susceptibility and electrical conductivity of coordination and conducting polymers.
5. Thermal analysis and degradation of polymers:
   i. TGA: Isothermal and non-isothermal;
   ii. DTA: Glass transition temperature and melting point
6. Crystallinity of polymers by density measurement.
7. Swelling and solubility parameters of polymers.
8. Synthesis of Graft-Polymers and its characterization by density and IR spectra.
9. Dielectric behavior of polymers.
10. Kinetics of polymerization:
    a) Polycondensation
    b) Peroxide initiation polymerization.

List of books:

1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.
2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.

3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.
4. Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.
5. Principles of polymer Chemistry: Flory, Cornell Univ. press.
6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.
7. Principles of polymerization: Odian.
8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.
9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.
10. A practical course in polymer chemistry: S.J. Punea , Pergamon Press.

Semester III

Paper XI Elective (Code: 3T3)

Medicinal Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT-I: 15 h

Drug Design:

Development of new drugs, factors affecting development of new drugs, sources of lead compounds, serendipity and drug development. Concept of QSAR, QSAR methods and parameters, procedure followed in drug design, structure activity relationship (SAR) method, Free and Wilson analysis, Hansch analysis, concept of prodrugs and softdrugs, SOFT DRUGS, isosterism, bioisosterism, drug receptors, theories of drug action, types of reversible enzyme inhibitors, some special inhibitors and design of inhibitors.

UNIT-II: 15 h

A] **Pharmacokinetics and pharmacodynamics:** Indroduction drugs absorption, distribution and disposition of drugs, excretion and elimination, Pharmacokinetics of elimination and Pharmacokinetics in drug development process.
Pharmacodynamics: Introduction, enzyme stimulation, enzyme inhibition, membrane active drugs, drugs metabolism, biotransformation and significance of drug metabolism

B] **Diuretics:** Introduction, mode of action, loop diuretics. Synthesis of Bumetanide, Frusemide, Ethacrynic acid, clorexolone Quinethazone.

C] **Analgesics and Antipyretics:** Introduction, mode of action, evaluation of analgetic agents.Synthesis of: Aspirin, salsalate, phenacetin, phenylbutazone, Indomethacin, Analgin.

UNIT-III: 15h

A] **Cardiovascular Drugs:** Introduction, cardiovascular diseases, Synthesis and uses of cardiovascular drugs; amyl nitrate, diltiazem, varapamil, methyldopa, atenolol, sorbitrate, quinidine, oxyprenolol

B] **Antineoplastic Agent:** Introduction, mechanism of tumor formation, treatment of cancer, types of cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer, carcinolytic antibiotics, mitotic inhibitors, harmones, natural products. Synthesis of melphalan , thiotepa, lomustine

UNIT-IV: 15 h

A] **Psychoactive drugs:** Introduction, neurotransmitters, structure of nerve cell, chemical transmitters, CNS depressants, sedative and hypnotics, Synthesis of Barbiturates, Phenobarbital, thiopental sodium, diazepam, lorazepam, bromazepam, ethosuximide, general anaesthetic: Antianxiety drugs, synthesis of oxazepam, alprazolam, puspirone, antipsychotic drugs and antidepressant drugs, MAO inhibitors, antimanic drugs, synthesis of thiopental sodium, ethiosuxmide, glutethimide, trimethadione, phenytoin.

B] Coagulant and Anticoagulants: Introduction, factors affecting coagulant and anti-coagulant. Mechanism of Blood coagulation and Anticoagulation. Structure of Vitamin K1, Vitamin K2 and heparin. Synthesis of Coumarins and indanediones.

Semester III

Practical VI–Elective (Code: 3P3)

Medicinal Chemistry Practical

12 h per week Marks-100

1. Volumetric estimation of Ibuprofen.
1. Estimation of aspirin by volumetric and instrumental methods.
2. Analysis of ascorbic acid in biological/tablet sample.
3. Determination of paracetamol by colorimetry.
4. Analysis of ampicillin trihydrate.
5. Determination of vitamin B12 in commercial sample by spectrophotometry.
6. Determination of phenobarbitone in given cough syrup.
7. Determination of tetracycline in given capsule.
8. Determination of iron, calcium and phosphorus from milk or drug sample.
9. To perform I.P. monograph of tablet.
10. Estimation of chloride in serum and Urine.
11. Separation and determination of sulpha drugs in tablets or ointments.

Preparation of Drugs: Synthesis, purification and identification of (8-10) of the following drugs.

1. Benzocaine from p-nitrobenzoic acid.
2. Dapsone from diphenyl sulphone.
3. Paracetamol from p-nitro phenol.
4. Uracil from sulphanil amide.
5. Diphenyl hydantion from benzoin.
6. Aluminium asprin from salicylic acid.
7. 4,6-diphenyl-thiazine from chalcone.
8. 6/8 nitro coumarin from resorcinol.
9. Copper aspirin from salicylic acid.
10. N-acetyl parabanic acid.
11. Nerolin from 2-naphthol
12. Phenothiazine from diphenylamine
13. Umbelliferon from resorcinol
14. Benzylidene from benzaldehyde and aniline
15. 1-phenyl-1,2-pentadine-3-one from benzaldehyde
16. 1,5 diphenyl-1,3-pentadiene-2-one from benzaldehyde
17. 1,3-diphenyl-prop-2-ene-1-one
18. 3-methy pyrazol-5-one from ethylacetoacetate
19. 6-methyl uracil
20. Sulphanilamide from acetanilide

List of books:

1. Text book of organic medicinal chemistry-Wilson,Geswold
2. Medicinal chemistry Vil I and II-Burger
3. A textbook of pharmaceitical chemistry-Jayshree Ghosh
4. Introduction to medicinal chemistry-A Gringuadge
5. Wilson andGisvold text book of organic medicinal and pharmaceutical chemistry-Ed.Robert F Dorge
6. An introduction to drug design-S S Pandey,and JR Demmock
7. Goodman and Gilmans pharmacological basis of therapeutics- Stragies for organic drug sythesis and design-D Lednicer

8. Textbook of Medicinal Chemistry- A. Kar
9. Medicinal Chemistry – D Sriram and P. Yogeeswari

Semester III

Paper XII (Code: 3T4)

Foundation Course - IApplied Analytical Chemistry– I

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Analysis of Pesticides and Fertilizers 15h

Pesticides: General introduction, analysis of pesticides in general with reference to DDT, Dieldrin, Malathion, Parathion, BHC by different analytical methods such as titrimetric, colorimetric, chromatography and electroanalytical methods.

Fertilizers: Sampling and sample preparation, determination of water, total nitrogen, urea, total phosphates, potassium, acid or base forming quality.

Unit-II: Forensic chemistry 15h

Introduction. Classification of poisons on the basis of physical states, mode of action and chemical properties with examples of each type. Methods of administration. Action of poisons in body. Factors affecting poisoning. Study of some common poisons used for suicide. Signs and symptoms of As, Pb, Hg and cyanide poisoning. Poisonous effects of kerosene and cooking gas.

Unit-III:Analysis of petroleum and petroleum products 15h

Introduction, determination of flash and fire point, Pensky Marten's apparatus, cloud and pour point, aniline point, drop point, viscosity and viscosity index, Redwood and Saybolt viscometer, API specific gravity, water and sulphur in petroleum products, carbon residue, corrosion stability, decomposition stability, emulsification, neutralization and saponification number.

Unit-IV: Analysis of alloys 15h

Definition of alloy. phase diagrams of Fe-C, Pb-Sn, Pb-Ag systems and their applications. Types of steel: hypoeutectic, hypereutectic steels, mild steel, and stainless steel. Uses of steel. Composition and uses of brass, bronze and soldering alloy. Analysis of iron, nickel, chromium and manganese in steel. Analysis of copper and zinc in brass, lead and tin in soldering alloy. Industrial applications of alloys.

OR

Semester III

Paper XII (Code: 3T4)

Core Subject Centric - I: Spectroscopy– I

60 h (4 h per week): 15 h per unit 80 Marks

Unit - I: Symmetry properties of molecules and group theory: 15h

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C_{2v}, C_{3v} and C_{2h}. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H_2O and NH_3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II: 15h

A] Mass spectrometry: Theory, ion production(EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, N-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, Mclaffferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry, problem based on mass spectral data

B] Mössbauer spectroscopy: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction,

applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit **-** III**:** 15h

A**]** Microwave spectroscopy: Classification of molecules on the basis of M.I., rigid and non rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass and nuclear quadrupole moment.

B**]** ESR spectroscopy: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4-semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV**:** 15h

A**]** Infrared spectroscopy: Diatomic molecules: 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero point energy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone and combination frequencies. Structure determination of organic molecules by IR spectroscopy, problem based on IR spectral data

B**]** Raman Spectroscopy: Rayleigh scattering. Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra, rotational fine structure. Selection rules, coherent antiStokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Organic Spectroscopy-RT Morrison and RN Boyd
7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
9] Fundamentals of Molecular Spectroscopy-CN Banwell
10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
11] Photoelectron Spectroscopy-Baber and Betteridge
12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
13] NMR –Basic Principle and Application-H Guntur
14] Interpretation of NMR spectra-Roy H Bible
15] Interpretation of IR spectra-NB Coulthop
16] Electron Spin Resonance Theory and Applications-W gordy
17] Mass Spectrometry Organic Chemical Applications, JH Banyon

Semester III

Seminar**-**III **(**Code**:** 3S1**)**

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 Credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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M.Sc. Chemistry Semester IV
INORGANIC CHEMISTRY SPECIALIZATION
Paper XIII(Code: 4T1)
Special I-Inorganic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15h

A) Nanoparticals & Nanostructural materials :Introduction, methods of preparation, physical properties, and chemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metal alkoxide, hybrid organic-inorganic compounds. Nanoporous Materials: Introduction, Zeolites & molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation & applications.

B) Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factors influencing reactivity, photographic process.

Unit-II 15h

A) Coordination Polymers:Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use of polymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.

B) Characterization of coordination polymers on the basis of:
i) Spectra (UV, Visible, IR and NMR)
ii) Magnetic and thermal (TGA,DTA and DSC) studies

Unit-III 15h

Catalysis: Basic principles, thermodynamic and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous and heterogeneous catalysis .Introduction, types & characteristics of substrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbital symmetry and reactivity. Catalytic reactions of coordination and Organometallic compounds including polymerization activation of small molecules, addition to multiple bonds, hydrogenation Zeigler-Natta polymerization of olefins, hydroformylations, oxidations, carbonylations and epoxidation.

Name organic reaction involving inorganic compounds: Suzuki Coupling, Heck Reaction, Negishi reaction and Sonogirhra reaction

Unit-IV 15h

A) Optical sensor for metal Ions: Chelates ligand (Multidentates, Ruthenium bipyridyls, calixarenes, Lanthanide ion); Macrocyclic ligands (Flexible Macrocycles, Azamacrocycles, Cryptands, porphyrins); Crown ether and Cryptands(Napthalene and Anthracene crowns, Cryptands, structural features)

B) Thin films and languir-Biodgett films: Preparation technique, evaporation/spultering, chemical processe MOCVD, solgel etc. Languir-Biodgett(LB) film, growth techniques, photolithography properties and applications of thin and LB films.

List of books:

1. Barsoum ,M.W.,Fundamentals of Ceramics,McGraw Hill ,New Delhi
2. Ashcroft ,N.W. and Mermin,N.D.,SolidStaePhysics,Saunders College
3. CallisterW.D.,Material Science and Engineering, An Introduction,Wiley
4. Keer,H.H,Principals of Solid State,Wiley Eastern
5. Anderson J.C.,LeverK.D.,Alexander J.M and Rawlings,R.D.,ELBS
6. GrayG.W.Ed.Thermotropic Liquid Crystals,John Wiley
7. Kelkar and Hatz Handbook of Liquid Crystals,ChemieVerlag.
8. Kalbunde K.I.,Nanoscale Materials in Chemistry,JohnWiley,NY.
9. Shull R.D.,McMichael R.D. and SwartzendrubL.J.,Studies of Magnetic Properties of Fine particles and their relevance to Mataerials Science, Elsevier Pub. Amsterdam

10. Optoelectronic Properties of Inorganic Compounds, D. Max Roundhill and John P. Fakler, Jr. Plenum Press, New York

Semester IV

Paper XIV(Code: 4T2)

Special II-Inorganic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15 h

A) Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energy dissipation by radiative and no-radiative processes, absorption spectra Frank-Condon principles; photochemical stages-primary & secondary processes.

B) Properties of excited states: Photochemical kinetics,Calculation of rates of radiative processes.

C) Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations, metods for obtaining charge transfer spectra.

Unit-II 15h

A] Photophysical and photochemical properties of Gold(I) complexes: Introduction, Binuclear and trinuclear complexes, Mixed metal Systems, Photochemical reactivity, Solid state studies, Mononuclear Gold(I) complexes, Mononuclear three coordinate Gold(I) complexess

B) Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction & strong interaction – exciplex formation, conditions of excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthroline complexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lie time of these processes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants in to highenergy products, chemical energy in to light.

Unit-III 15h

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability &decomposition pathways of alkyls & aryls of transition metals. Organocopper in Organic synthesis. Compounds of Transition Metal –Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes & carbynes–synthesis, nature of bond, structural characteristics, nucleophilic & electrophilic reactions on ligands, role inorganic synthesis.

Unit-IV 15h

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics & synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes, allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediates in oraganic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.

List of books:

1. ElschenbroichCh.andSalzer A.: Organometallics, VCH,Weinheim, NY.
2. BalzaniVandCavassitiV.:Photochemistry of Coordination compounds,AP,London
3. Purcell K.F.andKotzJ.C., An Introduction to Inorganic Chemistry,HoltSounder,Japan.
4. RohtagiK.K.andMukharjee,Fundamentals of Photochemistry,Wiley eastern
5. CalvertsJ.G.and Pits.J.N., Fundamental of Photochemistry, John Wiley
6. Wells, Inorganic Solid State Chemistry, Oxford University, Vth , Edition
7. Paulson,OrganometallicChemistry,Arnold
8. Rochow,OrganometallicChemistry,Reinhold
9. Zeiss,OrganometallicChemistry,Reinhold
10. Gilbert A.andBaggott,J,Essential of Molecular Photochemistry,BlackwellSci.Pub.
11. TurroN.J.and Benjamin W.A.,Molecular Photochemistry

12. CoxAandCamp,T.P.IntroductoryPhotochemistry,McGraw-Hill
13. KundallR.P.andGilbertA,Photochemistry, Thomson Nelson Coxon J and HaltonB.,Organic Photochemistry, Cambridge University Press.
14. Optoelectronic Properties of Inorganic Compounds, D. Max Roundhill and John P. Fakler, Jr. Plenum Press, New York

Semester IV

Practical-VII (Code: 4P1)

Inorganic Chemistry SpecialPractical

12 h /week Marks: 100

A Preparation and characterization of following complexes/organometallic compound including their structural elucidation by the available physical methods.(element analysis molecular weight determination, conductance and magnetic measurement and special studies)

1 Preparation of mercury tetrathiocyanotocobaltate(II)
2 Preparation of Iron (II) oxalate & potassium trioxalatoferrate (III) trihydrate
3 Preparation of cis & trans potassium dioxalatodiaquochromate (III)
4 Preparation of hexa-aminecobalt(III) chloride
5 Preparation of hexa-aminenickel(II) chloride
6 Preparation of tris (acetylacetonato) manganese (III)
7 Preparation of N-N bis (salicyldehyde) ethylene diaminonato nickel (II)
8 Preparation of trinitrotriaminocobalt(III)
9 Preparation of chloropentammine cobalt (III) chloride
10 Preparation of potassium trioxalatochromate (III)
11 To prepare copper (II) acetylacetonate complex
12 To prepare cis and trans bis (glycinato) Cu II monohydrate complex
13 To prepare dipyridineiodine (I) nitrate
14 Preparation of ammonium nickel(II) sulphate

B SOLID STATE

1 Preparation of oxides and mixed oxides(MnO_2 , NiO, Cu_2O,Fe_3O_4,$ZnFe_2O_4$,$ZnMn_2O_4$,$CuMnO_4$and $NiFe_2O$)
2 Preparation of silica and alumina by sol –gel technique
3 To study the electrical conductivity of ferrites, magnetite's, doped oxides and pure samples and determine band gap

C SEPARTION AND QUANTITATIVE ESTIMATION OF BINARY AND TERNARY MIXTURE BY THE USE OF FOLLOWING TECHNIQUES:

1 Paper and thin layer chromatography
2 Ion exchange
3 Solvent extraction

D INORGANIC PHOTOCHEMISTRY

1. Synthesis of potassium ferrioxalate and determination of intensity of radiation
2. Photo oxidation of oxalic acid by UO^{2+}sensitization
3. Photo decomposition of HI and determination of its quantum yield

List of books:

1. Practical Inorganic Chemistry - Pass
2. Practical Inorganic Chemistry - Marr & Rocket
3. Basic Concept Of Analytical Chemistry - Khopkar S. M.
4. Synthesis And Characterisation Of Inorganic Compounds – W. L. Jolly, Prentice Hall
5. Inorganic Experiments – J. Derck Woollins, Vch.
6. Practical Inorganic Chemistry – G. Marrand, B.W. Rockett, Van Nostrand
7. A Text Book Of Quantitative Inorganic Analysis – A.I. Vogel, Longoman.
8. Edta Titration – F. Laschka

9. Instrumental Methods Of Analysis – Willard, Merit And Dean (Cbs, Delhi)
10. Inorganic Synthesis – Jolly
11. Instrumental Methods Of Chemical Analysis – Yelri Lalikov
12. Fundamental Of Analytical Chemistry- Skoog D .A. And West D. M. Holt Rinehart And Winston Inc.
13. Experimental Inorganic Chemistry7 – W.G. Palmer, Cambridge
14. Solid Stst Chemistry – N.B. Hanney
15. Introduction To Thermal Analysis , Techniques And Applications – M. E. Brown, Springer
16. Preparation And Properties Of Solid State Materials – Wilcox, Vol I&Ii, Dekker
17. The Structure And Properties Of Materials – Vol Iv, John Wulff,Wiley Eastern

Semester IV

ORGANIC CHEMISTRY SPECIALIZATION

Paper XIII (Code: 4T1)

Special I-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit I:

A] Carbanions in organic Chemistry 15 h

Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, keto-enol equilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism, geometry of carbanions, kinetic and thermodynamic control in the generation of enolates, LDA, hydrolysis of haloforms, use of malonic and acetoacetic esters, Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoin condensation, Julia olefination, alkylation of enolates and stereochemistry thereof, Conjugate additions, enamines in organic synthesis

B] Organometallic reagents -I

Synthesis and applications of organo Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester, epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition to carbonyl compounds, *o*-metallation of arenes using organolithium compounds.

Unit II: 15 h

A] Organometallic reagents-II:Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction.

Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragnocuprates, Gilman's reagent. Organo Hg and Cd reagents in organic synthesis.

B] Transition metals in organic synthesis: Transition metal complexes in organic synthesis-Introduction-oxidation states of transition metals, 16-18 rule, dissociation, association, insertion, oxidative addition, reductive elimination of transition metal

Organopalladium in organic synthesis-Heck reaction, carbonylation, Wacker oxidation, coupling reactions: Kumada Reaction, Stille coupling, Sonogashira, Negishi and Suzuki coupling reactions and their importance

Applications of $Co_2(CO)_8$, $Ni(CO)_4$, $Fe(CO)_5$ in organic synthesis. Wilkinson catalyst of Ruthenium and Rhodium – synthesis and uses its use in hydrogenation reactions-deallylation, C-C, C-O, C-N bond cleavages. Olefin metathesis by I^{st} and II^{nd} generation catalyst, reaction mechanism and application in the synthesis of homo and heterocyclic compounds

Unit III: 15 h

A] Advanced Stereochemistry: Conformation of sugars,monosaccharides, disaccharides, mutorotation, Recapitulation of Stereochemical concepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, regio-, diastereo- and enantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesis use of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation,

B] Protection and Deprotection of functional groups: Protection and deprotection of functional groups like, hydroxyl, amino, carbonyl and carboxylic acids groups, Solid phase peptide synthesis.

Unit IV: Designing the synthesis based on retrosynthetic analysis 15 h

A) Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis

B) One Group C-C Disconnections: Alcohols andcarbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis

C) Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annelation, Methods of ring synthesis, Linear and convergent synthesis

List of books

1] Principle of Organic Synthesis R. O. C. Norman and J. M. Coxon
2] Modern Synthetic Reaction. H. O. House and W. A. Benjamin
3] Organic Synthesis: The Disconnection Approach-S. Warren
4] Designing Organic Synthesis-S. Warren
5] Some Modern Methods of Organic Synthesis-W. Carruthers
6] Advance Organic Reaction. Mechanism and Structure-Jerry March
7] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
8] Organic Reaction and their Mechanism-P. S. Kalsi
9] Protective Groups in Organic Synthesis-T. W. Greene
10] The Chemistry of Organo Phosphorous-A. J. Kirbi and S. G. Warren
11] Organo Silicon Compound-C. Eabon
12] Organic Synthesis via Boranes-H. C. Brown
13] Organo Borane Chemistry-T. P. Onak
14] Organic Chemistry of Boron-W. Gerrard

Semester IV

Paper XIV(Code: 4T2)

Special II-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit I: Enzyme chemistry 15h

A] Enzymes: Introduction, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Nomenclature and classification, Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Baker's yeast catalyzed reactions

B] Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

C] Co-Enzyme Chemistry: Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, biotin as CO_2 carrier. Mechanisms of reactions catalyzed by the above cofactors.

Unit II: Heterocycles 15h

A*]* Azoles**:** Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages, Carbonyldiimidazole as coupling agent

B*]* Benzofused heterocycles**:** Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

C*]* Diazines**:** Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.

D**]** Synthesis of following bioactive compounds**:** Vitamin B_6, Ondansetron, Serotonin, Indometacin, Cyanamid, fentiazac, trimethoprim, papaverine

Unit III**:** 15h

A*]* Nucleic Acids**:** Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structure and function of mRNA, tRNA and rRNA. Purines and pyrimidine bases of nucleic acids and their preparation.

B**]** Lipids**:** Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerophospho lipids, spingolipids, lipoproteins, composition and function, role in atherosclerosis
Properties of lipid aggregates, micells, bilayers, liposomes and their biological functions, biological membranes, fluid mosaic model of membrane structure, Lipid metabolism, β-Oxidation of fatty acids

C**]** Vitamins**:** Structure determination, and synthesis of vitamin A, E and H.

Unit IV**:** 15h

A**]** Dyes**:** General Introduction, classification on the basis of structure and methos of application dying mechanism, methods of dying, such as direct dying, vat dying, dispersive dying, formation of dye in fibre, dying with reactive dyes, study of quinoline yellow, cyamine dye, ethyl red, methylene blue, Alizarin, cyamine-green, fluorescein, cosin, erythrosine, Rhodomines and Indigo.

B**]** Pharmaceutical chemistry**:**
History, medical terms in pharmaceutical chemistry, classification of drugs, antibacterial and antifungal drugs, specific clinical applications, Synthesis and applications of: Benzocaine, Methyl dopa, dilantin, ciprofloxacin, acyclovir, terfenadine, salbutamol

C**]** Polymer chemistry**:** Importance of polymers, Basic concepts: monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization and their mechanisms, Polymerization in homogeneous and heterogeneous systems. Ziegler-Natta polymerization with mechanism, Stereo regulated polymers, syndiotactic, isotactic and atactic polymers

List of books

1] Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley
2] Polymer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern
3] Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite
4] Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag
5] Understanding Enzymes, Trevor Palmer, Prentice Hall
6] Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
7] Enzyme Structure and Mechanism, A. Fersht, W. H. Freeman
8] Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
9] Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert F. Dorge
10] Burger's Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley
11] Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley
12] The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press

Semester IV
Practical-VII (Code: 4P1)
Organic Chemistry Special Practical

12 h /week Marks: 100

A] Quantitative Analysis based on classical and instrumental technique (any 9-10)

1] Estimation of nitrogen.
2] Estimation of halogen.
3] Estimation of sulphur.

Spectrophotometric/calorimetric and other instrumental methods of estimation

1] Estimation of streptomycin sulphate.
2] Estimation of vitamin B-12.
3] Estimation of amino acids.
4] Estimation of proteins.
5] Estimation of carbohydrates.
6] Estimation of Ascorbic acid.
7] Estimation of Aspirin.
8] Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the same oil.

B] Organic multi-step preparations (Two/Three steps): Minimum 10-12 preparations

[1] Aniline → Diaminoazobenzene → p-aminoazobenzene
[2] Benzoin → Benzyl → Dibenzyl
[3] Aniline → acetanilide →*p*-bromoacetanilide →*p*-bromoaniline
[4] Aniline → Acetanilide →*p*-nitroacetanilide →*p*-nitroaniline
[5] Benzaldehyde (thiamine hydrochloride) → benzoin → benzil → benzilic acid
[6] *p*-Nitrotoluene →*p*-nitrobenzoic acid→ PABA →*p*-iodobenzoic acid
[7] *p*-Cresol →*p*-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone
[8] Benzaldehyde → benzilidene acetophenone → 4,5-dihydro-1,3,5-triphenyl-1*H*-pyrazole
[9] Aniline → phenylthiocarbamide → 2-aminobenzthiazole (Microwave in step I)
[10] Chlorobenzene → 2,4- Dinitrochlorobenzene → 2,4- Dinitrophenylhydrazine.
[11] Acetophenone → acetophenone phenyl hydrazone → 2-phenylindole
[12] Benzion → benzoin benzoate → 2,4,5-triphenyl oxazole
[13] Benzophenone → benzpinacol → benzopinacolone (Photochemical preparation)
[14] Benzophenone → Benzophenone oxime → Benzanilide → Benzoic acid + aniline
[15] Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
[16] Aniline → N-arylglycine → indoxyl → indigo
[17] Phthalimide → Anthranilic acid → Phenyl glycine-o-carboxylic acid → Indigo
[18] Phalic anhydride → Phthalimide → Anthranilic acid → o-chlorobenzoic acid
[19] Phalic anhydride → Phthalimide → Anthranilic acid →Diphenic acid
[20] Ethyl acetoacetate → 3-methyl-pyrazol-5-one → 4,4-dibromo-3-methyl-pyrazol-5-one Butanoic acid
[21] Biosynthesis of ethanol from sucrose
[22] Enzyme catalyzed reactions

[C] SPECTRAL INTERPRETATION

Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, ^{1}H and $^{13}CNMR$ and Mass) (Minimum 12 compounds are to be analysed during regular practicals).

Semester IV
PHYSICAL CHEMISTRY SPECIALIZATION

Paper XIII(Code: 4T1)
Special I-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT-I CHEMICAL DYNAMICS - II 15h

A] Overview of Arrhenius rate law, Non-conventional equilibrium between reactants and activated complexes. Potential energy surfaces and reaction coordinate. Derivation of transition state theory based equation for rate constant of bimolecular reaction. Prediction of rate constant using partition function and comparison with that given by collision theory. Arrhenius equation and activated complex theory. Transmission coefficient, quantum mechanical tunneling,

B] Reactions in solution: Cage effect, diffusion controlled reactions, volume of activation its determination and correspondence with entropy of activation, Ionic reactions: Primary (Ionic strength) and Secondary salt effect and their nature.

UNIT II CORROSION AND CORROSION ANALYSIS 15h

A] Scope and economics of corrosion, causes (Change in Gibbs free energy), Electrochemical Series and Galvanic series, dry (atmospheric) and wet (electrochemical) corrosion, other types of corrosion- Pit, Soil, chemical and electrochemical, inter-granular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

B] Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, polarization methods), passivity and its breakdown, corrosion prevention (electrochemical inhibitor and coating methods).

UNIT – III: RADIATION CHEMISTRY 15h

A] Interaction of radiation with matter, radiation track spurs and □-rays. Linear energy transfer, Bathe's equation for linear energy transfer, Bresstrahlung effect, Passage of neutron through matter, Interaction of □-radiation with matter, photoelectric effect and Compton effect, pair production phenomena, units of measuring radiation absorption, Radiolysis of water, Radiolysis of some aqueous solutions. Effect of radiation on biological substances, genetic effects, Radiation effects on organic compounds and Polymers.

UNIT IV: ELECTRICAL AND THERMAL PROPERTIES OF SOLIDS 15h

A] Classical free electron theory, electrical conductivity, thermal conductivity, Wiedemann-Franz Law, Lorenz number, Electronic distribution in solids using Fermi Dirac Statistics, The Fermi Distribution function and effect of temperature, Quantum theory of free electrons, periodic potential, The Kronig-Penney Model, Brillouin Zones, Distinction between metals, insulators and intrinsic semiconductors based on above theory.

B] Thermal Properties: Specific heat of solids, Classical theory, Einstein's theory of heat capacities, Debye theory of heat capacities or Debye T-cubed law

Books Sugggested:

1. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
3. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan IndianLtd., New Delhi (1993)
5. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 1., Elsevier Publications, New York, 1969.
6. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 2., Elsevier Publications, New York, 1969.

7. S. Glasstone, K. J. Laidler and H. Eyring, The Theory of Rate Processes, Mc-Graw Hill, New York, 1941.
8. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
9. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
10. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
11. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
12. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
13. C.Kittel, " Introduction to solid state Physics",Wiley
14. L.V.Azaroff, " Introduction to solids", McGraw Hill
15. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
16. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
17. N. B. Hanny, "Solid State Chemistry"
18. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
19. C.N.Rao. Nuclear Chemistry
20. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
21. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.
22. W. Loveland, D. Morrissey and G. Seaborg, Modern Nuclear Chemistry, Wiley-Interscience, 2006.
23. P. P. Milella, Fatigue and Corrosion in Metals, Springer, 2013.
24. Corrosion- Understanding the Basics, asminternational.org, 2000.
25. H. H. Uhlig, Corrosion and Corrsion Control – 3rd edn, John Wiley & sons, New York.
26. J. W. T. Spinks and R. J. Woods, An Introduction to Radiation Chemistry, John Wiley and sons., New Yoek, 1975.
27. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

Semester IV

Paper XIV (Code: 4T2)

Special II-Physical Chemistry

60h *(4h/week)* 15h/unit 80 Marks

UNIT I: SOLID STATE AND THEIR MAGNETIC PROPERTIES 15h

A] Solid State Chemistry: Metals, Insulators and Semiconductors, Electronic structure of solids—band theory. Band structure of metals, Insulators and Semiconductors, Intrinsic and Extrinsic Semiconductors, p-n junction, energy band formation, forward bias and reversed bias p-n junction, their applications, Superconductors— types, Meissner effect, BCS theory, Low Temperature Superconductor (LTSC) and High Temperature Superconductor (HTSC), Conventional and organic Superconductors, their applications.

B] Magnetic Properties: Behaviour of substances in magnetic field, effect of temperature, Curie and Curie-weiss law, calculation of magnetic moments, magnetic materials, their structure and properties, Applications, structure/ property relations, numericals.

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES 15h

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization, Debye equations, limitation of the Debye theory, Clausius-Mossotti equation. electrostatic of dielectric medium, molecular basis of dielectric behavior, structural information from dipole moment measurements, use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment and ionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids and in solutions. The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction. Dispersion, dielectric loss and refractive index. Lennard-Jones potential.

Unit III: LIQUID STATE AND INTERFACES 15h

A] Theory of liquids: - Theory of liquids, partition function method or model approach, single cell models, communal energy and entropy, significant structure model.

B] Liquid gas and liquid interfaces: Surface tension, methods of determination of surface tension, surface tension across curved surfaces, vapor pressure of droplet (Kelvin equation), surface spreading, spreading coefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

Unit IV: IONIC LIQUIDS AND BATTERY TECHNOLOGY 15h

A] Supercooled and ionic liquids: Supercooled and ionic liquids, theories of transport properties, non Arrhenius behavior of transport properties, Cohen-Turnbull free volume model, configurational entropy model, Macedo- litovitz model, glass transition in supercooled liquids.

B] Battery Technology: basic concept, classification of batteries, primary, secondary and reserve batteries, Construction, working and application of Acid Storage batteries, Lithium - MnO_2 batteries, Nickel- Metal hydride batteries, Fuel Cells, Construction and working of $H_2O_2$and methanol-O_2 Cell.

List of books

1. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
2. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
3. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
4. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
5. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
6. A. Kokorin, Ionic Liquids: Theory, Properties and New Approaches, Intech, Croatia, 2011.
7. Gholam-Abbas Nazri, Gianfranco Pistoia, Lithum Batteries-Science and Technology, Springer, 2003.
8. N. H. March and M. P. Tosi, Introduction to Liquid State Physics, World Scientific, London, 2002.
9. George Kackson, Liquid State Theory,
10. C.Kittel, " Introduction to solid state Physics",Wiley
11. L.V.Azaroff, " Introduction to solids", McGraw Hill
12. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
13. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
14. N. B. Hanny, Solids,
15. H. Y. Erbil, Surface Chemistry of Solid and Liquid Interfaces, Blackwell Publishing, 2013.
16. N. B. Hanny, "Solid State Chemistry"

Semester IV

Practical-VII (Code: 4P1)

Physical Chemistry Special Practical

12 h /week Marks: 100

Adsorption:

1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hence determine the limiting cross section area of alcohol molecule.

Kinetics:

5. Clock reaction- activation energy of bromide-bromate reaction.
6. Temp dependence of persulfate-iodide reaction by iodine clock method and calculation of thermodynamic and Arrhenius activation parameters. Study of ionic strength effect on persulfate-iodide reaction.
7. Kinetics of B-Z reaction; Kinetics of modified B-Z reaction
8. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
9. Determination of pKa value of a weak acid by chemical kinetic method (formate-iodine reaction)

Potentiometry:

10. Transport number by potentiometry.

11. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by potentiometry method.
12. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
13. Complexation between Hg^{2+} and I^- conductometrically.

Conductometry:

14. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by conductometric method.
15. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
16. Complexation between Hg^{2+} and I^- conductometrically.
17. To determine solubility product of lead chromate.
18. Kinetic study of saponification ethyl acetate by conductometry.

Spectrophotometry:

19. To determine the stability constant of reaction between Ferric ion solution and SCN^- ion solution by Job's method.
20. To determine the stability constant between Fe^{3+} and SCN^- ion solution by Ostwald & Frank method.

Transport Number:

21. To determine transport number by Hittorff's method
22. To determine the transport number by moving boundary method

List of Books

1. Vogel A, 3rd Edition : A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
5. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood :Quantitative Analysis
7. Merits And Thomas:Advanced Analytical Chemistry
8. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
9. Drago, R.S:Physical Methoods In Inorganic Chemistry
10. Christain G.D:Analytical Chemistry
11. Khopkar S.M.:Basic Concept Of Analytical Chemistry
12. Koltath And Ligane:Polorography
13. Braun:Instrumental Methods Of Chemical Analysis
14. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
15. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
16. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
17. Dilts R.V.: Analytiacl Chemistry
18. Jahgirdar D.V :Experiments In Chemistry
19. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
20. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
21. Ramesh Rand Anbu M, Chemical Methods For Envirnmental Analysis : Watewr And Sedient , Macmillion India

Semester IV

ANALYTICAL CHEMISTRY SPECIALIZATION

Paper XIII(Code: 4T1)

Special I-Analytical Chemistry

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-II 15h

Preparation of some commonly used radioisotopes (^{22}Na, ^{60}Co, ^{131}I, ^{65}Zn, ^{32}P), Use of radioactive isotopes in analytical and physico-chemical problems, Industrial applications, Neutron sources, Neutron Activation Analysis, Isotope Dilution Analysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits), Radiochromatography, Carbon dating, Numericals based on above.

Unit-II: Optical methods of analysis-IV 15h

Inductively coupled plasma-atomic emission spectroscopy: Principle, atomization and excitation. Plasma source and sample introduction. Instrumentation. Comparison of ICP-AES with AAS. Applications.

X-ray fluorescence spectroscopy: Principle. Instrumentation: wavelength and energy dispersive devices. Sources and detectors. Comparison between wavelength and energy dispersive techniques. Sample preparation for XRF. Matrix effects in XRF. Applications in qualitative and quantitative analysis.

*Particle induced X-ray emission (PIXE):*Basic principle, Instrumentation and applications.

*Electron microscopy:*Principle, instrumentation and applications of scanning electron microscopy (SEM) and transmission electron microscopy (TEM)

Unit-III:Electrochemical methods of analysis-III 15h

Ion selective electrodes: Theory of membrane potential. Types of ion-selective electrodes. Construction of solid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes, Selectivity coefficients, Glass electrodes with special reference to H^+, Na^+ and K^+ ions. Applications of ISE in analysis of environmentally important anions like F^-, Cl^-, Br^-, I^-, NO_3^- and CN^-. Advantages of ISE.

Coulometry: Principle. Coulometry at constant potential and constant current. Instrumentation. Applications and advantages of coulometric titrations.

Electrochemical microscopy: Introduction to scanning probe microscopy (SPM), scanning tunneling microscopy (STM), atomic force microscopy (AFM) and scanning electrochemical microscopy (SECM).

Unit-IV: Thermal methods of analysis 15h

Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistatic thermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750, Thermogram, Factors affecting thermogram, Applications of thermogravimetry, Differential Thermal Analysis (DTA)- Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis, Differential Scanning Calorimetry (DSC)- Introduction, Instrumentation, DSC curves, factors affecting DSC curves, applications, Thermogravimetric titration-Theory, Instrumentation and applications.

Semester IV

Paper XIV(Code: 4T2)

Special II-Analytical Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit-I: Pharmaceutical and clinical analysis 15h

Requirements of a quality control laboratory for pharmaceutical units.

Structures, category, identification (qualitative) and assay (quantitative) of following drugs

1. Antibiotics: Amoxycillin, Azithromycin, Cefixime, Levofloxacin

2. Antihistamine: Cetirizine, Cinnarizine
3. Vitamins: Thymine hydrochloride (Vitamin-B_1) Riboflavin (Vitamin-B_2), Ascorbic acid (Vitamin-C)
4. Analgesics: Diclofenac, paracetamol, Aspirin.

Composition of blood, sample collection for blood and urine, clinical analysis, Immuno Assay-RIA, Setting up of RIA and applications, Fluorescence Immunoassay, Enzyme immunoassay, Blood gas analyzer, Trace elements in the body.

Unit-II: Soil analysis and coal analysis 15h

Soil analysis- Classification and composition, pH and conductivity, analysis of constitutents such as nitrogen, phosphorous, potassium and microconstitutents (Zn and Cu).

Coal analysis- Proximate analysis (moisture content, ash content, volatile matter, fixed carbon). Ultimate analysis (carbon, hydrogen, sulphur, nitrogen, oxygen content). Combustion of carbonaceous fuel- Flue gas. Calorific value and its units, Bomb calorimeter.

Unit-III: Corrosion and corrosion analysis 15h

Definition, draw backs and theories of corrosion-dry and wet corrosion, Different types of corrosion-Pit, Soil, chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

Unit-IV: Automation in analytical chemistry 15h

Automation in the laboratory, Principle of automation, automated instruments, classification, continuous analyzer, automatic instruments, semiautomatic instruments GeMSAEC Analyzer, Flow Injection Analysis (FIA), Dispersion coefficient, Factors af fecting Peak Height, microprocessor based instruments, Numericals based on above.

Hyphenated techniques: Introduction to GC-MS, LC-MS, ICP-MS and MS-MS (Tandem) spectrometry.

Semester IV

Practical-VII (Code: 4P1)

Analytical Chemistry Special Practical

12 h /week Marks: 100

A. Organoanalytical chemistry

1. Estimation of sulphur, nitrogen, phosphorous,chlorine in organic compound.
2. Estimation of phenol.
3. Estimation of aniline.

B. Separation techniques

Ion exchange

1. Separation and estimation of zinc and magnesium/cadmium in a mixture on anion exchanger.
2. Separation and estimation of chloride and iodide in a mixture on anion exchanger.
3. Determination of total cation concentration in water.

Solvent extraction

1. Estimation of Copper using Na-DDC.
2. Estimation of Iron using 8-hydroxyquinoline.
3. Estimation of Nickel using DMG.
4. Estimation of Cobalt using 8-hydroxyquinoline.
5. Estimation of Nickel by synergistic extraction with 1,10-phenanthroline and dithizone.

Paper chromatography

1. Separation and estimation of copper and nickel in a mixture.
2. Separation and estimation of cobalt and nickel in a mixture.

Thin layer chromatography

1. Separation and estimation of bromophenol blue, congo red and phenol red in a mixture.

2. Separation and estimation of metal ions in mixture.

C. Water analysis

1. *Mineral analysis*: Ttemperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphate, hardness
2. *Demand analysis*: DO, COD
3. *Heavy metals*: Fe, Cd and Pb

D. Demonstrations

1. Gas chromatography
2. HPLC

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Thermal analysis: Blazek (translated by J. F. Tyson, Van Nostrand)
4. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
5. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
6. Vogel's Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
7. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
8. Atomic Absorption Spectroscopy: Robinson (Marcel Dekker)
9. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
10. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
11. Analysis of Water: Rodier
12. Ion selective electrods: Koryta (Cambridge University Press)
13. Instrumentation in analytical chemistry: Borman (American Chemical Society)
14. Industrial Chemistry: Arora and Singh (Anmol Publications)
15. Diffraction Methods: John Wormald (Clarendon Press)
16. Electroanalytical Chemistry: Bard (Dekker)
17. Analytical Chemistry by Open Learning (Wiley)
18. An Introduction to Electron Diffraction: Beeston (North Holand Publishing Co.)
19. Material Science and Engineering: V. Raghavan (Printice-Hall of India)
20. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)
21. Indian Pharmacoepia, Vol-I, II and III.

Semester IV

Paper XV (Code: 4T3)

Elective- Nuclear Chemistry

60 h (4 h per week): 15 h per unit — 80 Marks

Unit-I: Radiation Chemistry, Radiolysis — 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions, calculation of absorbed dose-various types of dosimeters, chemical dosimeters (Fricke, Ceric sulphate and FBX), experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions, hydrated electron,

Effect of radiation on biological substances, genetic effects, radiation effects on organic compounds (Halides-carboxylic acids), polymers, nitrates and solid thermoluminescence.

Unit-II: Hot Atom Chemistry and Radiochemistry — 15h

Recoil energy and calculations, Szilard Chalmers effects, Kinetics, primary and secondary retention-effect of various factors on retention and its uses, Mossbauer effect- principle, instrumentation and chemical applications,

Unit-III: Radioanalytical techniques — 15h

Neutron sources, Neutron activation analysis, principle, methodology and application for trace analysis, Isotope dilution analysis-principle and application, Isotopic exchange reaction, mechanism

and application in use of radioisotopes and tracers, radioactive dating based on carbon-14 and lead isotopes.

Unit-IV: Radiopharmaceuticals 15h

Radioimmunoassay (RIA), discovery, principle, set up of RIA, Principle of Immunoradiometric assay (IRMA), principle and set up, Radiopharmaceuticlas, classification of products, preparations, quality control aspects, ^{99}Mo-^{99m}Tc generator, Cylotron based products, PRT studies, Therapeutic applicatyions , Radiotherapy

Semester IV

Paper XV (Code: 4T3)

Elective- Environmental Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water Pollution 15h

Pollutants- Types of pollutants, sources of water pollution, sampling, preservation and storageof water sample, physico –chemical, organoleptic and chemical analysis of water, electro-analytical,optical (UC-visible spectrophotometry, AAS, flame photometry, XRF, ICPAES), chromatographic (GC and HPLC) and neutron activationmethods of analysis of Co, Ni, Cu, Fe, Mn, Zn, Cd, Pb, Hg, As, Cl^- ,F^-, $SO4^{--}$,PO_4^-, NO_3^-. Historical development of detergents, chemistry of soaps and detergents.

Unit-II: Air Pollution 15h

Natural versus polluted air, air quality standards, air sampling, analysis and control of Particulates, Chemistry and analysis of SOx, NOx, CO, ozone, hydrocarbons, CFCs.Chemistry of gaseous, liquid and solid fuels- gasoline and additives, antiknock agents.Air pollution control—control of automobile emission and control measures in thermal power stations.

Unit-III: Soil Pollution 15h

Types and sources of soil pollution, classification of soil pollutants, impact of soil pollutionon air quality, Specifications for disposal of sewage and effluent on land for irrigation andground water recharge. Methodology of waste water disposal on land in India. Impact of usage of land for solid waste disposal both municipal solid waste and industrial solid wastes (fly ashfrom thermal power station, lime sludge from paper and pulp industry), cause of soil erosion,effects of soil erosion, conservation of soil, control of soil pollution.

Unit-IV: Solid waste pollution 15h

Sources, types and consequences, classification of wastes- domestic, industrial, municipal, hospital, nuclear and agricultural and their methods of disposal. Transfer and transport,Recycle, reuse, recovery, conversion of solid wastes -energy / manure.Analysis and monitoring of pesticides.

Impact of toxic chemicals on enzymes, Biochemical effects of As, Cd, Pband Hg, their metabolism, toxicity and treatment.

Semester IV

Paper XV (Code: 4T3)

Elective- Polymer Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Polymerization 15h

Types of polymerization, addition-chain, free radical, ionic polymerization, step polymerization, electropolymerization, ring-opening polymerization.

Unit II: Techniques of polymerization 15h

Techniques of polymerization-suspension, emulsion and bulk polymerization, coordination, polymerization mechanism of Ziegler Natta polymerization, stereospecific polymerization, interfacial polycondensation, mechanism of polymerization.

Unit III: Characterization of polymers 15h

Electronic, IR and NMR spectral methods for characterization of polymers (Block and Graft)

Thermal methods-TGA, DTA, DSC, thermomechanical and X-ray diffraction study, Block and Graft copolymers, random, block, graft co-polymers, methods of copolymerization.

Unit IV: Specific polymers 15h

A) Biomedical polymers: Contact lens, dental polymers, artificial heart, kidney and skin.

B) Inorganic polymers: Synthesis and application of silicon, phosphorous and sulphur containing polymers.

C) Coordination polymers: Synthesis and applications of coordination polymers.

Semester IV

Paper XV (Code: 4T3)

Elective- Medicinal Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT-I: 15 h

A] Drug rules and drug acts, Overview of Intellectual property right, Indian and International framework for patent protection.

B] Statastical method: For sampling and interpretation of results, Statastic in quality control, T-Test, F-Test, Validation of analytical methods as defined proceeding USP Radio immune analysis, Investigational drugs.

C] Antidiabetic Agents- Type-I and Type-II diabetes, Insulin, thiazolidinediones, Synthesis of ciglitazone.

UNIT-II: 15 h

A] Anti-Viral agents: Inroduction, viral diseases, viral replication, and transformation of cells, investigation of antiviral agents,. Chemotherapy for HIV. Synhesis of: Idoexuidine, acyclovir ,amantadine and cytarabin.

B] Anti-malarial agents: Introduction, malarial parasite, and its life cycle, development of antimalarials, chemotherapy of malaria. Synthesis of: Chloroquin, primaquin, proguanil, and Quinacrine

C] Local Anti-infective drug: Introduction and general mode of action. Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone ,amino salicylic acid, isoniazid, ethionamide, ethambutal, econozole, griseofulvin.

UNIT-III: 15 h

A) Histamines and Antihistamic agents: Introduction, histamine H1-receptor antagonists. Inhibitors of histamine release. Synthesis of: alkyl amines, phenothiazines, piperzines derivatives.

B) Antibiotics: Introduction, β-lactam antibiotics, classification, SAR and chemical degradation of penicillin, cephalosporins-classification , tetracycline antibiotics-SAR,miscellaneous antibiotics. Synthesis of ampicillin, cephradine, methacycline,chloramphenicol

UNIT-IV: 15 h

A) Anthelminitics and antiamoebic drugs: Introduction to Helminthiasis, Anthelminitics, drugs used in cestode infection, drugs used in trematode infection, origin of antiamoebic drug, drugs used in nematode infection. Synthesis of: Clioquinol, Iodoquinol, Haloquinol, Dichlorphen, Niclosamide.

B) Anti-inflammatory drugs: Introduction, etiology of inflammatory diseases. The inflammatory response, biochemical response. Synthesis of: Phenyl butazone and its derivatives, pyrazolone derivatives, pyrole and indole acetic acid derivatives.

Semester IV

Paper XVI (Code; 4T4)

Foundation Course–IIApplied Analytical Chemistry-II

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water treatment 15h

Hardness of water and types of hardness. Problems due to hardness. Removal of hardness by lime-soda process, Zeolite process and synthetic ion-exchange resins. Principle, instrumentation and comparison of these three processes. Numericals based on hardness removal. Desalination of sea-water.

Unit-II: Polymer chemistry and leather analysis 15h

Polymer chemistry: Definition, classification, co-polymers, conducting polymers, determination of acid value, saponification value, iodine value, molar mass by end group analysis- amide and hydroxyl, molecular weight by viscosity method, glass transition temperature of polymers, TGA and DTA studies of polymers.

Analysis of leather: Determination of moisture, acid, free sulphur, total ash, chromic oxide in leather, tensile strength and stretch of leather.

Unit-III: Metallurgy

Ores and minerals, General principles of extraction of metals from ores. Steps involved in metallurgical extraction. Purification and concentration of ores. Extraction of crude metal from concentrated ore-pyrometallurgy, hydrometallurgy and electrolytic processes. Refining of metal. Thermodynamic aspects of metallurgical processes and Ellingham diagram. Furnaces in metallurgy. Metallurgy of Cu, Ag, Au, Al and Fe.

Unit-II: Clinical analysis 15h

General composition of blood, Collection and storage of blood samples, Estimation of chloride, calcium, sodium, potassium and bicarbonate in blood sample. Qualitative tests for reducing sugar. Estimation of blood glucose, urea, uric acid, blood urea-nitrogen, total serum protein, serum albumin, serum creatinine, serum phosphate, serum bilirubin, serum cholesterol. Radioimmunoassay (RIA).

OR

Semester IV

Paper XVI (Code: 4T4)

Core Subject Centric –IISpectroscopy – II

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: 15 h

A] Ultraviolet and visible spectroscopy: Natural line width, line broadening, transition probability, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. General nature of band spectra. Beer- Lambert Law, limitations, Frank-Condon principle, various electronic transitions, effect of solvent and conjugation on electronic transitions, Fiesher Wooodward rules for dienes, aldehydes and ketones. Structure differentiation of organic molecules by UV Spectroscopy

B] Photoelectron spectroscopy: Basic principles, photoelectric effect, ionization process, Koopman theorem, PES and XPES, PES of simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy.

Unit II: Nuclear magnetic Resonance Spectroscopy 15 h

Magnetic properties of nuclei, resonance condition, NMR instrumentation, chemical shift, spin spin interaction, shielding mechanism, factors affecting chemical shift, PMR spectra for different types of organic molecules, effect of deuteration, complex spin spin interaction(1^{st} order spectra), stereochemistry, variations of coupling constant with dihedral angle, electronegativity, Karplus equation etc., classification of molecules as AX, AX_2, AMX, A_2B_2, Shift reagents. NMR studies of ^{13}C, chemical shift in aliphatic, olefinic, alkyne, aromatic, heteroatomic and carbonyl compounds, ^{19}F, ^{31}P. Structure determination of organic molecules by NMR spectroscopy

Unit III: 15 h

A] Application of NMR spectroscopy: FT-NMR, advantages of FT-NMR, two dimensional NMR spectroscopy-COSY, HETCOR, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques, Nuclear overhauser effect, use of NMR in medical diagnosis

B] Problems based on structure determination of organic molecules by using NMR (^{1}H and ^{13}C nuclei) data, Structure elucidation using combined techniques including UV, IR, NMR and mass spectrometry (based on data and copies of the spectra)

Unit IV**:** Diffraction techniques 15 h

X ray diffraction: Braggs condition, Miller indices, Laue method, Bragg method, Debye Scherrer method, identification of unit cells from systematic absences in diffraction pattern, structure of simple lattices and x-ray intensity, structure factor and its relation to intensity and electron density, absolute configuration of molecules.

Electron diffraction: scattering intensity vs scattering angle, Wierl equation, measurement techniques, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces.

Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques, elucidation of structure of magnetically ordered unit cell.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
7] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
8] Fundamentals of Molecular Spectroscopy-CN Banwell
9] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
10] Photoelectron Spectroscopy-Baber and Betteridge
11] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
12] NMR –Basic Principle and Application-H Guntur
13] Interpretation of NMR spectra-Roy H Bible
14] Interpretation of IR spectra-NB Coulthop
15] Electron Spin Resonance Theory and Applications-W gordy
16] Mass Spectrometry Organic Chemical Applications, JH Banyon
17] Spectroscopy- H. Kaur

Semester IV

Practical VIII **(**Code**:** 4PROJ1**)**

Project

12 h/week 100 Marks

Project is a part of practical examination. Project should be carried out by the student under the supervision of Guide/Teacher. The examination shall be conducted by External and Internal Examiners. Students are supposed to present their work either on LCD Projector / OHP or blackboard.

The division of marks will be as follows**:**

For written Project Work	: 40 Marks	- Evaluated jointly by External and Internal Examiners
Presentation	: 20 Marks	- Evaluated jointly by External and Internal Examiners
For Viva-Voce	: 20 Marks	- Evaluated by External Examiner
Internal Assessment	: 20 Marks	- Evaluated by Internal Examiner

Note**:** One external examiner shall be appointed for evaluation of group of 6 students**.**

Semester IV

Seminar**-**IV **(**Code**:** 4S1**)**

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 Credit). Seminar should be delivered by the student under the guidance of concerned teacher on thetopic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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SYLLABUS for M. Sc. Physics
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
With effect from 2018-19

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.
The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

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Revised Syllabus to be implemented from 2018-19
Choice Based Credit System(CBCS)

Subject Scheme of Revised Syllabus 2015-2016 Semester Pattern
Syllabus for Each theory paper is based on 60 clock hours of teaching.

M.Sc. Physics Semester I
1. (Core 1)Paper 1: Mathematical Physics
2. (Core 2) Paper 2: Complex Analysis and Numerical Methods
3. (Core 3) Paper 3: Electronics
4. (Core 4)Paper 4: Electrodynamics I

M.Sc. Physics Semester II
1. (Core 5) Paper 5: Quantum Mechanics-I
2. (Core 6) Paper 6: Statistical Physics
3. (Core 7) Paper 7: Classical Mechanics
4. (Core 8) Paper 8: Electrodynamics II

M.Sc. Physics Semester III
1. (Core 9) Paper 9: Quantum Mechanics-II
2. (Core 10) Paper 10: Solid State Physics and Spectroscopy
3. Any one of the Elective papers from the following list. Paper 11 (Core Elective 1)
E1.1 Materials Science I **E1.2. X-ray I**
E1.3Nanoscience and Nanotechnology I **E1.4. Atomic and Molecular Physics I**
E1.5Applied Electronics I

4. Foundation course 1
Paper 12 (Not for Physics Students) : Physics I (Classical Physics)

Subject Centric Core Course which can be taken in lieu of Foundation course 1.
S1.2 Nanoscience and Nanotechnology **S1.3 Quantum Computing**
S1.4 Digital Electronics and Microprocessor
M.Sc. Physics Semester IV
1. (Core 11) Paper 13: Nuclear and Particle Physics
2. (Core 12) Paper 14: Solid State Physics
3. One of the elective papers from list below Paper 15 (Core Elective 2)
E2.1 Materials Science II **E2.2 X-ray II**
E2.3 Nanoscience and Nanotechnology II **E2.4 Atomic and Molecular Physics II**
E2.5 Applied Electronics II

4. Foundation course 2
Paper 16 (Not for Physics students) : Physics II (Modern Physics)

Subject Centric Core Course which can be taken in lieu of Foundation course 2.
S2.2 Experimental Techniques in Physics S2.3 Communication Electronics
S2.4 Electroacoustics

Semester I Paper 1 (Core 1) 1T1 Mathematical Physics

Unit I

Curvilinear co-ordinate Systems, Physical ideas about gradient, divergence and Curl, Fourier Series : Definition, Dirichlet's condition, Convergence, Fourier Integral and Fourier transform, Convolution theorem, Parseval's identity, Applications to the solution of differential equations,

Unit II

Elementary ideas about tensors, Cartesian tensors, differential of Cartesian tensors, gradient, divergence and curl , Laplacian of Cartesian tensors. Non-Cartesian tensors.Tensor densities and capacities. Differentiation of Non-Cartesian tensors, Chrisoffel symbols. gradient, divergence and curl , Laplacian of Non-Cartesian tensors

Laplace transform of elementary functions – Inverse Laplace transforms – Methods of finding Inverse Laplace transforms – Heaviside expansion formula – Solutions of simple differential equations

Unit III

Linear vector spaces - linear independent bases, Dimensionality, inner product, matrices, linear transformation, Matrices- Inverse, Orthogonal and Unitary matrices, Cayley Hamilton theorem, eigen vectors and eigen value problem, Diagonalization, Complete orthonormal sets of function.

Unit-IV

Linear differential equations, Special Function- Laguerre, Hermite, Legendre polynomials, Special Bessel's function, Spherical harmonics, Generating Function and recursion relations, differential and integral form.

1.Matrices and Tensor in Physics: A.W.Joshi
2. Mathematical Physics: H.K.Dass
3. Vector analysis – Newell
4. Rajput B S, Mathematical Physics, PragatiPrakashan (Meerat) 1999

Semester I Paper 2 (Core 2) 1T2 Complex Analysis and Numerical Methods

Unit I

Definition of Complex Numbers, Equality of Complex Number, Complex Algebra, Conjugate Complex Numbers, Geometrical representation of Complex Number, Geometrical representations of the sum, difference, product and quotient of Complex Number, Cauchy-Rieman Conditions, Analytic functions, Multiply connected regions, Cauchy Theorem, Cauchy Integration formula, Derivatives, problems (Rajput – 283 – 314).

Unit II

Singularities- Poles, Branch Points, Calculus of Residues-Residues Theorem, Cauchy Principle value, Pole Expansion of Meromorphic Functions, Product expansion of entire Functions, problems (Rajput 326 – 384).

UNIT III

Methods for determination of zeros and linear and non-linear single variable algebraic and transcendental equations, (Bisection method, false position method, iteration method, Newton-Raphson method, secant method), Finite differences. Newton's formulae (no proofs)

Unit IV

Lagrange's interpolation, Divided differences. Numerical integration, trapezoid rule, simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule, Linear least squares.

Euler and RungeKutta methods for solving ordinary differential equations. (No proofs)

References:

1. Rajput B S, Mathematical Physics, PragatiPrakashan (Meerat) 1999
2. Introductory Methods of Numerical Analysis: S SSastry
3. Computer Oriented Numerical Methods: V Rajaraman
4. R. V. Churchill, Complex variables and Applications, 7th Edition McGraw Hill
5. Computer oriented Numerical Methods: R.S.Salaria
6. Mathematical Physics: H.K.Dass
7. Higher Engineering Mathematics : B. S. Grewal

Semester I Paper 3 (Core 3) 1T3 Electronics

Unit I

Electronics Semiconductor discrete devices (characteristic curves and physics of p-n junction), Schottky, Tunnel and MOS diodes, Bipolar junction transistor, junction field effect transistor (JFET),Metal-oxide-Semiconductor Field effect transistor (MOSFET), unijunction transistor(UJT) and sillicon controlled rectifier (SCR), Opto-electronic devices (Photo-diode, solar cell, LED, LCD and photo transistor), Diffusion of impurities insillicon, growth of oxide.

Unit II

Applications of semiconductor devices in linear and digital circuits- Zener regulated power supply, Transistor (bipolar, MOSFFT, JFET) as amplifier, coupling of amplifier stages (DC, RC and Transformer coupling), RC-coupled amplifier, dc and power amplifier Feedback in amplifiers and oscillators (phase shift, Hartley, Colpitts and crystal controlled) clipping and clamping circuits. Transistor as a switch OR, AND and NOT gates (TIL and CMOS gates).

Unit III

Digital integrated circuits- NAND and NOR gates building block, X-OR gate, simple combinational Circuits -Half and full address, Flip-Flops, Multivibrators (using transistor) and sweep geneator (using transistors, UJT and SCR). shift registers, counters, A/D and D/A coverters, semiconductor memories (ROM, RAM, and EPROM, basic, architecture of 8 bit microprocessor (INTEL 8085). Linear integrated circuits-Operational amplifier and its applications-Inverting and noninverting amplifier, adder, integrator, differentiator, waveform generator, comparator and Schmittrigger, Butterwoth active filter, phase shifter,

Unit IV

Communication Electronics-Basic principle of amplitude frequency and phase modulation. Simple circuits for amplitude modulation and demodulation, digital (PCM) modulation and demodulation. Fundamentals of optical communication, Microwave Oscillators (reflex, klystron, megnetron and Gunn diode), Cavity resonaters. Standing wave detector.

Textbooks:

1. A. Malvino and D. J. Bates: Electronic Principles (Mc Graw Hill Education, India)
2. Boylstad&Neshishkey, “Electronic devices & circuits” , PHI
3. Milliman, J. Halkias, “integrated elctronics”, Tata McGraw Hill
4. J. J. CatheySchaum’s Outlines “Electronic Devices & Circuits” Tata McGraw Hill.
5. J. D. Ryder,” Electronics Fundamentals and Applications”, John Wiley-Eastern Publications.
6. A. P. Malvino, D.P. Leach, “Digital Principles and Applications”, McGraw Hill Book Co., 4th Edition (1986).
7. Ramakant A. Gayakwad, “Op-amps and Linear Integrated Circuits” PHI
8. Anil Maini, Varsha Agrawal, “ Electronic Devices and acircuits” Wiley
9. George Kennedy, “ Electronic Communication Systems”, Tata McGraw Hill.
10. Dennis Roddy, John Coolen, “Electronic Communication Systems ”, Pearson.

Semester I Paper 4 (Core 4) 1T4 Electrodynamics I

Unit I

Electrostatics: Coloumb's law, Electric field, Charge distribution, Dirac delta function, Field lines, Gauss's law and applications, Differential form of Gauss's law, Electric potential, Poisson and Laplace's equations, Electrostatic potential energy.

Unit II

Electrostatics: Boundary value problems, Uniqueness theorems, Green's theorem, Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion.

Unit III

Magnetostatics: Biot-Savart law, Ampere's law, Differential form of Ampere's law, Vector potential, Magnetic field of a localized current distribution, magnetic moment, Magnetostatics boundary conditions, Magnetic Shielding.

Unit IV

Time varying fields: Faraday's law, Maxwell's displacement current, Maxwell's equations, Maxwell's equations in matter, Scalar and vector potentials, Gauge Transformation, Wave equations, Poynting's theorem, Conservation laws.

Text Books:

1.Introduction to Electrodynamics, David J. Griffith, Prentice Hall of India Private Limited.
2. Classical Electrodynamics, John D. Jackson, Wiley Eastern Limited.
3. Classical Electrodynamics, Tung Tsang, World Scientific Publishing Private Limited.

Semester I Practical 1P1 and 1P2

Practical 1 (core 1 and 2)

1. To find the largest or smallest of a given set of numbers.
2. Bubble sort.
3. To generate and print first hundred prime numbers.
4. Matrix multiplication.
5. To generate and print an odd ordered magic square.
6. Other exercises involving conditions, loop and array
7. Lagrange Interpolation.
8. Method of successive approximation
9. Bisection Method
10. Newton-Raphson Method.
11. Gaussian Elimination
12. Linear Least Squares Fit.
13. Simpson's rule integration.
14. Computation of special functions

Practical 2 (Core 3 and 4)

1. Design of a regulated power supply.
2. Characteristics and applications of silicon controlled rectifier.
3. Design of common emitter Power transistor amplifier.
4. Experiments on bias stability.
5. Negative feedback (Voltage series / shunt and current series / shunt).
6. Astable, Monostable and Bistablemultivibrator.
7. Experiment on FET and MOSFET characterization and application as an
8. amplifier.
9. Experiment on Uni-junction transistor and its application.
10. Digital – I: Basic, TTL, NAND and NOR.
11. Digital – II: Combinational logic.
12. Flip-Flops.
13. Study of modulation (FM, AM, etc.).
14. Operational Amplifier.
15. Differential Amplifier.
16. Microprocessor.
17. Verification of Biot-Savart law.
18. Verification of Faraday's Law

Semester II Paper 5 (Core 5) 2T1 Quantum Mechanics I

Unit- I

Time dependent and time-independent Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states.

Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest's theorem, momentum eigen functions in the coordinate representation, box normalization and Dirac delta function.

Coordinate and momentum representations, Schrodinger equation in momentum representation,

Unit-II

Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, eigen values and eigen vectors, hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations.

Matrix representation of operators, change of basis, unitary transformations,

quantum dynamics, Schrodinger, Heisenberg and interaction picture.

Unit-III

Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method.

Angular momentum operator, commutation relations, expression for L^2 operator in spherical polar coordinates, Role of L^2 operators in central force problem, eigen value problem for L^2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator.

Unit-IV

Generalized angular momentum, raising and lowering operators, matrices for J^2, Jx, Jy, Jzoperators,Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions.

Text and Reference Books:

1. Quantum mechanics: E. Merzbacher
2. Quantum mechanics: L.I.Schiff
3. Quantum mechanics: Mathews and Venkatesan
4. Quantum mechanics :Ghatak and Loknathan
5. Quantum mechanics: B.Craseman and J.D.Powell
6. Modern quantum mechanics: J.J.Sakurai
7. Quantum Theory D. Bohm, (Asia Publishing House)
8. Quantum Mechanics: 500 problems with Solutions: Aruldhas (PHI)

Semester II Paper 6 (Core 6) 2T2 Statistical Physics

Unit I

Fundamentals of classical statistical mechanics, microstate and macrostate, distribution function, Liouville's theorem, Gibbs Paradox, ensembles (micro-canonical, canonical and grand-canonical), partition function, free energy and connection with thermodynamic quantities, energy and density fluctuations

Unit II

Fundamentals of quantum statistical mechanics, BE and FD Statistics, Symmetry of wave functions, Boltzmann limit of Bosons and Fermions, Ideal Bose system: Bose-Einstein condensation, Behaviour of ideal Bose gas below and above Bose temperature, Photons and liquid helium as bosons.

Unit III

Ideal Fermi system: Weak and strong degeneracy, Fermi function, Fermi energy, Behaviour of ideal Fermi gas at absolute zero and below Fermi temperature, Fermionic condensation, Free electrons in metals as fermions, Electronic specific heat,
Cluster expansion for classical gas, Virial equations of states.

Unit IV

Phase transition: Phase transition of first and second order, Landau theory of phase transition, Ising model, Order parameter, Critical exponents, Scaling hypothesis, Random walk, Brownian motion, Langevin theory, Correlation function and fluctuation-dissipation theorem, Fokker-Planck equation. Weiss theory of ferromagnetism.

Text and Reference Books:

1. Fundamentals of Statistical Physics: B. B. Laud
2. Statistical Mechanics: R. K. Pathria
3. Statistical Mechanics: S. K. Sinha
4. Statistical and Thermal Physics: F. Reif
5. Statistical Mechanics: K. Huang
6. Statistical Mechanics: Loknathan and Gambhir
7. Statistical mechanics: R. Kubo
8. Statistical Physics: Landau and Lifshitz

Semester II Paper 7 (Core 7) 2T3 Classical Mechanics

Unit-I

Survey of elementary principles of mechanics of a particle, Dynamical systems, Phase space dynamics, stability analysis, constraints & their classifications, D'Alemberts Principle, Variational Principle, Lagrange's equation, Hamilton's Principle

Unit-II

Conservation theorems and symmetry properties, Hamiltonian formalism, Hamiltons equations, Routh's procedure for cyclic coordinates, conservation laws
Canonical transformations, Poisson brackets and Poisson theorems, Hamilton-Jacobi Theory

Unit-III

Central force motion, reduction to one body problem, equations of motions and first integrals , classification of orbits for inverse square central forces. Two body collisions, Rutherford scattering in laboratory and centre-of-mass frames;

Unit-IV

Rigid body dynamics, Euler's angles, Euler's theorem, moment of inertia tensor, eigen values and principal axis transformation, non-inertial frames and Pseudo forces, Periodic motion,: small oscillations, normal modes.

Text and Reference books:

1. Classical Mechanics: H. Goldstein
2. Classical Mechanics: N.C.Rana and P.S.Joag
3. Classical Mechanics : J. C. Upadhyaya (Himalaya Publishing House)

Semester II Paper 8 (Core 8) 2T4 Electrodynamics II

Unit-I

Scalar waves : Plane waves, spherical waves, phase and group velocities and wave packets Vector waves : Electromagnetic plane waves, harmonic plane waves, elliptic linear and circular polarization, Stokes parameters (iii) Reflection and refraction of plane waves, Fresnel polarization on reflection and refraction, (iv) Propagation in dielectric films.

Unit-II

Symmetries of Maxwell equations : Lorentz transformations, Covariance of electrodynamics, Lorentz gauge condition, equation of continuity and Maxwell equations, electrodynamics field tensor and its transformation.

Unit-III

Motion of a charge in EM fields : Lorentz force, motion in uniform, static, electric and magnetic fields and combined static EM fields.

Electric dipole, electric quadrupole and magnetic dipole radiation, Radiation by a moving charge :Lienard-Wiechert potentials of a point charge, Larmor's formula, Angular distribution of radiation. Fields and radiation of a localized oscillating source, Bremstrahlung, Synchrotron radiation.

Unit-IV

Wave guides : fields on the surface and within a hollow metallic conductor,TE, TM, TEM modes in a rectangular and cylindrical wave guide, Resonant Cavities, Dielectric waveguides.

Reference Books

1.Introduction to Electrodynamics: David Griffiths (PHI)
2. Electrodyanamics J. D. Jackson
3. Introduction to Electrodynamics, A. Z. Capri and P. V. Panat (Narosa)
4. Classical theory of fields, Landau &Lifshitz
5. Electrodynamics, W. Panofsky and M. Phillips
6. Principles of Optics, M. Born & E. Wolf Pergamon Press
7. Electromagnetism and Classified Theory, A. D. Barut, Dover

Semester II Practical 2P1 and 2P2

Practical 3 (C5 and C6)

1. Study of B-H Curve
2. Determination of e/m of electron by normal Zeeman effect using Febry Perot Etalon.
3. Determination of Lande's factor of DPPH using ESR spectrometer
4. Determination of e/m by Thomson method.
5. Determination of e/m by Busch's helical beam method.
6. Study of paramagnetic to ferromagnetic phase transition.
7. Study of Paramagnetic salt by Guoy's balance
8. Differential scanning Calorimetry
9. Determination of Plank's constant.
10. Determination of Stephan's constant.
11. Simulation of Ising model.
12. Location of critical point in Ising model using Binder cumulant.
13. Simulation of random walk.
14. Simulation of mean field model of para-ferro transition.
15. Numerical solution of particle in a box.
16. Simulation of Maxwell's velocity distribution.

Practical 4 (core 7 and 8)

1.Study of Focault pendulum
2.Study of Bifilar pendulum
3.Fibre optics
4.Study of waveguide
5.Thickness of thin wire with lasers
6.Measurement of wavelength of He-ne laser light using ruler.
7.To study Faraday effect using He-Ne laser.
8.Simulation of simple pendulum
9.Simulation of compound pendulum
10. Simulation of planetary motion.

Semester III Paper 9 (Core 9) 3T1 Quantum Mechanics II

Unit- I

Time independent perturbation theory, First order perturbation theory applied to non-degenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic oscillator.

Unit II

Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission, atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein's A and b coefficients and their calculations.

Approximation methods: W. K. B. method and its application to barrier penetration.

Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential.

Unit III

System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.

Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule.

Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential, Partial wave method, phase shifts and their importance, scattering by a square well potential and a perfectly rigid sphere, resonance scattering.

Unit IV

Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac's relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac's theory, negative energy states and their qualitative explanations.

Text and References Books:

1. E. Merzbacher, Quantum Mechanics (Wiley and Sons-Toppon)
2. J. L. Powell and B. Crasemann, Quantum mechanics (B I Publications)
3. L. I. Schiff, Quantum Mechanics (McGraw-Hill)
4. Quantum Mechanics: Aruldhas
5. Pauling and Wilson, Introduction to Quantum Mechanics
6. A.K. Ghatak and Lokanathan, Quantum Mechanics (Macmillan, India)
7. Quantum Mechanics: 500 problems with Solutions: Aruldhas (PHI)

Semester III Paper 10 (Core 10) 3T2 Solid State Physics and Sprectroscopy

Unit I: Order in Solids-Crystal classes and system, 2d and 3d lattices, Space groups, b Concept of point group, bonding of common crystal structure; reciprocal lattice, diffraction and structure factor, Miller and Bravais indices, Bonding, diffraction and structure factor in solids, short and long range order in liquids and solids, liquid crystals, quasicrystals and glasses

Unit II

Defects: Vacancies, Point defects, line defects and stacking faults, Burgers vector and Burger circuit, presence of dislocation, dislocation motion, perfect and imperfect dislocations, slip planes and slip directions, dislocation reactions

Dielectric Properties: -Polarization mechanisms, Clausius-Mossotti equation, piezo, pyro and ferroelectricity

Unit III

Atomic Structure and Atomic Spectra : Quantum states of an electron in an atom. Electron spin.Spectrum of helium and alkali atom. Some features of one-electron and two electron atoms, Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Inner shell vacancy, X-rays and Auger transitions.chemical shift. Frank-Condon principle.

Unit IV

Molecular Structure and Molecular Spectra : Types of molecules, Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule, PQR branches. Elementary discussion of Raman, ESR and NMR spectroscopy, chemical shift

Reference Books: 1. Physics of Atoms and Molecules: Bransden and Joachain.
2. Introduction to Atomic Spectra: H.E. White.
3. Solid State Physics, Charles Kittel, John Willey & Sons
4. Molecular Spectra and Molecular Spectroscopy (Vol. 1), G. Herzberg
5. Introduction to Atomic Spectra: HG Kuhn
6. Fundamentals of molecular spectroscopy, C.B. Banwell
7. Introduction to molecular Spectroscopy , G. M. Barrow
8. Introduction to Solid State Physics: C. Kittle
9. Materials Science and Engineering: V. Raghavan
10. Solid State Physics: S. O. Pillai (New Age International 2006)
11. Ferroelectricity Jona and Shirane

Semester III Practical 3P1

Practical 5 (Core 9 and Core 10).

1.Determination of ionization potential of lithium
2.X-ray diffraction by TELEXOMETER.
3.Study of emission spectra of iron (Iron arc).
4.Determination of Dissociation Energy of Iodine Molecule by photography of the absorption band of Iodine in the visible region.
5.Study of Stark effect
6.Study of Molecular Spectra
7.Determination of Rydberg's constant
8.Determination of Plank's constant
9. Study of Crystals
10. Study of line spectra

Semester III Paper 11 (Core Elective E1.1) 3T3 Materials Science I

Unit- I

Equilibrium and kinetics: Stability and metastability, Basic thermodynamic functions, Statistical nature of entropy, Kinetics of thermally activated process.

Phase diagrams: The phase rule, free energy composition diagram, correlation between free energy and phase diagram, calculation of phase boundaries, thermodynamics of solutions, single component system (water), two component system containing two phases and three phases, Binary phase diagrams having intermediate phases, Binary phase diagrams with eutectic system. Lever principle, maximum, minimum, super lattice, miscibility gap, microstructure changes during cooling, application to zone refining.

Unit – II

Phase transformations: Time scale for phase changes, peritectic reaction, eutectoid and eutectic transformations, order disorder transformation, transformation diagrams, dendritic structure in alloys, transformation on heating and cooling, grain size effect on rate of transformation at constant temperature and on continuous cooling, grain size effect on rate of transformation, nucleation kinetics, growth kinetics, interface kinetics leading to the crystal growth.

Unit-III

Diffusion in solids: Fick's laws and their solutions, the Kirkendall effect, mechanism of diffusion, temperature dependence of diffusion co-efficient, self diffusion, interstitial diffusion, the Snoek effect in diffusion, diffusion in ionic crystals, diffusion path other than the crystal lattice, thermal vibrations and activation energy, diffusion of carbon in iron.

Solid State Ionics: Definition, classification and characteristic properties of solid electrolytes. Complex impedance spectroscopy, Arrhenius theory of ionic conductivity. Chemical sensors: Nernst equation, potentiometer and amperometric sensors for various gases, electrochemical redox-reaction, advantages of electrochemical sensors.

UNIT-IV

Solid state energy devices: Fundamental of Solar cells, Primary and secondary solid state cells, advantages of lithium batteries, ion intercalation compounds for secondary cell, open circuit voltage and short circuit current, intercalation compounds for secondary cell, open circuit voltage and short circuit current, Energy density, power density. Fuel cells –advantages and disadvantages, classification, efficiency- emf of fuel cells, hydrogen/oxygen fuel cell, criteria for the selection electrode and electrolyte, methanol fuel cell, solid oxide fuel cells, phosphoric acid fuel cells, molten carbonate fuel cell, proton exchange membrane fuel cell, biochemical fuel cell.

Text and Reference books:

1. Vanvellak: Materials Science.
2. V. Raghvan: Materials Science.
3. D. Kingery: Introduction to ceramics.
4. R. E. Reedhil: Physical metallurgy.
5. Martin Start Sharger: Introductory materials.
6. Sinnot: Solid state for engineers.
7. Kelly and Groves: Crystal and defects.
8. Kittel: Solid state physics, Vth edition.
9. M. A. Azaroff: Elements of crystallography
9. Introduction to solid state theory: Modelung.
10. Fuel Cells – A. Mcdougall, Macmillan 1976 Ch 3,5,7,8 and 11.

Semester III Paper 11 (Core Elective E1.2) 3T3 X-ray I

Unit I

Production of X-rays: Continuous and characteristic X-ray spectra. X-ray emission from thick and thin targets. Efficiency of X-ray production.Various types of demountable and sealed X-ray tubes.

Basics of high-tension circuits and vacuum systems used for the operation of X-ray tubes.

Synchrotron radiation: Production and properties of radiation from storage rings, Insertion devices.

Unit II

Absorption of X-rays: Physical process of X-ray absorption. Measurement of X-ray absorption coefficients.Units of dose and intensity.Radiography, Microradiography and their applications.

X–ray fluorescence: Fluorescence yield. Auger effect.X–ray fluorescence analysis and its applications.Techniques and applications of Photoelectron spectroscopy and Auger electron spectroscopy.

Unit III

X-ray spectroscopy: Experimental techniques of wavelength and energy dispersive x-ray spectroscopy.

Bragg and double crystal spectrographs.Focusing spectrographs.Dispersion and resolving power of spectrographs, Photographic and other methods of detection, resolving power of detectors.

X–ray emission and absorption spectra.Energy level diagram. Dipole and forbidden lines, Satellite lines and their origin, Regular and irregular doublets. Relative intensities of X-ray lines.

Unit IV

Chemical Effects in X-ray Spectra: Chemical effects in X-ray spectra. White line, Chemical Shifts of absorption edges, Fine structures (XANES and EXAFS) associated with the absorption edges and their applications.

Dispersion Theory: Dispersion theory applied to X-rays, Calculation of the dielectric constant, Significance of the complex dielectric constant, Refraction of X-rays, Methods for measurement of refractive index

Text and Reference Books:

1. A. H. Compton and S. K. Allison: X-rays in Theory and Experiment
2. J. A. Nielsen and D. Mc. Morrow: elements of Modern X-ray Physics.
3. M. A. Blokhin: X-ray Spectroscopy.
4. E. P. Bertin: Principles and Practice of X-ray Spectrometric Analysis.
5. C. Bonnelle and C. Mande: Advances in X-ray Spectroscopy.
6. D. C. Koningsberger and R. Prins: X-ray Absorption Principles, Applications, Techniques of EXAFS, SEXAFS and XANES.
7. C. Kunz: Synchrotron Radiation.

Semester III Paper 11 (Core Elective E1.3)3T3 Nanoscience and Nanotechnology I

Unit I:

Introduction to Nanoscience:

Free electron theory (qualitative idea) and its features, Idea of band structure, Density of states for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size, Structure property relation, Size dependence properties. Determination of particle size, Increase in width of XRD peaks of nano-particles, Shift in photoluminescence peaks, Variation on Raman spectra of nano-materials.

Unit II:

Synthesis of Nanomaterials:

Physical methods**:** High energy Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Laser ablation, Laser pyrolysis, Sputter deposition, Electric arc deposition, Photolithography.

Chemical methods**:** Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Microemulsions, Sol-gel method, Combustion method, Wet chemical method

Unit III:

Nanomaterials Characterizations:

X-ray diffraction, UV-VIS spectroscopy, Photoluminescence spectroscopy, Raman spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Scanning Tunnelling Electron Microscopy, Atomic Force Microscopy, Vibration Sample Magnetometer, Spintronics

Unit IV:

Special Nanomaterials and Properties:

Carbon nanotubes, Porous silicon, Aerogels, Core shell structures. Self assembled nanomaterials. Metal and semiconductor nanoclusters

Mechanical, Thermal, Electrical, Optical, Magnetic, Structural properties of nanomaterials

Text and Reference books:

1. Nanotechnology: Principles &Practicals. Sulbha K. Kulkarni ,Capital Publishing Co.New Delhi.

2. Nanostructures & Nanomaterials Synthesis, Properties & Applications**.** Guozhong Cao, Imperials College Press London.

3.Nanomaterials: Synthesis, Properties & Applications**.** Edited by A.S. Edelstein &R.C.Commorata.Institute of Physics Publishing, Bristol & Philadelphia.

4. Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student ed.

5. Nano: The Essentials. T.Pradeep , McGraw Hill Education.

6. Handbook of Nanostructures: Materials and Nanotechnology. H. S. Nalwa Vol 1- 5, Academic Press, Bostan.

7. Hand Book of Nanotechnology, Bhushan

8. Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng

Semester III Paper 11 (Core Elective E1.4) 3T3 Atomic and Molecular Physics I

Unit I

Quantum states of an electron in an atomic Electron spin, spectrum of hydrogen, Helium and alkali atoms, Relativistic corrections for energy levels of hydrogen; Basic principles of interaction of spin and applied magnetic field.

Concepts of NMR spectroscopy concepts of spin-spin and spin-lattice relaxation, chemical shift; spin-spin coupling between two and more nuclei; chemical analysis using NMR.

Mossbauer effect-Recoil less emission of gamma rays, chemical shieft, magnetic hyperfine interaction,

Unit II

electron spin resonance, experimental setup, hyperfine structure and isotopic shift,width of spectral lines, LS & JJ coupling, Zeeman, Paschen Back & Stark effect. Spontaneous and Stimulated emission, Einstein A & B Coefficients; LASERS, optical pumping, population inversion, rate equation, modes of resonators and coherence length, Role of resonant cavity, three and four level systems, Ammonia MASER, ruby, He-Ne, CO_2, dye and diode lasers, Lasers applications

Unit III

Rotational, vibrational and Raman spectra of diatomic molecules, Quantum theory, Molecular polarizability, Intensity alteration in Raman spectra of diatomic molecules, Experimental setup for Raman spectroscopy in the structure determination of simple molecules. polyatomic molecules, symmetric top asymmetric top molecules. Hunds rule.

Unit IV

Electronic spectra of diatomic molecules, Born Oppenheimer approximation, Vibrational Coarse structure of electronic bands, intensity of electronic bonds, Franck Condon principle, and selection rules,dissociation and pre dissociation, dissociation energy, rotational fine structure of electronic bands. General treatment of molecular orbitals, Hund's coupling cases.

Text Book and References:

1. Molecular Spectroscopy: - Jeane L. McHale.
2. Mossbauer spectroscopy –M. R. Bhide.
3. NMR and Chemistry – J. W. Akitt.
4. Structural Methods in inorganic chemistry, E.A V.Ebsworth, D. W. H.Rankin, S.Crdock.
5. Introduction to Atomic Spectra – H. E. White.
6. Fundamental of Molecular Spectroscopy – C. B. Banwell.
7. Spectroscopy Vol. I, II and III, Walker and Straghen.
8. Introduction to Molecular Spectroscopy – G. M. Barrow.
9. Spectra of diatomic molecules – Herzberg.
10. Molecular spectroscopy – Jeanne L. McHale.
11. Molecular spectroscopy – J. M. Brown.
12. Spectra of Atoms and Molecules – P. F. Bemath.
13. Modern Spectroscopy – J. M. Holkas.
14. Laser spectroscopy and instrumentation- Demtroder

Semester III Paper 11 (Core Elective E1.5) 3T3 Applied Electronics I

Unit – I

Operational Amplifiers, Block diagram of a typical operational amplifier, analysis, open loop configuration, inverting and non-inverting amplifiers, operational amplifier with negative feedback,voltage series feedback, effect of feedback on close loop gain, input resistance output resistance bandwidth and output offset voltage, voltage follower. Practical operational amplifier, input offset voltage, input bias current, input off set current, total output off set voltage, CMRR, frequency response, dc and ac amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, integrator and differentiator.Application of Op-Amp as fixed and variable voltage regulator. Oscillators principles- Barkhausen criterion for oscillations, The phase shift oscillator, Weinbridge oscillator, LC tunable oscillator, multi-vibrators, mono-stable and astable, comparators, square wave and triangular wave generators

UNIT II

Communication electronics: Amplitude modulation , generation of AM waves, demodulation of AM waves, DS BSC modulation, generation of DSBSC waves, coherent detection DSBSC wave, SSB modulation, generation and detection of SSB waves, Vestigial sideband modulation, frequency division multiplexing (FDM).

Microwave communication: Advantage and disadvantage of microwave transmission, loss in free space propagation of microwaves, atmospheric effect on propagation, Fresnel zone problem, ground refection,fading sources, detector components, antennas used in microwave communication systems

Unit – III

Microprocessor: Introduction to microcomputers, Memory. Input-output devices, interfacing devices.8085 CPU, architecture, bus timing, de-multiplexing, the address bus, generating control signals,instruction set, addressing modes, illustrative programmes, assembly language programmes, looping, counting and indexing, counters and timing delay, stack and sub routings. read only memory (ROM) and applications. Random access memory (RAM) and applications,

Digital to analogue converters. Ladder and weighted register types, analog to digital converters, ,successive approximations and dual slop converters, application of DAC and ADC,

Unit – IV

Microwave devices: Klystrons, magnetrons, and travelling wave tubes, velocity modulation, basic principle of two cavity klystrons and reflex klystrons, principle of operation of magnetrons, Helix travelling wave tubes, wave modes, transferred electron devices, gunn effect, principle of operation,modes of operation, read diode, IMPATT diode, TRAPATT diode..

Text and Reference Books:

1. Electronic devices and circuit theory: RobortBoylested and L. Nashdsky (PHI, New Delhi).
2. OP-Amps and linear integrated circuits: Ramakanth A. Gayakwad (PHI 2nd Edn).
3. Digital principles and Applications: A. P. Malvino and D. P. Leach (Tata Ma-Graw Hill).
4. Microprocessor architecture, programming and Application with 8085/8086, Ramesh S. Gaonkar(Wiley-Estern).
5. Microelectronics: Jacob Millman (Mc-Graw Hill International).

6. Optoelectronics: Theory and Practices: Edited by Alien Chappal (Mc Graw Hill).
7. Microwaves: K. L. Gupta (Wiley Ester New Delhi).
8. Advanced electronics communication systems: Wayne Tomasi (Phi Edn).
9. Fundamentals of microprocessors and Micro-computers: B. Ram. (Dhanpat Rao and Sons.).

Semester III Paper 12 (Foundation course F1.1) 3T4 Physics I

(Classical Physics)

Unit 1

Kinetic Energy and Work, Work done by gravitational force, Work done by spring, Work done by general variable force, power.

Potential energy, path independence of conservative force, determining potential energy, conservation of mechanical energy, work done on system by force, conservation of energy.
(Ch. 7 and 8 of Ref. 1)

Unit 2

Rotation, nature of angular quantities, kinetic energy of rotation, Newton's second law for rotation, Work and rotational energy.
Rolling as translation and rotation, kinetic energy of rolling, forces of rolling, torque, angular momentum, Newton's second law in angular form. Angular momentum of system of particles, angular momentum of rigid body rotation about a fixed axis. Conservation of angular momentum
(Ch. 10 and 11 of Ref. 1)

Unit 3

Equilibrium, requirements of equilibrium. Centre of gravity, examples of static equilibrium, indeterminate structures.

Fluids, density and pressure, measuring pressure, Archimedes principle, Paskal's principle, ideal fluids in motion, equation of Continuity, Bernoulli's equation.
(Ch. 12 and 14 of Ref. 1)

Unit 4.

Avogadro's number, ideal gases, pressure temperature and rms speed, translated kinetic energy, molar specific hear, adiabatic expansion of ideal gas
Irreversible process and entropy, changes in entropy, second law of thermodynamics, examples of entropy in real world, efficiencies of real engines, statistical view of entropy.
(Ch. 19 and 20 of Ref. 1)

References:

1. Halliday, Resnick and Walker “Principles of Physics” International Students Version 9^{th} Ed.

Semester III Practical 3P2 for elective papers

Practical 6 (elective)

Materials Science

1. Crystal structure determination by powder diffraction.
2. Study of microstructures of metal alloys.
3. Dislocation in alkali halide crystals.
4. Crystal growth from slow cooling of the melt.
5. Thermal analysis of binary alloy.
6. Differential thermal analysis of $BaTiO_3$-$PbTiO_3$ solid solution.
7. To study electrochemical method of corrosion control.
8. Dielectric behaviour of $LiNbO_3$ and $BaTiO_3$ in crystals and ceramics.
9. Electrical conductivity of ionic solids.
10. To test hardness of a material by Brinell hardness tester.
11. Photo elasticity study.
12. Multiple beam interferromentric study of surfaces.
13. Thermal conductivity of bad conductor. 14. Thermal expansion coefficient of metals.
15. Study of transport property in solid electrolytes.
16. Verification Nernst law/Oxygen sensor.
17. Determination of Thermoelectricity Power.

X-Rays

1. Study of Crystal Models.
2. X-ray Diffraction Photograph of a Metal Foil by transmission (Hull Method).
3. X-ray Diffraction Photograph of a Metal Foil by Back Reflection.
4. Powder Photograph by Debye Scherrer Method, Computer Analysis.
5. Laue Photograph and Gnomonic Projection.
6. Rotation oscillation Photograph.
7. Diffraction of X-rays by Liquids.
8. Bragg's Spectrometer: Uhler and Cooksey's method. 55
9. Bent Crystal (Cauchois) Transmission Type Spectrograph: Study of K and L Absorption Edges.
10. Bent Crystal (Cauchois) Transmission Type Spectrograph: Study of K and L emission Spectra.
11. Measurement of Intensities of Emission Lines, Computer Analysis.
12. Study of Satellite Lines. 13. Analysis of XANES Spectrum, Computer Analysis.
14. Analysis of EXAFS Spectrum, Computer Analysis.
15. Determination of Planck's constant by X-rays.
16. X-ray Fluorescence Spectrum Analysis.
17. Absorption Coefficient for X-rays by G. M. / Scintillation Counter.
18. Characteristics of G. M. tube.
19. Compton Effect.
20. Operation of a Demountable X-ray Tube.

Nanoscience and Nanotechnology

1. Synthesis of metal oxide nanoparticles by wet chemical method.
2. Deposition of thin films by spray pyrolysis technique.
3. Synthesis of inorganic nanomaterials by combustion method.

4. Synthesis of nanomaterials by sol-gel method.
5. Synthesis of conducting polymer nanofibres by chemical oxidation method.
6. Study of optical absorption of nanoparticles.
7. Determination of particle size of nanomaterials from x-ray diffraction.
8. Study of photoluminescence of well known luminescent nanoparticles.
9. Deposition of thin films by spin coating method.
10. Thermoluminescence study of nanomaterials.
11. Deposition of thin films by dip coating technique.
12. Study of particle size effect on luminescence.
13. Electrical characterization of nanostructured materials.
14. Synthesis of metal oxide nanoparticles by hydro-thermal method.
15. Deposition of thin film in vacuum.
16. Electrical resistivity of nanomaterials using four probe method
17. Photoluminescence study of prepared red/blue/green luminescent nanomaterials.
18. Characterization of nanomaterials using SEM/TEM.
19. Computer modelling methods for studying materials on a wide variety of length and time scales.

Atomic and Molecular Physics

1. Study of line spectra on photographed plates/films and calculation of plate factor.
2. Verification of Hartman's dispersion formula.
3. Study of sharp and diffuse series of potassium atom and calculation of spin orbit interaction constant.
4. Determination of metallic element in a given inorganic salt.
5. To record the spectrum of CN violet bands and to perform vibrational analysis.
6. To record the visible bands of ALO and to perform vibrational analysis.
7. To photograph and analyse the reddish glow discharge in air under moderate pressure.
8. To photograph the analyse the whitish glow discharge in air under reduced pressure.
9. To perform vibrational analysis of a band system of N2.
10. To perform vibrational analysis of band system of C2
11. To photograph and analyse the line spectrum of Calcium atom.
12. To record/analyse the fluorescence spectrum of a sample.
13. To record/analyse the Raman spectrum of a sample.
14. Study of Hyperfine structure of the green line of mercury.
15. To photograph the (O, O) band of CuH and to perform rotational analysis.
16. Flashing & quenching in Neon Gas.
17. E/m of electron.
18. Experiments on Prism/Grating Spectrometer.
19. Wavelength of laser light.
20. Faraday effect with laser.
21. Michelson interferometer.
22. Analysis of ESR Spectra of transition metals.
23. Analysis of H-atom spectra in minerals.
24. Measurements of dielectric constant of polymer sheet at low frequency.
25. E.S.R. of DPPH.
26. To measure the dielectric constant and polarisation of unknown liquid.
27. To measure the dielectric constant of unknown wood at microwave frequency
28. To measure the ultrasonic velocity in unknown liquid.

29. He-Ne Layer
30. To study polarisation of sodium light
31. To study polarisation of light using Babinet compensator

Semester III (Subject Centric Core Course S1.2) 3T4 Nanoscience and Nanotechnology

Unit I: Introduction to Nanoscience

Introduction to quantum physics, electron as waves, wave mechanics, Schrödinger equation and particle in a box, Free electron theory (qualitative idea) and its features, Idea of band structure, Density of states for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size, Size dependence properties. Determination of particle size, Increase in width of XRD peaks of nano-particles, Shift in photoluminescence peaks, Variation on Raman spectra of nanomaterials.

Unit II: Nanomaterials Synthesis

Physical methods**:** High energy ball milling, Physical vapour deposition, Ionised cluster beam deposition, Laser ablation, Laser pyrolysis, Sputter deposition, Electric arc deposition, Photolithography.

Chemical methods**:** Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Microemulsions, Sol-gel method, Chemical bath deposition, Wet chemical method.

Unit III: Nanomaterials Characterizations

X-ray diffraction, UV-VIS spectroscopy, Photoluminescence spectroscopy, Raman spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Scanning Tunnelling Microscopy, Atomic Force Microscopy, Vibration Sample Magnetometer.

Unit IV: Special Nanomaterials and Properties:

Special Nanomaterials: Carbon nanotubes, Porous silicon, Aerogels, Core shell structures. Self assembled nanomaterials.

Properties of nanomaterials: Mechanical, Thermal, Electrical, Optical, Magnetic, Structural.

Text and Reference books:

a. Nanotechnology: Principles & Practicals. Sulbha K. Kulkarni ,Capital Publishing Co.New Delhi.
b. Nanostructures & Nanomaterials Synthesis, Properties & Applications**.** Guozhong Cao, Imperials College Press London.
c. Nanomaterials: Synthesis, Properties & Applications**.** Edited by A.S. Edelstein & R.C.Commorata. Institute of Physics Publishing, Bristol & Philadelphia.
d. Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student Edition.
e. Nano: The Essentials. T.Pradeep , McGraw Hill Education.
f. Handbook of Nanostructures: Materials and Nanotechnology. H. S. Nalwa Vol 1-5, Academic Press, Bostan..
g. Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng
h. Hand Book of Nanotechnology, Bhushan

(This course cannot be offered to students opting for elective Nanoscience and Nanotechnology E1.3 and E2.3)

Semester III (Subject Centric Core Course S1.3) 3T4 Quantum Computing

Unit 1 Introducing quantum mechanics:
Quantum kinematics, quantum dynamics, quantum measurements.Single qubit, multiqubits, gates. Density operators, pure and mixed states, quantum operations, environmental effect, decoherence. Quantum no-cloning, quantum teleportation.

Unit 2 Introduction to quantum algorithms.
Deutsch-Jozsa algorithm, Grover's quantum search algorithm, Simon's algorithm. Shor's quantum factorization algorithm.

Unit 3 Quantum Cryptography:

Cryptography, classical cryptography, introduction to quantum cryptography. BB84, B92 protocols. Introduction to security proofs for these protocols.

Unit 4 Quantum Entanglement:

Quantum correlations, Bell's inequalities, EPR paradox.

Theory of quantum entanglement. Entanglement of pure bipartite states.

Entanglement of mixed states. Peres partial transpose criterion. NPT and PPT states, bound entanglement, entanglement witnesses

Textbook

Nielsen, Michael A., and Isaac L. Chuang. *Quantum Computation and Quantum Information.* Cambridge, UK: Cambridge University Press, September 2000. ISBN: 9780521635035.

N. David Mermin “Quantum Computer Science: An introduction” Cambridge University Press (2007).

Semester III (Subject Centric Core Course S1.4) 3T4 Digital Electronics and Microprocessor

Unit–I:

Logic gates: Characteristics of TTL, ECL, CMOS circuits with reference to fan in / out noise, speed, power dissipation with suitable examples. Simplifying logic circuits: Algebric method SOP (minterm) and POS (maxterma) forms. Karnaugh mapping Fundamental products, pairs, gaurds, octats, Don□t□s care conditions.

Complementary Karnaugh map. Diagonal adjacencies. NAND-NAND and NOT-NOR networks. Applications of K maps to half adder, full adder. Arithmetic circuits: Number representation. Binary point, negative numbers, sign and magnitude. 1s and 2 s complement adder, parallel binary adder, BCD addition, parallel BCD adder, binary multiplication and division

Unit – II

Multiplexers, demultiplexers : IC 74150 multiplexer and IC 74154 demultiplexer.

Tristate buffers, their use in bus organization. Key board encoders, BCD, octal, Hex and scanned matrix keyboard.

A/D and D/A converters: Weighted resistor and R-2R ladder D/A converters. A/D converter –parallel comparator and Application. ADC 0808, 08116/08117, DAC 0800, look up table, measurement of electrical and physical quantities.

Unit -III:

Memories Allied Devices: Design consideration of Bipolar RAM, MOS memory and dynamic RAM, ROM, EXROM and CCD. Read/Write operation. Expanding memory sizewordsize and word capacity. FIFO and LIFO. Study of 7489 RAM and 745370 RAM and other chip. Magnetic bubble memories. Floppy disks-track and sector organization, data format Winchester disk (hard disk).

Unit – IV:

Microprocessor Architecture: Introduction to architecture, pin configuration etc. of 8086, The parts of up. CPU, memory requirements, numerical data,representation of characters, microprocessor instructions, program storage, instruction execution fetch and execute cycles, addressing modes including simple memory paging, direct scratch and pad addressing. The instruction set including memory reference, immediate conditional jump-shift, change control, stack and program counter, subroutines, flow charts, masking, simple programs.

I/O Systems: Program interrupts including multiple interrupt priorities. Interfacing memory mapping, memory mapped and I/P mapped I/O. Use of decoders, I/O posts. ic 8212.

, IC 8155 and IC8255 (with block diagram of internal circuits) Typical programs using these ICS.

Text and Reference Books

1. Design of Digital Systems : P. C. Pitman (Galgotia Pub).
2. Digital Computer Electronics :A. P. Malvino (TMH).35
3. Digital Fundamentals: T. L. Floyd (Universal Book Stall).
4. Theory and Problems of Digital Principles : R. L. Tokheim (TMH).
5. Modern Digital Electronics : R. P. Jain (TMH).
6. Introduction to UP : A. K. Mathur (PHL).
7. Up and Small Digital Computer Systems for Scientist and Engineers L G. A. Korn, (McGraw Hill).
8. An Introduction to Micro-computer: Adam Osborne(Galgotia).
9. Introduction top 4 bit and 8 bit UP : Adam Osborne

(This course cannot be offered to students opting for elective Applied Electronics E1.5 and E2.5)

Semester IV Paper 13 (Core 11) 4T1 Nuclear and Particle Physics

UNIT 1 ;

Basic nuclear properties; size, radii, shape, and charge distribution, spin, parity, mass, binding energy, semi-empirical mass formula, liquid drop model, nuclear stability, laws of radioactive decay. Nature of nuclear force, elements of deuteron problem, n-n scattering, charge independence and charge symmetry of nuclear forces.Electric and magnetic moments of nuclei.Evidence for nuclear shell structure, single particle shell model-its validity and limitations.

UNIT 2 :

Elementary properties of alpha-, beta-, and gamma-, decay of nuclei, their classification, characteristics and selection rules. Elementary theories of alpha-, beta-, and gamma-, decay. Nuclear reactions- conservation laws, mechanism, and cross section. Nuclear reaction mechanism, compound nucleus, direct reactions. Fission and fusion reactions, nuclear energy, elements of nuclear power.

UNIT 3 :

Interaction of charged particles and electromagnetic radiation with matter. Principles of nuclear radiation detectors: G-M counter, proportional counter, Na(Tl) scintillation detector, semiconductor detectors. Elementary principles of particle accelerators: linear accelerators, Van de Graaf, cyclotron, betatron, synchrocyclotron, ion beam accelerators.

UNIT 4 :

Classification of elementary particles, strong, weak and electromagnetic interaction.Gellmann-Nishijima formula Properties of hadrons, baryons, mesons, leptons, and quarks- their quantum numbers, charge, mass, spin, parity, iso-spin, strangeness etc. Symmetry and conservation laws.Elements of quark model and standard model.Higgs boson.

Text-books recommended:

1) Introductory Nuclear Physics,: Kenneth S Krane, Wiley, New York ,1988.
2) Nuclear and Particle Physics: Brian Martin.
3) Atomic and Nuclear Physics: S.N. Ghoshal.
4) Introduction to Particle Physics : D. Griffiths.
5) Introduction to Nuclear Physics: F. A. Enge, Addison Wesley (1975)
6) Introductory Nuclear Physics: Burcham

Semester IV Paper 14 (Core 12) 4T2 Solid State Physics

Unit I: Band Theory: Bloch theorem, the Kronig- Penney model, construction of Brillouin zones, extended and reduced zone schemes, effective mass of an electron, tight binding approximation. Fermi surface.

Magnetic Properties:

Quantum theory of paramagnetism, magnetism of iron group and rare earth ions,.exchange interactions. Pauli paramagnetic susceptibility

Unit II

Lattice Dynamics: Energy of atomic motions, adiabatic principle, harmonic approximation, cyclic boundary condition.Lattice vibrations of linear monoatomic and diatomic chains.Dispersion relations, acoustic and optical phonons.

Theories of lattice specific heat, Dulong and Petit'slaw, Einstein and Debye models, T^3 law, Born procedure, anharmonicity and thermal expansion.

Unit III: Free Electron Theory: Electrons moving in one and three dimensional potential wells, quantum state and degeneracy, density of states, electrical and thermal conductivity of metals, relaxation time and mean free path, the electrical resistivity of metals, thermonic emission. Seebeck effect, thermoelectric power.

Semiconductors: Free carrier concentration in semiconductors, Fermi level and carrier concentration in semiconductors, effect of temperature on mobility, electrical conductivity of semiconductors, Hall effect in conductors and semiconductors.

Unit IV

Superconductivity, Type I and II super conductors, Meissner effect, isotope effect, London equation, coherence length, elements of B. C. S. theory, tunnelling DC and AC Josephson effect, Ginzberg-Landau Theory macroscopic quantum interference. Josephson junction.high temperature superconductor (elementary).

Text and Reference books:

1. C. Kittle: Introduction to Solid State Physics (2nd and 4th Edition).
2. A. J. Dekker : Solid State Physics.
3. Kubo and Nagamiya : Solid State Physics.
4. Feynman Lectures: Vol. III.
5. Board and Huano : Dynamical Theory of Crystal Lattice.
6. N. W. Ashcroft and D. Mermin: Solid State Physics.

Semester IV Practical 4P1 for core papers

Practicals based on core 11 and core 12

1. Measurement of resistivity of a semiconductor by four probe method at two different temperatures and determination of band gap energy.
2. Measurement of Hall coefficient of given semiconductor: identification of type of semiconductor and estimation of charge carrier concentration.
3. Determination of Hall life of 'In".
4. Determination of range of Beta-rays from Ra and Cs.
5. G-M counter
6. Magnetoresistance by Hall effect
7. Determination of Dielectric constant
8. Random decay of nuclear disintegration using dice (or simulation)

In all 7 practicals, instructor can introduce new and relevant experiments which are not in the list.

Semester IV Paper 15 (Core Elective E2.1) 4T3 Materials Science II

Unit –I

Mechanical response of Materials : Elasticity, model of elastic response, inelasticity, viscoelasticity, stress-strain curves, concept of various mechanical properties such as hardness, yield strength, toughness, ductility, yield toughness, ductility, brittleness, stiffness, young modulus, shear modulus, shear strength, Frenkel model, Peierls-Nabarro relation, Plastic deformation,

Corrosion and degradation of materials – electrochemical considerations – passivity forms of corrosion – corrosion inhibition.

Spintronics and Photonics: Spin glass, magnetic bubbles, domain walls, magnetic multilayers, magnenites, GMR and CMR, DMS materials. Photonic band gap materials.

Unit – II

Concept of Synthesis: Concept of equilibrium and nonequilibrium processing and their importance in materials science.

Synthesis of materials: Physical method – Bottom up: cluster beam evaporation, Ion beam deposition, Gas evaporation, Chemical method – Hydrothermal, combustion, bath deposition with capping techniques and top down: Ball milling. Solvated metal atom dispersion – thermal decomposition – reduction methods – colloidal and micellar approach.

Unit-III

Processing of materials: Metallic and non metallic, Ceramics and other materials. Only basic elements of powder technologies, compaction, sintering calcination, vitrification reactions, with different example, phenomenon of particle coalescence, porosity.Quenching : concept, glass formation

structural characterization:

Diffraction techniques: interpretation of x-ray powder diffraction patterns, Identification & quantitative estimation of unknown samples by X-ray powder diffraction technique Electron and neutron diffraction.

Unit –IV

Structural determination by fluorescent analysis. Theory and method of particle size analysis. Integral breadth method, Warren-Averbach's Fourier method, profile fitting method.

Microscopic techniques –TEM, SEM & STEM.AFM, EDX and XPS.

Text and Reference Books:

1. Basic Solid State Chemistry, 2nd Edition, Anthony R. West, John Wiley & Sons, 1996.
2. New Directions in Solid State Chemistry, C. N. R. Rao and J. Gopalkrishnan, Cambridge University Press, Cambridge, 1986.
3. Chemical approaches to the synthesis of inorganic materials, C. N. R. Rao Wiley Eastern Ltd.1994.

4. Materials Science and Engineering – An Introduction, W. D. Callister Jr. John Wiley & Sons,1991.
5. Materials Science, J. C. Anderson, K. D. Leaver, R. D. Rawlings and J. M. Alexander, 4th Edition, Chapman & Hall (1994).
6. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press (1998).

Semester IV Paper 15 (Core Elective E2.2) 4T3 X-ray II

Unit I

Space lattice and unit cell of a crystal, Choice of a unit cell, Crystal systems, Bravais lattices, Crystal faces and internal arrangement, Miller indices, Law of rational indices, Indices of a direction. Point groups, Space groups.

Perspective projections: Gnomonic projection, Stereographic projection, Orthographic projection.

Reciprocal lattice concept: Graphical construction, Relation to interplanar spacing, Interpretation of Bragg's law.

Unit II

Scattering of X-rays: Thomson scattering, Compton scattering, Wave mechanical treatment of scattering, Scattering by a pair of electrons, Theory of scattering by a helium atom, Scattering by many electrons, Experiments on scattering by monatomic and polyatomic gases, liquids and amorphous solids.

Unit III

Physical Basis of X-ray Crystallography: Atomic and crystal structure factors, Structure factor calculations, The integrated intensity of reflection. Different factors affecting the intensity of diffraction lines in a powder pattern.Dynamical theory X-ray diffraction.

The Fourier Transform, electron density projections in crystals, Application to X-ray diffraction.

Unit IV

Experimental Methods of Structure Analysis: Laue method, Debye-Scherrer method, rotation Oscillation method, Weisenberg camera, The sources of systematic errors and methods of attaining precision.

Principles of energy dispersive and time analysis diffractometry.

Methods of detecting and recording diffraction patterns.

Structures of metals and alloys. Phase transformations, Order-disorder phenomenon. Super lattice lines.Determination of grain size.

Other Diffraction Techniques: Electron and neutron diffraction tsechniques and their applications. Comparison with X-ray diffraction.

Text and Reference Books:

1. A. H. Compton and S. K. Allison: X-rays in Theory and Experiment.
2. N. F.M. Henry, H. Lipson and W. A. Wooster: The interpretation of X-ray Diffraction Photographs.
3. K. Lonsdale: Crystals and X-rays.
4. B. D. Cullity: elements of X-ray Diffraction.
5. M. M. Woollfson: X-ray Crystallography.
6. M. J. Buerger: X-ray Crystallography.
7. Bacon: Neutron Physics.

Semester IV Paper 15 (Core Elective E2.3) 4T3 NanoScience and Nanotechnology II

Unit – I:

Nanophotonics:

Fundamentals of photonics and photonic devices, Lasers, CFLs, LEDs, OLEDs, Wall paper lighting, Display devices, X-ray imaging nanophosphers, Photo therapy lamps and its applications, Nanomaterials for radiation, Dosimetery special for thermoluminescence. Optical stimulated luminescence, Luminescence solar concentration.

Unit – II:

Nanomagnetics:

Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics.

Unit – III:

Nanoelectronics:

Top down and bottom up approach, CMOS Scaling, Nanoscale MOSFETs, Limits to Scaling, System Integration, Interconnects;

NanoDevices: Nanowire Field Effect Transistors, FINFETs, Vertical MOSFETs, Other Nanowire Applications, Tunneling Devices, Single Electron Transistors, Carbon nanotube transistors, Memory Devices,

Unit – IV:

Nanocomposites:

Classification of nanocomposites, Metallic, ceramic and polymer nanocomposites, Tribology of polymeric nanocomposites, Nano ceramic for ultra high temperature MEMS, Optimizing nanofiller performance in polymers, Preparation techniques, Graphene/Fullerene/Carbon nanotube (CNT) polymer nanocomposites, One dimensional conducting polymer nanocomposites and their applications

Text and reference books:

1. H.S.Nalwa; Hand book of Nanostructure materials and nanotechnology; (Vol.1-5), Acad. Press, Boston, 2000
2. C.P.Poole Jr., F.J.Owens; Introduction to Nanotechnology, John Wiley and sons, 2003
3. C. Furetta; Hand book of thermoluminescence; World Scientific Publ.
4. S.W.S. McKEEVER; Thermoluminescence in solids; Cambridge Univ. Press.
5. Alex Ryer; Light measurement hand book; Int. light Publ.
6. M.J.Weber; Inorganic Phosphors; The CRC Press.
7. T.J.Deming; Nanotechnology; Springer Verrlag, Berlin, 1999
8. W.D.Kalister Jr., Materials Science and Engineering, 6th Eds, WSE Wiley, 2003
9. Gusev; Nanocrystalline Materials
10. C. Delerue, M.Lannoo; Nanostructures theory and Modelling
11. Fausto, Fiorillo ; Measurement and Characterization of Magnetic materials
12. Bhushan; Hand Book of Nanotechnology
13. Janos H., Fendler; Nanoparticles and Nanostructured Films
14. T.Pradip; Nano: The Essentials

15. Liu; Hand Book of Advanced Magnetic Materials (4 Vol.)
16. Lakhtakia; Nanometer Structure
17. Banwong, Anurag Mittal; Nano CMOS Circuit and Physical Design
18. G.W.Hanson: Fundamental of Nanoelectronics
19. Edward L. Wolf (2nd Ed.), *Nanophysics & Nanotechnology: An Introduction to Modern Concepts in Nanoscience*, WILEY-VCH, 2006
20. S. Sakka; Sol-gel science and technology processing, characterization and applications; Kluwer Acad. Publ.
21. Goser et al, "*Nanoelectronics&Nanosystems: From Transistor to Molecular & Quantum Devices"*
22. SupriyoDatta, "*From Atom to Transistor*"
23. John H. Davies, *The Physics of Low Dimensional Semiconductors: An Introduction"*, Cambridge University Press, 1998.
24. Hari Singh Nalwa, "*Encyclopedia of Nanotechnology*"
25. A. A. Balandin and K. L. Wang, "*Handbook of Semiconductor Nanostructures &Nanodevices*"
26. Cao Guozhong, "*Nanostructures &Nanomaterials - Synthesis, Properties & Applications*

Semester IV Paper 15 (Core Elective E2.4) 4T3 Atomic and Molecular Physics II

Unit I

Time dependence in quantum mechanics, Time dependent perturbation theory, rate expression for emission, perturbation theory, calculation of polarizability.Quantum mechanical expression for emission rate.

time correlation function and spectral Fourier transform pair, properties of time correlation functions and spectral time shape,

Fluctuation dissipation theorem rotational correlation function and pure rotational spectra, Re-orientational spectroscopy of liquids.

Unit II

Saturation spectroscopy, Burning and detection of holes in Doppler broadened two level systems, Experimental methods of saturation spectroscopy in laser, Ramsey fringes, Saturation techniques for condensed matter application,

Laser optogalvanicspectroscopy.Two photon absorption spectroscopy, Selection rules, Expression for TPA cross section –photo acoustic spectroscopy, PAS in gaseous medium, Roseneweig and Greshow theory, Thermally thin, thick samples, Typical experimental set up, Application in Spectroscopy,

Unit III

Stimulated Raman scattering, Quantum mechanical treatment, Raman Oscillation Parametric instabilities, Electromagnetic theory of SRS.Vibronic interaction, Herzberg Teller theory, Fluorescence spectroscopy, Kasha's rule, Quantum yield, Non-radioactive transitions, Jablonski diagram, Time resolved fluorescence and determination of excited state lifetime.Light detectors, Single photon counting technique, Phase sensitive detectors.

Unit IV

Matrix isolation spectroscopy, Fourier transforms spectroscopy, Laser cooling. Molecular symmetry and group theory, Matrix representation of symmetry elementsof a point group, Reducible and irreducible representations, and character tables specially for C_{2v} and C_3 point group molecules, Normal coordinates normal modes, Application of group theory to molecular vibrations.

Text Book and References:

1. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.
2. Quantum electron – A. Yariv.
3. Introduction to non-linear laser spectroscopy – M. D. Levenson.
4. Photoacoustics and its applications, Roseneweig.
5. J. M. Hollas, High resolution spectroscopy.
6. Cotton, Chemical Applications of Group Theory.
7. Herzberg, Molecular spectra and molecular structure II and III.
8. Demtroder, Laser spectroscopy and instrumentation.
9. King, Molecular spectroscopy.
10. Lakowicz, Principles of fluorescence spectroscopy.
11. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.

Semester IV Paper 15 (Core Elective E2.5) 4T3 Applied Electronics II

Unit – I:

An Overview of Electronic Communication system ; block diagram of an digital electronic Communication system, Pulse modulation systems, sampling theorem, lowpass and band-pass signals,PAM channel bandwidth for a PAM signal, Natural sampling, flat top sampling, signal recovery throughholding, quantization of signals, quantization, differential PCM delta modulation, adoptive delta modulation CVSD. Digital modulation techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK. Mathematical representation of noise, sources of noise, frequency domain representation of noise, Noise in Pulse Code and Delta modulation system, PCM transmission, calculation of quantization of noise, out pit signal power effect of thermal noise, outr signal to noise ratio in PCM, DM, quantization noise in DM, out put signal power, DM oput-put, signal to quantization noise ratio, effect of thermal noise in delta modulation, output signal to noise ratio in DM.

Unit – II

Computer communication systems: Types of networks, design features of communication network,examples, TYMNET, ARPANET, ISDN, LAN.Mobile radio and satellite - time division multiplex access (TDMA) frequency division multiplex access(FDMA) ALOHA, Slotted ALOHA, Carrier sense multiple access (CSMA) Poisson distribution protocols.

Unit – III

Microprocessor and Micro-computers: Microprocessor and architecture, Pin out and pin functions of 8086/8088 Internal microprocessor architecture, bus buffering and latching ,Bus timings, ready and wait states, minimum mode versus and maximum mode. Real and protected mode of memory addressing, memory paging, addressing modes, data addressing modes, programme memory addressing mode, stack memory addressing modes, instruction sets, data movement instruction, arithmetic and logic instruction, programme control instruction, clock generator (8284A),

Unit –IV

Memory and I/O Interface : Memory devices, ROM,RAM.,DRAM, SRAM, Address decoding , 3 to 8 line decoder 74LS138, 8086, and 80386(16 bits) Memory interface, , Introduction to I/O interface , Interfacing using 8255, Introduction to PIT 8254, Basic Communication device(UART) pin diagram and functioning of 16550 Interrupts: Basic interrupt processing, Hardware interrupt, expanding the interrupt structure, 8259A PIC.

Text and Reference books.

1. Principles of communication systems :Taub and Schilling (ii Edn THM ,1994)
2. Principles of communication systems: Taub and Schilling GoutamSaha Third Edition
3. Communication systems : Simon Haykin (iii Edn John Wiley & Sons)
4. The intel microprocessors 8086/80188,80386,80486, Pentium and Pentium processor architecture, programming and interfacing : Barry B. Brey (PHI iv Edn, 1999)
5. Microprocessor and interfacing ,programming and hardware : Douglas V. Hall (ii Edn, Mc GrawHill International edn. 1992)
6. The 80x86 IBMPC compatible computer: Muhammad Ali Maxidi and J .G. Mazidi (ii Edn.Prentice –Hall International.)

Semester IV Paper 16 (Foundation course F2.1) 4T4 Physics II

(Modern Physics)

Unit 1
Relativity: Postulates,, Measuring an event,, Relativity of simultaneity, Relativity of time, Relativity of length, Lorentz transformations, consequences of Lorentz equations, relativity of velocities, doppler effect, how momentum changes.

(Ch. 37 of Ref. 1)

Unit II

Photon, quantum of light, photoelectric effect, photons have momentum, light as a probability wave, electrons and matter waves, Schrodinger's equation, Heisenberg's uncertainty principle.

Sring waves and matter waves, energies of trapped electron, wave functions of trapped electrons, electron traps in various dimensions, Bohr Model, Schrodinger equation and Hydrogen atom

(Ch. 38 and 39 of Ref. 1)

Unit III
Nuclear Physics and Nuclear Energy: Discovering nucleus, nuclear properties, radioactive decay, alpha decay, beta decay, radioactive dating, nuclear model.
Nuclera fission: Basic process, Model for fission, nuclear reactor, natural nuclear reactor, thermonuclear fusion: the basic process, thermonuclear fusion in sun and other stars, controlled thermonuclear fusion.
(Ch. 42 and 43 of Ref. 1)

Unit IV
Particle physics, leptons, hadrons, conservation law, quark model, messenger partiles, expanding univers, background radiation, dark matter, big bang

(Ch. 44 of Ref. 1)

References:
1. Halliday, Resnick and Walker "Principles of Physics" International Students Version 9th Ed.

Semester IV (Subject Centric Core Course S 2.2) 4T4 Experimental Techniques in Physics

Unit 1: Radiation Sources, Detectors and Sensors

Different types of radiations (X-rays, UV-VIS, IR, microwaves and nuclear) and their sources
Detectors: gamma-rays, X-rays, UV-VIS, IR, microwaves and nuclear detectors
Sensors: Sensor's characteristics, Classification of sensors, Operation principles of sensors such as electric, dielectric, acoustic, thermal, optical, mechanical, pressure, IR, UV, gas and humidity with examples

Unit 2:Structural Characterization and Thermal Analysis

X-ray Diffraction – Production of X-rays, Types (continuous and characteristics), Bragg's diffraction condition, principle, instrumenation (with filters) and working, Techniques used for XRD – Laue's method, Rotating crystal method, Powder (Debye-Scherrer) method, Derivation of Scherrer formula for size determination Neutron Diffraction: Principle, Instrumentation and Working
Thermal analysis: Principle, Instrumentation and Working: Thermo-gravimetric (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC); Graphical analysis affecting various factors. Numericals

Unit 3: Morphological and Magnetic Characterization

Optical Microscopy: Principle, Instrumentation and Working of optical microscope.
Electron Microscopy: Principle, Instrumentation and Working of Scanning Electron Microscope (SEM), Field Emission Scanning Electron Microscope (FESEM) – Advantages over SEM, Transmission Electron Microscope (TEM), Selected Area Electron Diffraction (SAED)
Probe Microscopy: Principle, Instrumentation and Working of Scanning Tunneling Microscope (STM) and Atomic Force Microscope (AFM)
Magnetic Characterization: Principle, Instrumentation and Working of Vibrating Sample Magnetometer (VSM), Analysis of Hysteresis loop, SQUID Technique:
Principle, Instrumentation and Working. Numericals

Unit 4 : Spectroscopic Analysis

Spectroscopic characterization (principle, instrumentation and working): Infra-Red (IR), Fourier Transform Infra-Red (FTIR), Ultraviolet-Visible (UV-VIS), Diffused Reflectance Spectroscopy (DRS), X-ray Absorption (XPS), Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR). Numericals.

Reference Books:

1. Nuclear Radiation Detectors, S.S. Kapoor, V. S. Ramamurthy, (Wiley-Eastern Limited, Bombay)
2. Instrumentation: Devices and Systems, C.S. Rangan, G.R. Sarma and V.S.V. Mani, Tata Mc Graw Hill Publishing Co. Ltd.
3. Instrumental Methods of Chemical Analysis, G. Chatwal and S. Anand, Himalaya Publishing House
4. Instrumental Methods of Analysis by H.H. Willard , L.L. Merritt, J.A. Dean, CBS Publishers
5. Characterization of Materials, John B. Wachtman & Zwi. H. Kalman, Pub. Butterworth Heinemann (1992)
6. Elements of X-ray diffraction, Bernard Dennis Cullity, Stuart R. Stock, (Printice Hall, 2001 - Science – 664

Semester IV (Subject Centric Core Course S 2.3) 4T4 Communication electronics

UNIT I

Modulation AM and FM (Transmission and reception): Modulation, AM generation, Power consideration, Balanced modulator, SSB transmission, AM detection, AGC, Radio receiver characteristics, signal to noise ratio, FM analysis, noise considerations, generation, direct method and reactance tube method, FM transmitter, AFC, FM Propagation, phase discriminator.

UNIT II

(Propagation of radio waves) Ground wave, sky wave and space wave propagation. Ionosphere (Eccles- Larmer theory, magneto ionic theory).

UNIT III

(Antenna and TV) Antenna, HF antenna, Yagi antenna, loop antenna, Satellite communication, parabolic reflector, dish antenna, Fundamentals of image transmission, vestigial transmission, TV camera tubes, image orthicon, vidicon, TV transmitter, TV receiver and picture tubes.

UNIT IV

(Transmission Lines) Voltage and current relations on transmission line, propagation constant, characteristic impedance, impedance matching, quarter wave T/L as impedance transformer, attenuation along coaxial cable, cables of low attenuation, propagation of radio waves between two parallel lines, wave guide modes, TE10 mode and cut off wavelength, cavity resonator, light propagation in cylindrical wave guide, step index and graded index fibers, attenuation and dispersion in fibers.

Books Recommended:

1. George Kennedy & Davis: Electronics Communication Systems

2. Millar & Beasley: Modern Electronics Communication

3. R.R Gulani: Monochrome and colour television (Wiley Eastern Limited)

4. Taub and Schilling: Principle of Communication Systems (TMH)

5. Simon Gaykuti: Communication Systems (John Wiley & Sons Inc. 1994)

(This course cannot be offered to students opting for elective Applied Electronics E1.5 and E2.5)

Semester IV (Subject Centric Core Course S 2.4) 4T4 ElectroAcoustics

Unit – I:

Fundamentals of ultrasonic, Acoustics interaction with liquids, Velocity in fluids, Absorption due to heat conduction and viscosity, single relaxation, internal degrees of freedom, Relaxation in binary mixtures, Normal and associated liquid essential difference in low and high amplitude ultrasonic wave propagation of low amplitude waves, ultrasonic generators piezoelectric effect. Propagation in Solids Attenuation due to electron phonon interaction; Phonon-Phonon interaction, Measurement Techniques, optical method, interference method, Pulse method, Sign-around method. Applications of ultra-sound in industrial and medical fields.

Unit - II

Architectural Acoustics, Classical ray theory. Decay of sound in live and in dead rooms, Measurement of reverberation time. Effect of absorption on reverberation, Sound absorption coefficient, absorbing materials and their uses. Fundamentals of musical scales. Physics of musical instruments. Public address system and music sound system for auditoria. Instruments used for acoustical tests. Underwater acoustics, Velocity of Sound in Sea-water, sound transmission loss in sea-water. Refraction Phenomena, Masking by noise and by reverberation, Passive detection hydrophone systems.

Unit – III

Loud Speakers, idealized direct radiator, Typical cone Speaker, Effect of voice coil parameters, Horn Loudspeakers, pressure response, Woofer, midrange and tweeter, Crossover net works, Fletcher Munsion Curves, Baffles; Infinite type, vented type and acoustic suspension type, Microphones, Moving coil type, Carbon microphones, condenser microphones, Cardiod type, Polar response, Rating of microphone responses. Reciprocity theorem and calibration. RIAA equalization Preamplifiers, Tone control circuits, Equalization amplifiers, Noise filters, Dolby Noise Reduction, High Fidelity Stereo amplifiers, Recording and reproduction of sound.

Unit – IV

Noise Decibels and levels, dB Scales in acoustics, Reference Quantity for acoustic Power, intensity and pressure, Determination of overall levels from band levels, Basic sound measuring system using sound level meter. Octave band analyzer. Acoustic Calibrator, Definition of Speech interference levels (SIL), Noise criteria for various spaces. Nomogram relating SPL in octave bands to loudness in Tones, Computation of LL and SIL. .

Text and Reference books:

1. Fundamentals of Acoustics: Kinsler and Fry, (Wiley Eastern).
2. Acoustics: Leo L. Beranek (John Wiley and Sons.).
3. Noise Reduction: L. L. Beranek.
4. Fundamentals of Ultrasonic: J. Blitz.
5. Ultrasonic Absorption: A. B. Bhatia.
6. Acoustical Test and Measurements: Don Davis.

Scheme of M.Sc. (Mathematics) Under Semester pattern (CBCS)

w.e.f . Session (2020-2021)

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Mathematics

Semester I for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
								Max. Marks			Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total	Duration in hrs.	External Marks	Internal Ass	Total Marks	Th. External	Internal Ass.
Core 1	Paper 1	5	5	4	1	5	3	100	25	125	50	
Core 2	Paper 2	5	5	4	1	5	3	100	25	125	50	
Core 3	Paper 3	5	5	4	1	5	3	100	25	125	50	
Core 4	Paper 4	5	5	4	1	5	3	100	25	125	50	
Core 5	Paper 5	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	
Semester II for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teachig scheme (Hours / Week)		Credits			Examination Scheme					
								Max. Marks			Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total	Duration in hrs.	External Marks	Internal Ass	Total Marks	Th. External	Internal Ass.
Core 6	Paper 6	5	5	4	1	5	3	100	25	125	50	
Core 7	Paper 7	5	5	4	1	5	3	100	25	125	50	
Core 8	Paper 8	5	5	4	1	5	3	100	25	125	50	
Core 9	Paper 9	5	5	4	1	5	3	100	25	125	50	
Core 10	Paper 10	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

Semester III for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
								Max. Marks			Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total	Duration in hrs.	External Marks	Internal Ass	Total Marks	Th. External	Internal Ass.
Core 11	Paper 11	5	5	4	1	5	3	100	25	125	50	
Core 12	Paper 12	5	5	4	1	5	3	100	25	125	50	
Core 13	Paper 13	5	5	4	1	5	3	100	25	125	50	
Core Elective 1	Paper 14	5	5	4	1	5	3	100	25	125	50	
Foundation Course 1	Paper 15	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

Semester IV for M.Sc. Program in Mathematics												
Code	Theory / Practical	Teaching scheme (Hours / Week)		Credits			Examination Scheme					
								Max. Marks			Minimum Passing Marks	
		Th	Total	Theory	Int. Assessment	Total	Duration in hrs.	External Marks	Internal Ass	Total Marks	Th. External	Internal Ass.
Core 14	Paper 16	5	5	4	1	5	3	100	25	125	50	
Core 15	Paper 17	5	5	4	1	5	3	100	25	125	50	
Core 16	Paper 18	5	5	4	1	5	3	100	25	125	50	
Core Elective 2	Paper 19	5	5	4	1	5	3	100	25	125	50	
Foundation Course 2	Paper 20	5	5	4	1	5	3	100	25	125	50	
	TOTAL	**25**	**25**	**20**	**5**	**25**		**500**	**125**	**625**	**250**	

*Internal Assessment: For the purpose of internal assessment the department will conduct three tests (with equal weight of marks). Best two scores of a student in these tests will be considered to obtain the internal assessment score of that student.

Foundation Course: Student can choose this paper from any other subject other than his / her main subject for post graduation.

Appendix 8

Subject wise Elective Paper:

M. Sc. Subject	Core elective paper to be opted in semester III	Core elective paper to be opted in semester IV
M. Sc. (Mathematics)	Fluid Dynamics I	Fluid Dynamics II
	General Relativity	Cosmology
	Operations Research I	Operations Research II

Appendix 9

Foundation Course:

Candidate can opt for any one foundation course paper as shown below in the semester III and IV. However, Student shall opt for this paper from any other subject other than his / her main subject for postgraduarion.

List of foundation course available:

M. Sc. Subject	Foundation Course I in semester III (Sem V in case of M. Sc. (Tech) Applied Geology)	Foundation Course II in Semester IV (Sem VI in case of M. Sc. (Tech) Applied Geology)
M. Sc. (Mathematics)	Elementary Mathematics –I	Elementary Mathematics –II

Appendix-10

General Rules and Regulations regarding pattern of question paper, absorption scheme and choice based credit system:

A) Pattern of Question Paper

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 100
3. Question paper will consist of five questions, each of 20 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

B) Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

M. Sc. (Mathematics) Program shall consist of four semesters, wherein the student has to complete certain number of credits as indicated in Table 1. Each subject (or course) has fixed number of credits. The types of subject subheads are: Core, Core Elective, , Foundation Course.

Among the 100 credits the candidate needs to complete and clear for M. Sc. (Mathematics) in any concerned subjects, at least 90 credits must be taken from the parent department where he / she is registered for M. Sc. (Mathematics) Course. The remaining 10 credits (Maths) can be taken from any other department of university or affiliated colleges offering foundation courses of PG programs.

Table 1: Credit Requirements for Post Graduate Studies									
PG	Semester	Core	Pract Core	Core Elective	Pract Core Elective	Foundation Course	Project / Review Writing	Seminar	Total Credits
M. Sc. Maths	I	25							100
	II	25							
	III	15		5		5			
	IV	15		5		5			
Total		**80**		**10**		**10**			**100**

SYLLABUS for M. Sc. MATHEMATICS Choice Based Credit System (Semester Pattern) Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Course Study and Scheme of Examination with paper code

Semester I									
Sr. No.	Paper Core/Elective	Paper	Code	Title of the paper	Hrs. in week	Credit	Maximum Marks		
							Int. Ass	Ext. Mar	Total
1	Core -1	Paper -I	1T1	Algebra I	5	5	25	100	125
2	Core -2	Paper -II	1T2	Real Analysis I	5	5	25	100	125
3	Core -3	Paper -III	1T3	Topology I	5	5	25	100	125
4	Core-4	Paper -IV	1T4	Ordinary Differential Equations	5	5	25	100	125
5	Core-5	Paper -V	1T5	Integral Equations	5	5	25	100	125
Semester II									
Sr. No.	Paper Core/Elective	Paper	Code	Title of the paper	Hrs. in week	Credit	Maximum Marks		
							Int. Ass	Ext. Mar	Total
1	Core -1	Paper -VI	2T1	Algebra II	5	5	25	100	125
2	Core -2	Paper -VII	2T2	Real Analysis II	5	5	25	100	125
3	Core -3	Paper -VIII	2T3	Topology II	5	5	25	100	125
4	Core-4	Paper -IX	2T4	Differential geometry	5	5	25	100	125
5	Core-5	Paper -X	2T5	Classical Mechanics	5	5	25	100	125

M.Sc. (Mathematics) Under CBCS
Course Study and Scheme of Examination with paper code

Semester III									
Sr. No.	Paper Core/Elective	Paper	Code	Title of the paper	Hrs. in week	Credit	Maximum Marks		
							Int. Ass	Ext. Mar	Total
1	Core -1 (Compulsory paper)	Paper -XI	3T1	Complex Analysis	5	5	25	100	125
2	Core -2 (Compulsory paper)	Paper -XII	3T2	Functional Analysis	5	5	25	100	125
3	Core -3 (Compulsory paper)	Paper - XIII	3T3	Mathematical Method	5	5	25	100	125
4	Core Elective (Opt any one)	Paper – XIV (Opt any one)	3T4	(i) Fluid Dynamics-I (ii) General Relativity (iii) Measure and Integration Theory (New) (iv) Number Theory (v) Algebraic Topology- I	5	5	25	100	125
5	Foundation Paper	Paper - XV	3T5	Elementary Mathematics -I	5	5	25	100	125
OR	Subject Centric	Paper - XV	3T5	Operation Research -I	5	5	25	100	125

M.Sc. (Mathematics) Under CBCS
Course Study and Scheme of Examination with paper code

Semester IV									
Sr. No.	Paper Core/Elective	Paper	Code	Title of the paper	Hrs. in week	Credit	Maximum Marks		
							Int. Ass	Ext. Mar	Total
1	Core -1 (Compulsory paper)	Paper - XVI	4T1	Dynamical Systems	5	5	25	100	125
2	Core -2 (Compulsory paper)	Paper - XVII	4T2	Partial Differential Equations	5	5	25	100	125
3	Core -3 (Compulsory paper)	Paper - XVIII	4T3	Advance Numerical Methods	5	5	25	100	125
4	Core Elective (Opt any one)	Paper – XIX (Opt any one)	4T4	(i) Fluid Dynamics II (ii) Cosmology (iii) Cryptography (iv)Operator theory (v)Algebraic Topology-II	5	5	25	100	125
5	Foundation Paper	Paper - XX	4T5	Elementary Discrete Mathematics -I	5	5	25	100	125
OR	Subject Centric	Paper - XX	4T5	Operation Research - II	5	5	25	100	125

Detailed Syllabus

M. Sc. Mathematics

Semester-I

Paper – I (Code: 1T1)

Algebra -I

Unit I:

Permutation Group. Normal subgroups, Quotient groups Dihedral group. Commutator group. Isomorphism Theorems. Automorphisms. Characteristic subgroup. Conjugacy and G-Sets, - Cyclic Decomposition - Alternating group An – Simplicity of An.

Unit II:

Normal Series. Solvable groups. Nilpotent groups. Cyclic decomposition of permutation group. Alternating groups. Simplicity of An.

Unit III:

Direct product, semi-direct product of groups, initely generated abelian groups - Invariants of a finite abelian group, Sylows theorems. Groups of order 2 p and pq.

Unit IV:

Ideals and Homomorphisms. Sum and direct sum of ideals. Maximal and prime ideals. Nilpotent and Nil ideals. Modules. Submodules. Direct sums. R-homomorphisms and quotient modules. Completely reducible modules. Free modules.

Text Book:

Basic Abstract Algebra :Bhattacharya, Jain, and Nagpal ,Second Edition,
Cambridge University Press.

Reference Books:

1. Topics in Algebra, I. N. Herstein, Second Edition, John Wiley.

2. Abstract Algebra: David S.Dummit and Richard M. Foote, John Wiley.

M. Sc. Mathematics

Semester-I

Paper – II (Code: 1T2)

Real Analysis-I

Unit I:

Uniform convergence. Uniform convergence and continuity. Uniform convergence and integration. Uniform convergence and differentiation. Equicontinuous families of functions. The Stone-Weierstrass theorem.

Unit II:

Differentiation. The Contraction Principle. The Inverse Function Theorem. The Implicit Function Theorem. The Rank Theorem. Partitions of unity.

Unit III:

The space of tangent vectors at a point of Rn. Another definition of Ta (Rn). Vector fields on open subsets of Rn. Topological manifolds. Differentiable manifolds. Real Projective space. Grassman manifolds. Differentiable functions and mappings.

Unit IV:

Rank of a mapping. Immersion. Sub manifolds. Lie groups. Examples of Lie groups.

Text Books:

1. Principles of Mathematical Analysis (Third Edition): Walter Rudin Mc GRAW – HILL Book Company.

2. An Introduction to Differentiable Manifolds and Riemannian Geometry: W. Boothby, Academic Press, 1975.

Reference Books:

1. Methods of Real Analysis: R. R. Goldberg, John Wiley.

2. Calculus of Several Variables: C Goffman, Harper and Row.

M. Sc. Mathematics

Semester-I

Paper – III (Code: 1T3)

Topology-I

Unit I:

Countable and Uncountable sets. Examples and related Theorems. Cardinal Numbers and related Theorems. Topological Spaces and Examples.

Unit II:

Open sets and Limit points, Derived Sets. Closed sets and closure operators. Interior, Exterior and boundary operators. Neighbourhoods, bases and relative topologies.

Unit III:

Connected sets and components. Compact and countably compact spaces. Continuous functions and homeomorphisms, Arc wise connectivity.

Unit IV:

To and T1-spaces, T2-spaces and sequences. Axioms of countability. Separability. Regular and normal spaces.

Text Book:

Foundations of General Topology: W.J. Pervin, Academic press, 1964.

Reference Books:

1. Topology: J.R. Munkres, (second edition), Prentice Hall of India, 2002.

2.Introduction to Topology and Modern Analysis: G.F. Simmons, Mc Graw Hill 1963.

3. General Topology: J.L. Kelley, Van Nostrand, 1995.

4. Introduction to general Topology: K.D. Joshi, Wiley Eastern Ltd. 1983

M. Sc. Mathematics

Semester-I

Paper – IV (Code: 1T4)

Ordinary Differential Equations

Course Outcomes: The aim of this course is to study basic notions in Differential Equations and use the results in developing advanced mathematics. After completion of this course students will able to solve application problems modeled by linear differential equations and will able to use power series methods to solve differential equations about ordinary points and regular singular points.

Unit I:

Linear Equations with variable coefficients: Initial value problems for the homogeneous equations. Solutions of the homogeneous equations, The Wronskian and linear independence, Reduction of the order of a homogeneous equation, The non-homogenous equations, Homogeneous equations with analytic coefficients, The Legendre equations.

Unit - II:

Linear Equations with regular singular points: The Euler equations, Second order equations with regular singular points, The Bessel equation, Regular singular points at infinity.

Unit III:

Existence and uniqueness of solutions to first order equations: The method of successive approximations, The Lipschitz condition of the successive approximation. Convergence of the successive approximation, Non-local existence of solutions, Approximations to solutions and uniqueness of solutions.

Unit IV:

Existence and Uniqueness of Solutions to System of first order ordinary differential equations: An example- Central forces and planetary motion, Some special equations, Systems as vector equations , Existence and uniqueness of solutions to systems, Existence and uniqueness for linear systems, Green's function, Sturm Liouville theory.

Text Book:

1) E.A.Coddington: An introduction to ordinary differential equations (2012), Prentice Hall of India Pvt.Ltd. New Delhi.

2) G. Birkoff and G.G.Rota: Ordinary Differential equations, John Willey and Sons

3) Mark Pinsky: Partial differential equations and boundary-value problems with applications, AMS, 3rd edition(2011).

Reference books:

1. G.F. Simmons Differential Equations with Applications and Historical note, MeGraw Hill, Inc. New York. (1972)

2. E.A. Coddington and Levinson: Theory of ordinary differential equations McGraw Hill, New York(1955) 3.E.D. Rainvills :Elementary differential equations, The Macmillan company, New York. (1964)

M. Sc. Mathematics

Semester-I

Paper – V (Code: 1T5)

Integral Equations

Unit 1:

Preliminary concepts of integral equations. Some problems which give rise to integral equations. Conversion of ordinary differential equations into integral equations. Classification of linear integral equations. Integro-differential equations.

Unit 2:

Fredholm equations. Degenerate kernels. Hermitian and symmetric kernels. The Hilbert- Schmidt theorem. Hermitization and symmetrization of kernels. Solutions of integral equations with Green's function type kernels.

Unit 3:

Types of Voltera equations. Resolvent kernel of Voltera equations, Convolution type kernels. Some miscellaneous types of Voltera equations. Non-linear Voltera equations. Fourier integral equations. Laplace integral equations.

Unit 4:

Hilbert transform. Finite Hilbert transforms. Miscellaneous integral transforms. Approximate methods of solutions for linear integral equations. Approximate evaluation of Eigen values and Eigen functions.

Text Book:

Integral Equations: A short course: L. G. Chambers: International text book company Ltd, 1976.

Reference books:

1. Integral equations by Shanti Swaroop, Shiv Raj Singh
2. Linear integral equation, Theory and techniques, Academic press, New York 1971
3. R.P. Kanwal, Linear Integral Equation, Theory and Techniques, Academic Press, N.Y. (1971).
4. S.G. Mikhlin, Linear Integral Equations, Hindustan Book Agency, (1960).
5. A.M. Viazwaz, A First Course in Integral Equations, World Scientific (1997).
6. L.I.G. Chambers, Integral Equation: A Short Course, International Text Book Company Ltd. (1976).
7. Larry Andrews, Bhimsen Shiramoggo, Integral Transform for Engineers, Prentice Hall of India (2003).
8. Integral equations and boundary value problems by M. D. Raisinghania, S. Chand publication

M. Sc. Mathematics

Semester-II

Paper – VI (Code: 2T1)

Algebra-II

Unit 1:

Unique factorization domains. Principal Ideal domains. Euclidean domains. Polynomial rings over unique factorization domains.

Unit 2:

Irreducible polynomials and Eisenstein criterion. Adjunction of roots. Algebraic extensions. Algebraically closed fields. Splitting fields. Normal extensions. Splitting fields, multiple roots.

Unit 3:

Finite fields. Separable extensions. Automorphism groups, and fixed fields. Fundamental theorem of Galois theory. Fundamental theorem of algebra.

Unit 4:

Roots of unity and Cyclotomic polynomials. Cyclic extensions. Polynomials solvable by radicals. Ruler and compass constructions.

Text Book:

Basic Abstract Algebra: Bhattacharya, Jain, Nagpaul; Second Edition, Cambridge University Press.

Reference Books :

1. Topics in Algebra, I. N. Herstein, Second Edition, John Wiley.

2. Abstract Algebra, David S.Dummit and Richard M.Foote, John Wiley.

M. Sc. Mathematics

Semester-II

Paper – VII (Code: 2T2)

Real Analysis -II

Unit 1:

Outer measure.Measurable sets and Lebesgue measure. Anon-measurable set, Measurable functions, Littlewood's three principles.

Unit 2:

The Riemann integral. Lebesgue integral of a bounded function over a set of finite measure. Integral of a non-negative function. General Lebesgue integral. Convergence in measure. Differentiation of monotone functions. Functions of bounded variation. Differentiation of an integral.

Unit 3:

Absolute continuity.Convex functions. Lp-spaces. Holder and Minkowski inequality. Riesz-Fischer theorem. Approximation in Lp. Bounded linear functionals on Lp-spaces.

Unit 4:

Compact metric spaces. Baire category theorem. Arzela Ascoli theorem.
Locally compact spaces. Sigma compact spaces.

Text Book :

Real Analysis, H.L. Royden, Third edition, Prentice Hall, 1988.

Reference Books :

1. Measure theory and Integration, G. de Barra Wiley Eastern Limited, 1981.

2. An introduction to Measure & Integration, Inder K. Rana, Narosa Publishing House

M. Sc. Mathematics

Semester-II

Paper – VIII (Code: 2T3)

Topology-II

Objectives : To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.

Unit I :

Continuous Functions: Continuous functions - the product topology - The metric topology. Chapter 2 : Sections 18 to 21 [Omit Section 22]

Unit II:

Connectedness: Connected spaces - connected subspaces of the Real line - Components and local connectedness. [Chapter 3 : Sections 23 to 25]

Unit III:

Compactness: Compact spaces - compact subspaces of the Real line - Limit Point Compactness - Local Compactness. [Chapter 3 : Sections 26 to 29]

Unit IV:

Countability And Separation Axiom: The Countability Axioms - The separation Axioms - Normal spaces - The Urysohn Lemma - The Urysohn metrization Theorem - The Tietz extension theorem. [Chapter 4 : Sections 30 to 35]

Text Book:

James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)

Reference Books

1. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.

2. George F.Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963

3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York

4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.

5. S.Willard, General Topology, Addison - Wesley, Mass., 1970

M. Sc. Mathematics

Semester-II

Paper – IX (Code: 2T4)

Differential Geometry

Course outcome: The course introduces the fundamentals of differential geometry primarily by focusing on the theory of curves and surfaces in three space. The theory of curves studies global properties of curves such as the four vertex theorem. The theory of surfaces introduces the fundamental quadratic forms of a surface, intrinsic and extrinsic geometry of surfaces, and the Gauss-Bonnet theorem.

Unit I:

Definition of surface. Curves on a surface. Surfaces of revolution. Helicoids. Metric. Direction coefficients. Families of curves. Isometric correspondence. Intrinsic properties. Geodesics. Canonical geodesic equations.

Unit II:

Normal property of geodesics. Existence theorems. Geodesic parallels. Geodesic curvature. Gauss Bonnet theorem. Gaussian curvature. Surfaces of constant curvature. Conformal mapping. Geodesic mapping.

Unit III:

Second fundamental form. Principal curvatures. Lines of curvature. Developable. Developable associated with space curves. Developable associated with curves on surfaces. Minimal surfaces and ruled surfaces. Fundamental equations of Surface theory. Parallel surfaces.

Unit IV:

Compact surfaces whose points are umbilics. Hilbert's lemma. Compact surfaces of constant Gaussian or mean curvature. Complete surfaces. Characterisation of complete surfaces. Hilbert's theorem. Conjugate points on geodesics. Intrinsically defined surfaces. Triangulation. Two dimensional Riemannian manifolds. Problem of metrization. Problem of continuation.

Text Book:

An introduction to Differential Geometry: T.J. Wilmore; Oxford University Press

References:

1. W . Klingenberg (Springer), A course in Differential Geometry
2. Geometry of curves and surfaces: do Carmo, Academic Press.
3. Weatherburn, C. Riemannian Geometry and Tensor Calculus
4. D. Somasundaram, Differential Geometry a first course, Narosa Publishing House, 2008

M. Sc. Mathematics

Semester-II

Paper – X (Code: 2T5)

Classical Mechanics

Unit I:

Variational principle and Lagranges Equations : Hamilton's principle, some techniques of the calculus of variations. Derivation of Lagrange' s Equations from Hamilton's Principle. Extension of principle to nonholonomic systems. Conservation theorems and symmetry properties.

Unit II: Legendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorems, Routh's equations, Derivation of Hamilton's equations from a variational principle, the principle of least action.

Unit III:

Canonical transformations : The equations of Canonical transformation, examples of canonical transformations. Symmetric approach to Canonical Transformation, Poisson's bracket & other canonical invariants.

Unit IV:

Equations of motion. Infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, the angular momentum poisson bracket relations, Hamilton-Jacobi theory for Hamilton's principle, and Hamilton-Jacobi theory for characteristic functions.

Text Book:

H.Goldstein, Classical Mechanics, Second edition, Narosa Publishing House, New Delhi

References:

1. T.M. Karade, G.S.Khadekar, Lectures on Advanced Mechanics, Sonu-Nilu publication

2. A.S.Ramsey Dynamics Part-II, the English Language Book Society and Cambridge University Press.

3. Gupta, Kumar and Sharma, Classical Mechanics

4. I.D. Landau and E.M. Lifchitz, Vol. I third edition, Perguman press, New Delhi

5. N. C. Rana & P .S. Joag ,Classical Mechanics ,Tata Mc Graw Hill

6. L. M. Katkar, Classical Mechanics(Mathematics), Shivaji University Kolhapur, 2007

M. Sc. Mathematics

Semester-III

Paper – XI (Code: 3T1)

Complex Analysis

Unit I:

Impossibility of ordering Complex numbers. Extended complex plane and stereographic projection. Elementary properties and examples of analytic Functions: Power series, analytic functions.

Unit II:

Analytic functions as mappings, Mobius transformations. Power series representation of analytic functions, zeros of an analytic function, index of a closed curve.

Unit III:

Cauchy's theorem and integral formula, the homotopic version of cauchy's theorem and simple connectivity, counting zeros; the open mapping theorem, Goursat's theorem, Classification of singularities, residues, the argument principle.

Unit IV:

The maximum principle. Schwarz's lemma. convex functions and Hadamards three circles theorem. Phragmen-Lindel of theorem.

Text Book:

Functions of one complex variable: John B. Conway, Second edition, Springer international Student Edition.

Reference Book:

Complex Analysis, L.V. Ahlfors. Mc-Graw Hill, 1966.

M. Sc. Mathematics

Semester-III

Paper – XII (Code: 3T2)

Functional Analysis

Unit I:

Normed spaces, Banach spaces, Further properties of normed spaces. Finite dimensional normed spaces and subspaces. Compactness and finite dimension. Bounded and continuous linear operators.

Unit II:

Linear functionals. Normed spaces of operators. Dual spaces. Inner product space. Hilbert space. Further properties of inner product spaces. Orthogonal complements and direct sums. Orthonormal sets and sequences. Total orthonormal sets and sequences.

Unit III:

Representation of functionals on Hilbert spaces. Hilbert adjoint operators, self adjoint, unitary and normal operators. Hahn-Banach Theorem, Hahn-Banach Theorem for complex vector spaces and normed spaces. Reflexive spaces.

Unit IV:

Category theorem, Uniform boundedness theorem, strong and weak convergence, Convergence of sequences of operators and functionals. Open mapping theorem, Closed linear operators and closed graph theorem.

Text Book:

Introductory Functional Analysis with Applications by E. Kreyszig, John Wiley and Sons.

Reference Books:

1. Introduction to Functional Analysis by A.E. Taylor and D.C. Lay, John Wiley and Sons.

2. Introduction to Topology and Modern Analysis: G.F. Simmons, Mc Graw Hill

M. Sc. Mathematics

Semester-III

Paper – XIII (Code: 3T3)

Mathematical Methods

Unit I:

Fourier integral theorem. Fourier transform. Fourier cosine and sine transform. The convolution integral. Multiple Fourier transform. Solution of partial differential equation by means of Fourier transform.

Unit II:

Calculations of the Laplace transform of some elementary functions. Laplace transform of derivatives. The convolution of two functions. Inverse formula for the Laplace transform. Solutions of ordinary differential equations by Laplace transform.

Unit III:

Finite Fourier transform. Finite Sturm-Liouville transforms. Generalized finite Fourier transform.

Unit IV:

Finite Hankel transform. Finite Legendre transform. Finite Mellin transform.

Text Book:

The use of integral transforms: I N. Sneddon, Tata Mc Graw Hill Publishing Company Ltd.

References Books:

Modern Mathematics For Engineers: Edwin F Beckenbach, Second series, Mc Graw Hill Book Company.

M. Sc. Mathematics

Semester-III

Core Elective*

Paper – XIV (Code: 3T4)

(i) Fluid Dynamics-I

Unit I:

Real fluids and ideal fluids. Velocity of a fluid at a point. Stream lines and path lines. Steady and unsteady flows. Velocity potential. Velocity vector. Local and particle rate of change. Equation of continuity. Acceleration of a fluid. Condition at a rigid boundary. General analysis of fluid motion. Euler's equation of motion. Bernoulli's equation. Worked examples. Discussion of the case of steady motion under conservative body forces. Some further aspects of vortex motion.

Unit II:

Sources, sinks and doublets. Images in a rigid infinite plane. Images in solid spheres. Axisymmetric flows. Stokes' stream function. The complex potential for two-dimensional irrotational, incompressible flow. Complex velocity potential for standard two dimensional flow. Uniform stream. Line source and line sink. Line doublets. Line vortices. Two dimensional image systems. The Milne-Thomson circle theorem. Circle Theorem. Some applications of circle theorem. Extension of circle theorem. The theorem of Blasius.

Unit III:

The equations of state of a substance, the first law of thermodynamics, internal energy of a gas, functions of state, entropy, Maxwell's thermodynamic relation, Isothermal Adiabatic and Isentropic processes. Compressibility effects in real fluids, the elements of wave motion. One dimensional wave equation, wave equation in two and three dimensions, spherical waves, progressive and stationary waves.

Unit IV:

The speed of sound in a gas, equation of motion of a gas. Sonic, subsonic, supersonic flows; isentropic gas flow. Reservoir discharge through a channel of varying section, investigation of maximum mass flow through a nozzle, shock waves, formation of shock waves, elementary analysis of normal shock waves.

Text Book:

F. Chorlton, Text book of Fluid Dynamics, CBS Publishers, Delhi 1985.

Reference Books:

1. G.K. Batchelor, An Introduction to fluid Mechanics, Foundation Books, New Delhi 1994.

2. M.D. Raisinghania, fluid Mechanics, S. Chand and Company, Delhi.

M. Sc. Mathematics

Semester-III

Core Elective

Paper – XIV (Code: 3T4)

(ii) General Relativity

Unit I:

Tensor Algebra, Riemannian geometry, Curvature Tensor: Covariant Curvature tensor, Ricci tensor, Einstein Tensor, The Bianchi identity.

Unit II:

The principle of covariance, The principle of equivalence, Geodesic principle, Newton's equations of motion as an approximation of geodesic equations, Poisson's equations as an approximation to Einstein field equations.

Unit III:

Gravitational field equations in free space, Exterior Schwarzchild's solution and its isotropic form, Birkhoff's theorem, Schwarzchild singularity, planetary orbit, Advance of Perihelion of a planet, Bending of light rays in the gravitational filed, Gravitational Red shift in the spectral lines.

Unit IV:

Newtonian Incompressible star, The pressure contribution mass of static, spherically symmetric System, The Tolman-Oppenheimer-Volkoff Equation, Schwarzchild's Interior solution,

Text Book:

(i) Introduction to General Relativity: Ronald Adler, Maurice Bezin and Manamen Schiffer, McGraw-Hill Kogakusha Ltd.

(ii) Lecture Notes on General Theory of Relativity, **Øyvind Gron** (Oyvind Gron) , Springer publication

Unit 4 : Chapter 10 , articles [10.1, 10.2,10.3, 10.4]

References Books:

1. Introduction to theory of relativity, Rosser W.G.V., ELBS(1972).
2. Lecture on General Relativity, T M Karade, G S Khadekar and Maya S Bendre, Sonu Nilu Publication (2004)
3. Relativity Special, General and Cosmology, Rindler W., Pub. Oxford University Press (2003).
4. The Classical Theory of Fields By Landau I.D. and Lifshitz E.M., Pub. Pergamon Press (1978).

M. Sc. Mathematics

Semester-III

Core Elective

Paper – XIV (Code: 3T4)

(iii) Measure and Integration Theory

Unit-I:

Lebesgue outer measure, measurable sets, Regularity,Measurable functions, Borel and **Lesbesgue measurability.**

Unit II:

Integration of Non-negative function, the general integral, integration of series, Riemann and Lebesgue integrals.

Unit-III:

The Four derivatives, continuous non-differentiable functions, functions of bounded variation, Lebesgue differentiation theorem, differentiation and integration.

Unit-IV: Measures and outer measures, Extension of a measure, : The uniqueness of Extension, completion of a measure, measure spaces, integration with respect to a measure. spaces, convex functions, Jensen's inequality

Text Book:

Bartle R.G ., The Elements of Integration, John Wiley & Sons, Inc.,New York, 1966.

References :

1. Bartle R.G ., The Elements of Integration, John Wiley & Sons, Inc.,New York, 1966.
2. G .de Barra, Measure Theory and Integration. Wiley Eastern Limited,1981.
3. Halmos P .R. Measure Theory, Van Nostrand Princeton, 1950.
4. Hawkins T. G., Lebesgue' s Theory of Integration, its origins and Development, Chelsea, New York, 1979.
5. Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.
6. Karade T .M., Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, Nagpur, 2004.
7. Royden H.L., Real Analysis, Macmillan Pub. Co. Inc., 4th Edition, New York, 1993
8. P.K. Jain and V.K.Gupta, Leabegue Measure and integration, June-2010

M. Sc. Mathematics

Semester-III

Core Elective

Paper – XIV (Code: 3T4)

(iv) Number Theory

Unit I:

Introduction, The Mobius function u(n), The Euler totient function φ(n), A relation connecting φ and μ. A product formula for φ (n),The Dirichlet product of arithmetical functions, Dirichlet inverses and Mobius Inversions formula. The Mangoldt function π(n), Multiplicative functions. Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function (n), The divisor function (n). Generalised convolutions.

Unit II:

Introduction, The big oh notation Asymptotic equality of functions, Euler's summation formula, some elementary asymptotic formulas, the average order of d(n), the average order of divisor functions (n), the average order of φ(n), An application to the distribution of lattice points visible from the origin. The average order of μ(n) and π(n), The partial sums of a Dirichlet product, Applications to μ(n) and π(n), Another identity for the partial sums of a Dirichlet product.

Unit III:

Introduction, Chebyshev's functions Ψ(x)and v(x). Relations connecting Ψ (x)and v(x), some equivalent forms of the prime number theorem, Inequlities of π(n) and Pn Shapiro's Tauberian theorem. Application of Shapiro's theorem. An asymptotic formulae for the partial sums $\sum (1/p)$.

Unit-IV:

Definition and basic properties of congruences. Residue classes and complete residue systems. Linear congruences. Reduced residue systems and Euler - Format theorem, Polynomial congruences modulo p, Lagrange's theorem. Simultaneous linear congruences, the Chinese remainder theorem. Applications of the Chinese remainder theorem. Polynomial congruences with prime power moduli.

Sections: 2.2 to 2.14 3.1 to 3.12 4.1 to 4.9 5.1 to 5.9

Text Book:

Introduction to analytic number theory - by Tom M-Apostol, Narosa Publishing House, New Delhi.

M. Sc. Mathematics

Semester-III

Core Elective

Paper – XIV (Code: 3T4)

(v) Algebraic Topology- I

Unit I:

The Elements of Homotopy theory: Introduction. Homotopic mappings. Essential and inessential mappings. Homotopically equivalent spaces. Fundamental group. Knots and related embedding problems. Higher homotopy groups. Covering spaces.

Unit II:

Polytopes and triangulated spaces: E^n as a vector space over E^1.Barycentric coordinates. Geometrical complexes and polytopes. Barycentric subdivision. Simplicial mappings and simplicial approximation theorem.

Unit III:

Abstract simplicial complexes. Embedding theorem for polytopes. Simplicial homology theory: Introduction. Oriented complexes. Incidence numbers. Chains, cycles and groups.

Unit IV:

Decomposition theorem for abelian groups. Betti numbers and torsion coefficients. Zero dimensional homology groups. Universal coefficients. Euler Poincare formula. Universal coefficients.

Text Book:

Topology : J.G. Hocking and G.S. Young : Addison Wesley, 1961

Reference Books :

1. Topology : J.R.Munkres, Prentice Hall, Second Edition, 2000

2. Basic Concepts of Algebraic Topology : Fred H.Croom , Springer Verlag 1978.

NOTE*: Candidates can choose any one paper from Core elective.

M. Sc. Mathematics

Semester-III

PAPER XV : FOUNDATION (For Students other than Mathematics)

Paper – XV (Code: 3T5)

MATHEMATICS-I

Elementary Mathematics-I

Unit I:

Differentiation: Derivative of a constant function, derivative of trigonometric functions, derivative of inverse trigonometric functions, derivative of hyperbolic function, derivation of parametrically defined functions, logarithmic differentiation.

Unit II:

Integration: Methods of integration, integration by substitution, three important forms of integrals, six important integrals, integration by parts, definite integrals, reduction formulae.

Unit III:

Matrices & Determinant: Transpose of matrix, orthogonal matrices, unitary matrices, Hermitian and Skew-Hermitian matrices, idempotent matrix, Involutory matrix, minors and factors, properties of determinants, determinants-general treatment, symmetric & Skew-symmetric determinant.

Unit IV:

Complex Number: Definition, conjugate, modulus and argument, Algebra of complex number (Addition, Subtraction, Multiplication and Division), power and square root of complex number, properties of complex number, Argand diagram, solution of quadratic equation in complex number system.

Text Books:

1. Differential Calculus by Shanti Narayan (Unit 1 & Unit 2)

2. An Introduction to Matrices by S.C. Gupta (Unit 3 & Unit 4)

M. Sc. Mathematics

Semester-III

CORE SUBJECT CENTRIC (Only Students of Mathematics)

Paper – XV (Code: 3T5)

Operational Research-I

Unit I:

Revised simplex method (with and without artificial variables). Post Optimality Analysis: changes in (i) objective function, (ii) requirement vector, (iii) coefficient matrix; Addition and deletion of variables, Addition of constraints.

Unit II:

Integer Programming: Gomory's cutting plane algorithm (All integer and mixed integer algorithms), Branch and Bound method.

Unit III:

Bounded variable technique for L.P.P. Unconstrained optimization, Constrained optimization with equality constraints- Lagrange's multiplier method, Interpretation of Lagrange multiplier.

Unit IV:

Inventory control: Deterministic inventory models including price breaks. Multi-item inventory model with constraints. Queueing Theory: Basic features of queueing systems, operating characteristics of a queueing system, arrival and departure (birth & death) distributions, inter-arrival and service times distributions, transient, steady state conditions in queueing process. Poisson queueing models- M/M/1, M/M/C for finite and infinite queue length.

Text book:

Operations Research: Kanti Swarup P.K. Gupta and Man Mohan: Sultan Chand and Sons New Delhi.

Recommended Books:

1. H. A. Taha, Operations Research – An Introduction, Prentice-Hall, 1997.

2. J. K. Sharma, Operations Research: Theory and Applications, Macmillan, 1997

3. S. D. Sharma, H. Sharma, Operations Research: Theory, Methods and Applications, Kedar Nath Ram Nath, 1972

4. S. S. Rao, Optimization-Theory and Applications, Wiley Eastern Ltd., 1977.

5. F. S. Hillier, G. J. Lieberman, Introduction to Operations Research, McGraw-Hill, 2001

6. M. S. Bazaraa, H. D. Sherali, C. M. Shetty, Nonlinear Programming-Theory and Algorithms, Wiley-Interscience, 2006

7. A. K. Bhunia and L. Sahoo, Advanced Operations Research, Asian Books Private Limited, New Delhi, 2011.

8. M. Aokie, Introduction to Optimization Techniques: Fundamentals and Applications of Nonlinear Programming, The Macmillan Company, 1971.

M. Sc. Mathematics

Semester-IV

Paper – XVI (Code: 4T1)

Dynamical Systems

Unit I:

Dynamical systems and vector fields. The fundamental theorem. Existence and uniqueness. Continuity of solutions in initial conditions. On extending solutions. Global solutions. The flow of a differential equation.

Unit II:

Nonlinear sinks. Stability. Liapunov function. Gradient systems. Gradients and inner products.

Unit III:

Limit sets, local sections and flow boxes, monotone sequences in planar dynamical systems. The Poincare Bendixson theorem, Applications of Poincare-Bendixson theorem; one species, predator and prey, competing species.

Unit IV:

Asymptotic stability of closed orbits, discrete dynamical systems. Stability and closed orbits. Non Autonomous equations and differentiability of flows. Persistence of equilibria, persistence of closed orbits. Structural stability.

Text Book:

Differential equations, dynamical systems & linear algebra: M.W. Hirsch & S. Smale, Academic Press, 1975.

Reference Book:

Dynamical systems: V.I. Arnold, Springer Verlag, 1992.

M. Sc. Mathematics

Semester-IV

Paper – XVII (Code: 4T2)

Partial Differential Equations

Course Outcomes: Upon successful completion of this course, the student will be able to:

i. Classify partial differential equations and transform into canonical form

ii. Solve linear partial differential equations of both first and second order.

iii. Solve boundary value problems for Laplace's equation, the heat equation, the wave equation by separation of variables, in Cartesian, polar, spherical and cylindrical coordinates.

Unit I:

Curves and surfaces, First order Partial Differential Equations, classification of first order partial differential equations, classifications of Integrals, Linear equations of first order. Pfaffian differential equations, Criteria of Integrability of a Pfaffian differential equation. Compatible systems of first order partial differential equations.

Unit II:

Charpits method, Jacobi method of solving partial differential equations, Integral surfaces through a given curve for a linear partial differential equations: Cauchy Problem, Quasi Linear Equations: Geometry of Solutions, Non-linear First Order partial differential equations.

Unit III:

Second order Partial Differential Equations, Classification of second order partial differential equation, Vibration of an infinite string (both ends are not fixed), Physical Meaning of the solution of the wave equation. Vibration of an semi infinite string, Vibration of a string of finite length:(Method of separation of variables), Uniqueness of solution of wave equation. Heat conduction Problems with finite rod and infinite rod.

Unit IV:

Laplace equation, Boundary Value Problems: Dirichlets problems and Neumann problems, Maximum and minimum principles . Dirichlet Problems and Neumann problems for a circle, for a rectangle and for a upper half plane, Families to

equipotential surfaces, Solution of Laplace equation, Laplace equation in polar form, Laplace equation in spherical polar coordinates. Kelvin's inversion theorem, Stability theorem, Duhamel's Principle.

Text Book:

1. T. Amarnath: An elementary course in Partial differential equations, 2nd edition, Narosa publishing House (2012).

Reference Books:

1. Mark Pinsky: Partial differential equations and boundary-value problems with applications, AMS,3rd edition(2011).

2. I. N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Int.

3. Fritz John: Partial Differential Equations, Springer(1952).

M. Sc. Mathematics

Semester-IV

Paper – XVIII (Code: 4T3)

Advance Numerical Methods

Unit I:

Simple enclosure methods, Secant method, Newton's method, general theory for one point iteration methods. Aitken extrapolation for linearly convergent sequences, Error tests, Numerical evaluation of multiple roots, roots of polynomials, Mullers method, Non-linear systems of equations, Newton's method for non- linear systems.

Unit II:

Polynomial interpolation theory, Newton's divided differences, finite difference and table oriented interpolation formulas. Forward-differences. Hermite interpolation.

Unit III: The Weierstrass theorem and Taylor's theorem. The minimax approximation problem, the least square approximation problem, orthogonal polynomial, economisation of Taylor series, minimax approximation.

Unit IV:

The trapezoidal rule and Simpson's rule, Newton- Cotes integration formulas.

Text book:

An Introduction to Numerical Analysis by K. E. Atkinson, Johan Wiley and sons, Inc.

M. Sc. Mathematics

Semester-IV

Core Elective

Paper – XIX (Code: 4T4)

(i) Fluid Dynamics-II

Unit I:

Stress components in a real fluid, relation between Cartesian components of stress translation motion of fluid elements, the rate of strain quadric and principal stresses, some further properties of the rate of the strain quadric, stress analysis in fluid motion, relation between stress and rate of strain, the coefficient of viscosity and laminar flow, the Navier-Stokes equations of motion of a viscous fluid, some solvable problems in viscous flow, diffusion of vorticity, energy dissipation due to viscosity, steady flow past a fixed sphere.

Unit II:

Nature of magneto-hydrodynamics, Maxwell electromagnetic field equations; Motion at rest, Motion in medium , Equation of motion of conducting fluid, Rate of flow of charge, Simplification of electromagnetic field equation. Magnetic Reynold number; Alfven's theorem, The magnetic body force. Ferraro's Law of Isorotation.

Unit III:

Dynamical similarity, Buckingham Theorem. Renold number. Prandtl's boundary layer, Boundary layer equation in two dimensions, Blasius solutions, Boundary layer thickness, Displacement thickness. Karman integral conditions, Separation of boundary layer flow.

Unit IV:

Turbulence: Definition of turbulence and introductory concepts. Equations of motion for turbulent flow. Reynolds Stresses Cylindrical coordinates. Equation for the conservation of a transferable scalar quantity in a turbulent flow. Double correlations between turbulence-velocity components. Change in double velocity correlation with time. Introduction to triple velocity correlations. Features of the double longitudinal and lateral correlations in a homogeneous turbulence. Integral scale of turbulence.

Text Books:

1. Text book of Fluid Dynamics: F. Chorlton; CBS Publishers, Delhi 1985.

2. Fluid Mechanics: Joseph Spurk; Springer.

3. Turbulence by J.O. Hinze, 2nd edition, Mc Graw-Hill, chapter 1 sections 1.1 to 1.7

4. Fluid Mechanics by M.D. Raisinghania, S. Chand and Company, Delhi.

Reference Books:

1. An Introduction to fluid Mechanics: G.K. Batchelor; Foundation Books, New Delhi, 1994.
2. Boundary Layer Theory: H. Schichting; Mc Graw Hill Book Company, New York 1971.

M. Sc. Mathematics

Semester-IV

Core Elective

Paper – XIX (Code: 4T4)

(ii) Cosmology

Unit I:

Static cosmological models of Einstein and de Sitter and their derivation and its Properties: (i) The geometry of the Universe (ii) Density and pressure (iii) Motion of test particle (iv) Doppler shift (v) comparison with actual universe, Comparison between Einstein and de-Sitter models.

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Unit II:

Cosmological principle, Hubble law, Weyl's postulate, Derivation of Robertson Walker Metric and its properties, Motion of a particle and light rays in FRW model, Red shift, Decelerationparameter and Hubble's constant, Matter Dominated era.

Unit III:

Friedman Model, Fundamental equation of dynamical cosmology, density and pressure of the present universe, Matter dominated era of the universe, critical density, flat, closed and open universe, age of the universe.

Unit IV:

Steady state cosmology, Distance measure in cosmology, Comoving distance, Apparent luminosity and luminosity distance, Angular diameter and Lookback time, Horizons and the Hubble radius; Galaxy count**,** the Particle horizons, the Event Horizon.

Text Books:

1. Relativity, Thermodynamics and Cosmology: Richard C. Tolman, Oxford Press

2. Gravitation and Cosmology : Principles and Applications of the General Theory of Relativity by Steven Weinberg.

References Books:

1. The Classical Theory of Fields, By Landau I.D. and Lifshitz E.M., Pub. Pergamon Press (1978).

2. ecture on General Relativity , Sonu Nilu Publication (2004) by T M Karade, G S Khadekar and Maya S Bendre

3. The Theory of Relativity Moller C, Pub. Oxford University Press (1982).

4. Introduction to theory of relativity, Rosser W.G.V., ELBS (1972).
5. Relativity Special, General and Cosmology, Rindler W., Pub. Oxford University Press (2003).
6. Relativity: The General Theory, Synge J.L., North Holland Pub. Comp. (1971).

M. Sc. Mathematics

Semester-IV

Core Elective

Paper – XIX (Code: 4T4)

(iii) Cryptography

Unit I:

Time estimates for doing arithmetic, divisibility and Euclidean algorithm, congruence's, quadratic residues and reciprocity, Fermat's little theorem, applications to factoring, finite fields.

Unit II:

Classical cryptosystems, Public key cryptography, Hash function, Probabilistic encryption, RSA cryptosystem, Pseudo primes, Pollard's P-1 method, The Rho method.

Unit III:

The El Gamal cryptosystem, discrete logarithm, Diffee-Hellman key exchange system, Algorithms for discrete logarithm problem- Shank's algorithm, the Pollard Rhoalgorithm, the Pohlig-Hellman Algorithm, security of ElGamal systems, the ElGamal signature scheme.

Unit IV:

Elliptic curves, Elliptic curve cryptosystems, Elliptic curve primality test, Elliptic curve factorization.

Text books:

1. Neal Koblitz, A Course in Number Theory and Cryptography (second edition), SpringerVerleg.
2. Douglas R. Stinson, Cryptography: Theory and practice (Third Edition), CRC Press.

Scope :

Unit I- From Koblitz's book (Chapter 1 and Chapter 2 excluding Existence and uniqueness of finite fields with prime power number of elements)

Unit II – From Koblitz's book (Chapter 4 –sections 1 and 2, Chapter 5- sections 1 and 2)

Unit III – From Stinson's book (Chapter 6- section 1and 2, Chapter 7- section 3)

Unit IV - From Koblitz's book (Chapter 6)

Reference Books:

1. William Stallings, Cryptography and Network Security, Prentice Hall.

M. Sc. Mathematics

Semester-IV

Core Elective

Paper – XIX (Code: 4T4)

(iv) Algebraic Topology- II

Unit I:

Simplicial mappings. Chain mappings. Barycentric Subdivision. The Brouwer Degree.
The fundamental theorem of algebra.

Unit II:

No retraction theorem and Brouwer fixed point theorem. Mappings into spheres. Relative homology groups. The exact homology sequence. Homomorphisms of exact sequences.

Unit III:

The excision theorem. The Mayer-Vietoris sequence. Eilenberg-Steenrod axioms for homology theory. Relative homotopy theory. Cohomology groups. Relations between chain and cochain groups.

Unit IV:

Simplicial and chain mappings. The cohomology product. The cap product. Exact sequences in cohomology theory. Relations between homology and cohomology groups.

Text Book:

Topology : J.G. Hocking and G.S. Young : Addison Wesley, 1961

Reference Books :

1. Topology : J.R.Munkres, Prentice Hall, Second Edition, 2000

2. Basic Concepts of Algebraic Topology : Fred H.Croom , Springer Verlag 1978.

M. Sc. Mathematics

Semester-III

Core Elective

Paper – XIV (Code: 4T4)

(v) Operator Theory

Unit I:

Basic concepts about spectrum. Spactral properties of bounded linear operators. Further properties of resolvent and spectrum. Use of complex analysis in spectral theory.

Unit II:

Banach Algebras. Further properties of Banach Algebras. Compact linear operators on normed spaces. Further properties of Compact linear operators. Spectral properties of compact linear operators.

Unit III:

Further spectral properties of Compact linear operators. Operator equations involving compact linear operators. Further theorems of Fredholm type. Fredholm alternative.

Unit IV:

Spectral properties of bounded self adjoint linear operators. Further Spectral properties of bounded self adjoint linear operators. Positive operators. Square roots of a positive operator. Projection operator. Further properties of projections. Spectral family. Statement of spectral representation theorem.

Text Book:

Introductory Functional Analysis with Applications by E. Kreyszig, John Wiley and Sons

Reference Book :

1. Introduction to Functional Analysis by A.E.Taylor and D.C.Lay, John Wiley and Sons

NOTE*: Candidates can choose any one paper from Core elective

M. Sc. Mathematics

Semester-IV

PAPER XX : FOUNDATION (For Students other than Mathematics)

Paper – XX (Code: 4T5)

MATHEMATICS-II

Elementary Discrete Mathematics-II

Unit I:

Mathematical Logic: Introduction, Proposition, compound Proposition, Proposition and truth tables, logical equivalence, algebra of Proposition, conditional Proposition, converse, contra positive & inverse, bi conditional statement, negation of compound statements, tautologies & contradictions, normal forms, logic in proof.

Unit II:

Lattice: Lattice as partially ordered sets, their properties, lattices as algebraic system, sub lattices, and some special lattices eg. Complete, complemented and distributive lattices.

Unit III:

Boolean algebra and Logic Circuits: Boolean algebra, basic operations, Boolean functions, De-Morgan's theorem, logic gate, sum of products and product of sum forms, normal form, expression of Boolean function as a canonical form, simplification of Boolean expression by algebraic method, Boolean expression form logic & switching network.

Unit IV:

Graph Theory: Basic terminology, simple graph, multigraph, degree of a vertex, types of a graph, sub graphs of isomorphic graphs, matrix representation of graphs, Euler's theorem on the existence of Eulerian path & circuits, directed graph, weighted graphs, strong connectivity, chromatic number.

Text Book:

Discrete Mathematical structures with applications to computer science by J.P.

Tremblay and R. Manohar, McGraw-Hill book company,1997.

M. Sc. Mathematics

Semester-IV

CORE SUBJECT CENTRIC (Only Students of Mathematics)

Paper – XX (Code: 4T5)

Operations Research–II

Course Outcomes: Students would be able to:

CO1 Identify and develop operations research model describing a real life problem.

CO2 Understand the mathematical tools that are needed to solve various optimization

problems.

CO3 Solve various linear programming, transportation, assignment, queuing, inventory

and game problems related to real life.

Unit I:

Operations Research: Origin, Definition and scope. Linear Programming: Formulation and solution of linear programming problems by graphical and simplex methods, Big - M and two-phase methods, Degeneracy, Duality in linear programming.

Unit II:

Transportation Problems: Basic feasible solutions, Optimum solution by stepping stone and modified distribution methods, Unbalanced and degenerate problems, Transhipment problem. Assignment problems: Hungarian method, Unbalanced problem, Case of maximization, Travelling salesman and crew assignment problems.

Unit III:

Concepts of stochastic processes, Poisson process, Birth-death process, Queuing models: Basic components of a queuing system, Steady-state solution of Markovian queuing models with single and multiple servers (M/M/1. M/M/C, M/M/1/k, M/MC/k).

Unit IV:

Inventory control models: Economic order quantity(EOQ) model with uniform demand, EOQ when shortages are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

Text book:

Operations Research: Kanti Swarup P.K. Gupta and Man Mohan: Sultan Chand and Sons New Delhi.

Recommended Books:

1. H. A. Taha, Operations Research – An Introduction, Prentice-Hall, 1997.

2. J. K. Sharma, Operations Research: Theory and Applications, Macmillan, 1997

3. S. D. Sharma, H. Sharma, Operations Research: Theory, Methods and Applications, Kedar Nath Ram Nath, 1972

4. S. S. Rao, Optimization-Theory and Applications, Wiley Eastern Ltd., 1977.

5. F. S. Hillier, G. J. Lieberman, Introduction to Operations Research, McGraw-Hill, 2001

6. M. S. Bazaraa, H. D. Sherali, C. M. Shetty, Nonlinear Programming-Theory and Algorithms, Wiley-Interscience, 2006

7. A. K. Bhunia and L. Sahoo, Advanced Operations Research, Asian Books Private Limited, New Delhi, 2011.

8. M. Aokie, Introduction to Optimization Techniques: Fundamentals and Applications of Nonlinear Programming, The Macmillan Company, 1971.

SYLLABUS for M. Sc. BIOTECHNOLOGY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.
The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Biotechnology

M. Sc. Biotechnology Semester I												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks		
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract	
Core 1 **(1T1)**	Paper 1: **Cell Biology and Enzymology**	4	-	4	4	3	80	20	100	40		
Core 2 **(1T2)**	Paper 2: **Molecular Biology**	4	-	4	4	3	80	20	100	40		
Core 3 **(1T3)**	Paper 3: **Biomolecules**	4	-	4	4	3	80	20	100	40		
Core 4 **(1T4)**	Paper 4: **Biophysical Techniques**	4	-	4	4	3	80	20	100	40		
Pract. Core 1 & 2 **(1P1)**	Practical 1: **Cell Biology and Enzymology**	-	8	8	4	3-8*	100**	-	100		40	
Pract. Core 3 & 4 **(1P2)**	Practical 2: **Macromolecules & Analytical Techniques**	-	8	8	4	3-8*	100**	-	100		40	
Seminar 1 **(1S1)**	Seminar 1	2	-	2	1			25	25	10		
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**	

M. Sc. Biotechnology Semester II											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 5 **(2T1)**	Paper 5: **Microbiology**	4	-	4	4	3	80	20	100	40	
Core 6 **(2T2)**	Paper 6: **Immunology**	4	-	4	4	3	80	20	100	40	
Core 7 **(2T3)**	Paper 7: **Fundamentals of Genetic Engineering**	4	-	4	4	3	80	20	100	40	
Core 8 **(2T4)**	Paper 8: **Applied Molecular Biology**	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6 **(2P1)**	Practical 3: **Microbiology & Immunology**	-	8	8	4	3-8*	100**	-	100		40
Pract. Core 7 & 8 **(2P2)**	Practical 4: **Genetic Engineering & Applied Molecular Biology**	-	8	8	4	3-8*	100**	-	100		40
Seminar 2 **(2S1)**	Seminar 2	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Biotechnology Semester III											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 9 **(3T1)**	Paper 9: **Genetic Engineering & its Applications**	4	-	4	4	3	80	20	100	40	
Core 10 **(3T2)**	Paper 10: **Plant Biotechnology**	4	-	4	4	3	80	20	100	40	
Core Elective 1 **(3T3)**	**Paper 11: A) Industrial Biotechnology I (3T3A) OR B) Environmental Biotechnology I (3T3B)**	4	-	4	4	3	80	20	100	40	
Foundation Course 1 / Core Subject Centric 1 **(3T4)**	Paper 12: **Introductory Biotechnology (3T4A) / Diagnostic Medical Biotechnology (3T4B)**	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10 **(3P1)**	Practical 5: **Genetic Engineering & Plant Biotechnology**	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 1 **(3P2)**	**Practical 6: A) Industrial Biotechnology OR B) Environmental Biotechnology**	-	8	8	4	3-8*	100**	-	100		40
Seminar 3 **(3S1)**	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Biotechnology Semester IV											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract
Core 11 **(4T1)**	Paper 13: **Animal Biotechnology**	4	-	4	4	3	80	20	100	40	
Core 12 **(4T2)**	Paper 14: **Biostatistics, Bioinformatics, Ethics & Patenting**	4	-	4	4	3	80	20	100	40	
Core Elective 2 **(4T3)**	**Paper 15: A) Industrial Biotechnology II (4T3A) OR B) Environnemental Biotechnology II (4T3B)**	4	-	4	4	3	80	20	100	40	
Foundation Course 2 / Core Subject Centric 2 **(4T4)**	Paper 16: **Basic rDNA Technology (4T4A)/ Therapeutic Medical Biotechnology (4T4B)**	4	-	4	4	3	80	20	100	40	
Pract. Core 11, 12 & Elective 2 **(4P1)**	**Practical 7: Animal Biotechnology, Biostatistics, Bioinformatics, Ethics & Patenting And A) Industrial Biotechnology II OR B) Environmental Biotechnology**	-	8	8	4	3-8*	100**	-	100		40
Project **(4PROJ 1)**	Project	-	8	8	4	3-8*	100**	-	100		40
Seminar 4 **(4S1)**	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

Note: Th = Theory; Pr = Practical/lab, * = If required, for two days.

** = The Practical and Project shall be evaluated by both the External and Internal Examiner in the respective Department / Center / Affiliated College.

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SYLLABUS for M. Sc. BIOTECHNOLOGY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

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M. Sc. BIOTECHNOLOGY
Semester I
Paper – I (Code: 1T1)
Cell Biology and Enzymology

UNIT I:
Structure and function of cell organelles:
Plasma membrane: transport of nutrients, ions and macromolecules.
Cell walls: Archaea, Bacteria, plant cells.
Mitochondria: Electron Transport Chain and Oxidative Phosphorylation.
Chloroplasts: Chlorophyll, carotenoids and photosynthesis.
Golgi complex: Endoplasmic reticulum, lysosomes, peroxisomes (functions).

UNIT II:
Cell cycle: Molecular events in S. cerevisiae.
Cell signaling: Signal transduction in animal and plant cells (tyrosine kinase, light induced signaling)

UNIT III:
Basic Enzymology
Basics: Enzyme nomenclature, classification and specificity. Concept of coenzymes.
Mechanism of enzyme action: Models, catalysis by proximity effect, acid-base catalysis, electrostatic interaction, metal ion catalysis, nucleophilic and electrophilic catalysis,
Concept of multienzyme complexes: fatty acid synthase and pyruvate dehydrogenase complexes.
Concept of enzyme regulation: Allosteric (example ATCase), chemical modification and calmodulin mediated regulation.

UNIT IV:
Basic aspects of enzyme kinetics: Michaelis-Menten equation (derivation, significance and transformation). Two substrate kinetics. Modifying factors of enzyme kinetics, enzyme inhibition and types of inhibitors.
Enzyme Engineering
Immobilization of Enzymes

M. Sc. BIOTECHNOLOGY
Semester I
Paper – II (Code: 1T2)
Molecular Biology

UNIT I:
DNA Replication: Prokaryotic and Eukaryotic DNA replication, mechanisms of DNA replication, fidelity of replication, enzymes and accessory proteins involved in DNA replication.
Gene mutations: Types of mutations. Suppression. Ames' test.
DNA Repair: Direct repair, Ada protein, NER, BER, MMR, SOS repair, Transcription-repair coupling, repair of double-strand breaks.

UNIT II:
Prokaryotic Transcription: RNA Polymerase holoenzyme and apoenzyme, different sigma factors, details of initiation, elongation, termination.
Eukaryotic Transcription: Three types of RNA polymerases. Promoter of RNA polymerase II. Enhancers. General and inducible transcription factors.
Modifications of RNA: 5' cap formation, polyadenylation, splicing of nuclear pre-mRNA, mRNA stability.

UNIT III

Genetic code: characteristics, deciphering the code.
Protein biosynthesis: Prokaryotic and eukaryotic translation, the translational machinery, mechanism of initiation, elongation and termination.

UNIT IV
Regulation of expression in prokaryotes: lac operon, ara operon, trp operon, negative autogenous control.
Regulation of expression in eukaryotes: Britten-Davidson model. DNA binding and activation domains of transcription factors. Packaging of chromosomes and its relation to transcription regulation. Regulation of translation by 3' and 5' UTR motifs.

M. Sc. BIOTECHNOLOGY
Semester I
Paper – III (Code: 1T3)
Biomolecules

UNIT I:
Chemistry of Carbohydrates: Energy storage molecules – starch, glycogen. Building blocks – cellulose, hemicellulose, and chitin. Cell surface molecules – glycolipids, proteoglycans.

UNIT II:
Chemistry of Lipids: Triglycerides, phospholipids, glycolipids, sphingolipids, sterols, terpenes, lipoproteins (LDL, VLDL, HDL, IDL). Lipid micelles, Liposomes.

UNIT III:
Proteins: Amino acids and peptides. Primary, secondary, and tertiary structures. Protein sequencing, protease mapping. Ramachandran plot. Collagen structure. Domain structure, models of protein folding, methods of study of protein folding, roles of chaperones and chaperonins.

UNIT IV:
Nucleic acids: Structure of DNA and RNA: A, B, and Z forms of DNA. Novel structures. DNA bending and bendability. Denaturation and renaturation studies and their applications, nucleic acid hybridization. Topological structure of DNA.

M. Sc. BIOTECHNOLOGY
Semester I
Paper – IV (Code: 1T4)
Biophysical Techniques

UNIT I:
Spectrophotometry: UV-Visible spectrophotometry, fluorescence spectrophotometry, absorption and emission spectrophotometry, IR, NMR, Lumionometry.
Basic introduction to Raman and Mass spectrophotometry.

UNIT II:
Chromatography: Basic principles and techniques of partition, adsorption, gel filtration, affinity, and ion exchange chromatography. Concept of GLC and HPLC.

UNIT III:
Electrophoresis: Gel electrophoresis (Agarose, PAGE, SDS PAGE), Disc gel electrophoresis, Gradient electrophoresis, Pulsed field gel electrophoresis, capillary electrophoresis.
Viscosity: Determination of conformational changes through viscosity.

UNIT IV:
Centrifugation
Basic principles, Mathematics & theory (RCF, Sedimentation coefficient etc)
Types of centrifuge: microcentrifuge, high speed & ultracentrifuges.

Differential & density gradient centrifugation, Isolation of cell components using centrifugation technique.
Radioactivity
Radioactive & stable isotopes, Pattern and rate of radioactive decay, Units of radioactivity.
Measurement of radioactivity: Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique),
Applications of isotopes in Biotechnology: Principles of tracer techniques, Its advantages and limitations, Distribution studies, Isotope dilution technique, Metabolic studies, Clinical application. Radioimmunoassay.

M. Sc. BIOTECHNOLOGY
Semester I
LAB I (Code: 1P1)
Cell Biology and Enzymology

1. Determination of activity of calcium ATPase of plasma membrane.
2. Subcellular fractionation and assay of marker enzymes.
3. Assay of activity of LDH.
4. Cell motility and flagellar staining.
5. Cell types of plants- maceration of various tissue explant and identification of xylem, trachied, stomata, root hair, etc.
6. Determination of activity of sodium/potassium ATPase of plasma membrane.
7. Isolation of neutrophils and demonstration of phagocytosis.
8. Determination of osmotic fragility of RBC membrane.
9. Assay of activity of beta-galactosidase
10. Assay of activity of acid phosphatase,
11. Enzyme purification by crystallization - urease.
12. Immobilization of enzymes (Invertase/ Protease/ Amylase.) by Na alginate method.
13. Whole cell immobilization (Yeast) by Na Alginate and the estimation of alcohol produced.
14. Effect of NaCl on amylase activity
15. Inhibition of alkaline phosphatase activity by EDTA
16. Estimation of lipase activity by titrimetric method
17. Effect of Temperature on activity of Amylase / Alkaline phosphatase and determination of optimum temperature.
18. Effect of Substrate concentration on activity of Amylase / Alkaline phosphatase and determination of optimum substrate concentration.
19. Effect of pH on activity of Amylase / Alkaline phosphatase and determination of optimum pH
20. Isolation of chlorophyll and xanthophyll from spinach leaves.
21. Effect of inhibitors on respiratory chain.
22. Study of Mitosis and Meiosis
23. Study of mutations by Ames Test.
24. Assay of Activity of SGOT & SGPT.
25. Isolation, Purity determination and quantitation of DNA by UV method.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester I
LAB II (Code: 1P2)
Macromolecules & Analytical Techniques

1. Separation of proteins / lipids by ion exchange chromatography
2. Separation of lipids / amino acids by thin layer chromatography
3. Polyacrylamide gel electrophoresis: a) native enzyme preparation, b) SDS-PAGE of proteins.
4. Introduction to measurements: balance and pipetting, preparation of solutions of given molarity and normality.
5. Measurement of pH: buffering capacity, to determine pKa value and hence the dissociation constant of a given acid using pH meter.

6. Colorimetry: To determine the dissociation constant of a given indicator colorimetrically and to prepare buffer solutions in the pH range 2.2 to 8.0
7. Colorimetry: Assay of DNA by diphenylamine method.
8. Colorimetry: Assay of RNA by orcinol method.
9. Potentiometry: To determine redox potential of Fe++ and Fe+++.
10. Conductometry: to determine cell constant of 0.1 M KCl.
11. Conductometry: Titration of strong acid vs strong base, to find out equivalent conductance of salt formed.
12. Viscometry: Effect of temperature on the viscosity of DNA using Ostwald's viscometer.
13. Viscometry: To determine molecular weight of protein and DNA.
14. Viscometry: To determine changes in the conformation of bovine serum albumin by viscosity measurements, effect of pH on conformation of BSA.
15. Spectrophotometry: To study the absorption spectrum of hemoglobin and NADH
16. Determination of Tm of nucleic acid
17. The validity of beers law for colorimetric estimation of creatinine.
18. The ultraviolet absorption of proteins and amino acids.
19. Estimation of proteins by Lowry"s and Bradford method.
20. Estimation of protein by E280/E260 method.
21. Fractionation of proteins: Salt precipitation, solvent precipitation, isoelectric precipitation, dialysis, centrifugation.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. Sem I
Seminar (Code: 1S1)

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M. Sc. BIOTECHNOLOGY
Semester II
Paper – I (Code: 2T1)
Microbiology

UNIT I:
Eukaryae and Viruses

- Algae: General characteristics, Applications in biotechnology.
- Fungi and slime moulds: General characteristics, applications in biotechnology.
- Viruses: Nature, symmetry, capsid structure, nucleic acid.
- Quantification of viruses
- Life cycles: T4 and lambda.
- Viroids and prions.

UNIT II:
General Microbiology and Taxonomy

- Prokaryotes: bacterial structure and morphology, endospore forming bacteria, pseudomonas, mycobacteria, archaebacteria.
- Microbial classification: 16s rRNA sequence and bacterial phylogeny.
- Bacterial genetic system: recombination (transformation, conjugation, transduction and transposition) Plasmids, salient features of the E. coli genetic map.

UNIT III:
Microbial Physiology

- Nutrition: nutritional classification, behavior, cultivation, isolation, media and their types, maintenance of culture.
- Growth: Measurement of growth, growth curve, continuous and synchronous culture, factors affecting microbial growth.

UNIT IV:
Microbial Control

- Microbial control: methods and dynamics of sterilization, mechanisms of control, biocontrol and preservation.
- Concept of chemotherapy, chemotherapeutic agents, mechanisms of action.
- Drug resistance, MDR, assessment and management of drug resistance.

M. Sc. BIOTECHNOLOGY
Semester II
Paper – II (Code: 2T2)
Immunology

UNIT I:
Immunology- fundamental concepts and anatomy of the immune system
Components of innate and acquired immunity; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system;; Mucosal and Cutaneous associated Lymphoid tissue.(MALT&CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, HLA typing, flow cytometry, Microarrays.

UNIT II:
Immune responses generated by B and T lymphocytes
Immunoglobulins-basic structure, classes & subclasses of immunoglobulins, antigenic determinants;Basis of self —non-self discrimination; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Cell-mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses, Hapten-carrier system

UNIT III:
Vaccinology

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.

UNIT IV:

Clinical Immunology

Hypersensitivity — Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; immunosuppressive therapy; Cancer immunotherapy. Apoptosis, transgenic mice, Gene knock outs.

M. Sc. BIOTECHNOLOGY
Semester II
Paper – III (Code: 2T3)
Fundamentals of Genetic Engineering

UNIT I:

- Restriction endonucleases and modification methylases
- Other enzymes needed in genetic engineering: exonucleases and endonucleases, ligases, polymerases, DNA modification enzymes and topoisomerases.
- Gene isolation and purification: general methods (shotgun method for producing gene library, cloning specific genes by hybridization and reverse transcriptase methods, direct selection of a gene)

UNIT II:

- Insertion of DNA and ligation: Berg's terminal transferase method (dA:dT joints); Boyer-Cohen-Chang experiment (cohesive ends), Butt joints (T4 DNA ligase); current ligation techniques (blunt-end ligation, complementary end ligation, linkers, adaptors, homopolymer tailing.

UNIT III:

Construction of Genomic DNA library and its applications

- Construction of cDNA Library: Method, problems to be addressed, advantages and disadvantages compared to the genomic DNA library, uses
- Screening of recombinants: Screening by complementation, southern hybridization, northern hybridization, colony lift, western blotting, immunoprecipitation, south-western screening. Synthesis and labeling of probes.
- DNA sequencing: Sanger-Coulson dideoxynucleotide method, Maxam-Gilbert chemical cleavage method, multiplex DNA sequencing, automated DNA sequencing. Basic idea of oligonucleotide synthesis.

UNIT IV:

Cloning vectors

- Plasmids as vectors, general characteristics of plasmids, bacterial vector plasmids, yeast vector plasmids,
- yeast artificial chromosomes
- Phage Vectors (lambda, M13).
- Cosmid vectors.
- Animal virus derived vectors – SV 40 and retroviral vectors

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M. Sc. BIOTECHNOLOGY
Semester II
Paper – IV (Code: 2T4)
Applied Molecular Biology

UNIT I:

Recombination and Genome Mapping,

- Homologous recombination: Holiday junction, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.
- Molecular mapping of genome: Genetic and physical maps, choice of mapping population, southern and fluorescence in situ hybridization for genome analysis, RFLP, RAPD, and AFLP analysis, molecular

markers linked to disease resistance genes, application of molecular markers in forensic, disease prognosis, genetic counseling, pedigree etc.

UNIT II:

Antisense, Ribozymes and Epigenetics

- Antisense and ribozyme technology: Molecular mechanism of antisense molecule, biochemistry of ribozyme, hammerhead ribozymes, applications of antisense and ribozyme technologies.
- Epigenetics: chromatin marking systems, Direct chemical modification of DNA, Basic concepts of RNAi.

UNIT III:

Cancer Biology

- Methods to study cancer: Animal models. Role of tissue culture in study of cancer. Combination of tissue culture and animal models.
- DNA Viruses and cancer: Polyoma virus, SV40, adenovirus
- Genetics of Cancer: Oncogenes (ras, myc), suppressor genes (p53, Rb).

UNIT IV:

- Angiogenesis: Brief idea of healthy vasculature, definition of angiogenesis, basic process of tumor induced angiogenesis, Hypoxia induced factor (HIF), basics of pro- and anti- angiogenic factors, positive and negative factors affecting angiogenesis.
- Metastatsis: Stages of metastatic progression, prerequisites for metastasis (properties a cell must acquire for metastasis), epithelial-mesenchymal transition, biochemical parameters acquired by metastatic cells.
- Basic idea of Cancer stem cells.

M. Sc. BIOTECHNOLOGY
Semester II
LAB I (Code: 2P1)
Microbiology & Immunology

1. Production of microbial products in bioreactors/fermentors.
2. Immobilization of cells/enzymes.
3. Cleanliness, media preparation, sterilization, culturing methods, dilution techniques.
4. Staining techniques in microbiology; simple staining, gram staining, spore staining capsule staining, flagella staining.
5. Isolation of pure culture by different techniques.
6. Replica plating technique.
7. Propagation of viruses.
8. Assay of viruses.
9. Purification of immunoglobulins, qualitative assessment.
10. Demonstration of immunochemical reactions (blood group, Widal, VDRL, pregnancy, ELISA)
11. Blood film preparation and identification of cells.
12. Ouchterlony immunodiffusion,
13. Determination of albumin by radial immunodiffusion.
14. Biochemical tests for identification of Bacteria – Oxidase, catalase, IMViC test, etc.
15. Isolation of antibiotic resistant bacteria from waste / sewage water.
16. Motility of bacteria by hanging drop method.
17. Assay of antibiotics by disc diffusion method.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester II
LAB II (Code: 2P2)
Genetic Engineering & Applied Molecular Biology

1. Induction of β-galactosidase in strains of E. coli (I+ and I-).
2. Southern blotting.
3. Isolation of genomic DNA.
4. Western blotting.
5. Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.
6. Isolation of RNA.
7. Restriction fragment length polymorphism.
8. Ames test.
9. Isolation of plasmid DNA (miniprep and alkaline bulk method)
10. Isolation of RNA
11. Isolation of polyA RNA using oligodT columns
12. Estimation of RNA by Orcinol method
13. Estimation of DNA by diphenylamine method
14. Estimation of DNA by E260 method
15. Isolation of Lambda phage DNA.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. Sem II
Seminar (Code: 2S1)

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M. Sc. BIOTECHNOLOGY
Semester III
Paper – I (Code: 3T1)
Genetic Engineering & its Applications

UNIT I:

- Transformation: DNA uptake by bacterial cells.
- Transfection: Chemical and physical methods, Viral vectors. Polyethylene glycol, DEAE-dextran, calcium phosphate coprecipitation, dimethyl sulfoxide, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection
- Amplification of DNA: Polymerase chain reaction.

UNIT II:

Plant transformation technology: Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, use of scaffold attachment regions, methods of nuclear transformation, viral vectors and their application, Biological and physical transformation methods. Chloroplast transformation.

UNIT III:

- Expression of heterologous genes: expression of eukaryotic genes in bacteria, expression of heterologous genes in yeast, insect and mammalian cells.
- Salient features of expression vectors.
- Processing of recombinant proteins: Refolding and stabilization.
- Industrial Products of Protein engineering

UNIT IV:

- Phage Display: Production of monoclonal bodies by phage display technique using filamentous phage vectors.
- Gene Therapy: somatic and germline, gene replacement, in vivo and ex vivo gene delivery, retrovirus gene transfer system, advantages and disadvantages of adenovirus, adeno-associated virus, herpes virus vectors, gene correction, replacement/augmentation, editing, regulation and silencing. Gene therapy of human diseases

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M. Sc. BIOTECHNOLOGY
Semester III
Paper – II (Code: 3T2)
Plant Biotechnology

UNIT I:

- Conventional plant breeding (introductory).
- Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids.
- Tissue culture media (composition and preparation)
- Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.
- Organogenesis. Embryogenesis; transfer and establishment of whole plants in soil.

UNIT II:

- Shoot tip culture: rapid clonal propagation and production of virus free plants.
- Embryo culture and embryo rescue.
- Hybrid plants: protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid, cybrid.
- Production of haploid plants: anther, pollen and ovary cultures for production of haploid plants and homozygous lines.

- Germplasm conservation: cryopreservation, slow growth cultures and DNA banking for germplasm conservation.

UNIT III:

- Applications of plant transformation for productivity and performance
- Herbicide resistance, phosphoinothricine glyphosate, sulfonyl urea, atrazin, insect resistance, Bt genes, non-Bt-like protease inhibitor, virus resistance, coat protein mediated nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP,
- antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress, post harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase.

UNIT IV:

- Plant metabolic engineering and industrial products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology.
- Molecular marker aided breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellite, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism), QTL, map based cloning, molecular marker assisted selection.
- Green House Technology

M. Sc. BIOTECHNOLOGY
Semester III
(NOTE: Candidates can choose any one elective paper from Core elective A or B)

Paper – III (Core Elective A) (Code: 3T3A)
Industrial Biotechnology I

UNIT I:
Bioreactors:

- Bioreactor function, utility, types of bioreactor. Modes of bioreactor operations. Main components of the bioreactor and their functions.
- Bioreactors
  a) Design/configuration of a basic fermentor; individual parts and probes for on-line monitoring of process.
  b) Concept of Batch and Continuous process, fed-batch semi-continuous systems; aerobic and anaerobic fermentors
  c) Submerged/liquid state and solid state fermentations

UNIT II
Types of Bioreactors:

- Continuous stirred tank and plug flow reactors
- Packed bed and fluidized bed reactors
- Trickle bed, immobilized bed, air lift, rotary disc reactors. Reactors with cell recycle.

UNIT III:
Immobilized reactor systems:

- Immobilization techniques for cells (physical adsorption, ionic binding, covalent binding, lattice entrapment, membrane entrapment, micro encapsulation) and enzymes (covalent binding, entrapment, micro encapsulation, cross-linking, adsorption, ionic binding, affinity binding, chelation, disulfide bonds)
- Immobilized enzyme kinetics
- Types of immobilized reactors

UNIT IV:
Scope of Downstream Processing:

- Importance of Down Stream Processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Role of DSP methods in bioprocess economics. Cell Disruption

Methods: Various cell disruption methods, need for cell disruption for (Homogenizer, French press & Dynomill) intracellular products, cell disruption equipment. Applications in bio-processing. Flocculation: Principles of flocculation various flocculating agents, applications in bio-processing. Coagulation: Principles of coagulations and its applications in bio-processing

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M. Sc. BIOTECHNOLOGY
Semester III
(NOTE: Candidates can choose any one elective paper from Core elective A or B)

Paper – III (Core Elective B) (Code: 3T3B)
Environmental Biotechnology I
Environmental Science & Bioresources

UNIT I:
Introduction to environmental Science: Environmental ethics: Environmentalism, Environment & Religion, Environmental education, Need for environmental education. Environmental Pollution: Classification of pollutants, Air pollution and their properties, Gaseous pollutants, water pollutants and their properties. Noise pollution, Soil pollution, thermal pollution, marine pollution, solid water pollution.

UNIT II:
Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes. Biotechnological processes: Bioconversion, Bioaccumulation, Bioconcentration, Biomagnification, Biodegradation.

UNIT III:
Energy & Biofuels: Non conventional or renewable sources of energy, Energy from Biomass, Biofertilizers, Biosensors and biochips, Biofilters, Biofuel cells,

UNIT IV:
Biofertilizers, Biopestisides and Integrated pest management: Bacterial biofertilizers, algal biofertilizers, Aquatic ferns as biofertilizers, Fungi as biofertilizers, earthworm as biofertilizers, biopestisides, Integrated pest management.

M. Sc. BIOTECHNOLOGY
Semester III
(NOTE: Candidates of other M. Sc. Subjects can choose this paper from Biotechnology subject)
Paper – IV (Foundation Paper I) (Code: 3T4A)
Introductory Biotechnology

UNIT I:
Basics of Proteins

- Amino acids: Structures of amino acids found in proteins, classification, peptide bond structure; Protein Structure:
- Primary (basic idea of sequencing and amino acid composition), secondary (alpha and beta structures), tertiary and quaternary structures

UNIT II:
Nucleic acids

- Nucleoside, Nucleotides, Bases; Basic Structure of DNA (Watson Crick structure) and RNA.

UNIT III:
Genes and chromosomes

- Gene definition, prokaryotic and eukaryotic gene structure; Structure of chromatin (nucleosome, 30 nm fiber, solenoid structure); basic understanding of chromosome structure; centromeres, telomeres, Unique genes and gene families

UNIT IV:

Enzymes

- Overview, Enzyme classification with specific examples. Characteristics of enzymes, Concept of active centre, binding sites, stereospecificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Enzyme activity, international units, specific activity
- Introduction to Enzymes used in biotechnology: Restriction enzymes, exonucleases and endonucleases, ligases, polymerases, DNA modification enzymes and topoisomerases

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M.Sc. Biotechnology (CBCS)
Semester-III
(Candidate can opt for this paper in their main subject of postgraduation ONLY).
Paper-IV: (Core Subject Centric I) (Code: 3T4B)
Diagnostic Medical Biotechnology

Molecular and Nanomolecular Diagnostics

Unit I

Host pathogen interactions in disease process (Bacterial: Tuberculosis and Staphylococcal Diseases & Viral: Influenza and HIV/AIDS); Disease pathology and clinical spectrum; Clinical diagnosis of diseases; Molecular Genetics of the host and the pathogen. Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis.

Unit II

Concept of Genomics, Human disease genes; DNA polymorphism including those involved in disease (Ex: Hemoglobin and the anemias); Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information: SSCP. Single nucleotide polymorphism and disease association; High throughput DNA sequencing and diagnosis; and Array based techniques in diagnosis.

Unit III

Outline of a typical proteomics experiment, clinical proteomics and disease biomarkers. Isolation of proteins and other molecules associated with disease; 2D analysis of such proteins by sequencing individual spots by Mass Spectrometry; Protein Microarray; Present methods for diagnosis of Specific diseases like Tuberculosis and AIDS; Ethics in Molecular Diagnosis

Unit IV

Nanomolecular diagnostics and Biosensor: Introduction to Nanodiagnostics, Nanoarrays for diagnostics, detection of single DNA, self-assembled protein nanoarrays, protein nanobiochip nanoparticles for molecular diagnostics, DNA nanomachines, Nanobiosensor, CNT biosensor, DNA nanosensor, Nanowire biosensor, application of nanodiagnostics.

Texts/References

1. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1st Edition, Academic Press, 2005.
2. Willey J. Prescott, Harley, and Klein's Microbiology-7th international ed./Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. New York: McGraw-Hill Higher Education; 2008.
3. Lela Buchingham and Maribeth L Flawsm, Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 1st Edition, F A Davis Company, Philadelphia, USA, 2007.
4. Campbell, M.A and Heyer L.J., Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2007.
5. Andrew Read and Dian Donnai, New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK, 2007.
6. Challa S.S.R. Kumar, Nanomaterials for medical diagnosis and therapy, Viley-VCH, 2007.
7. Dr.Parag Diwan and Ashish Bharadwaj (Eds), Nano Medicines, Pentagon Press, 2006.

M. Sc. BIOTECHNOLOGY
Semester III
LAB I (Code: 3P1)
Genetic Engineering & Plant Biotechnology

1. Recombinant DNA technology: in vitro DNA ligation and transformation of E. coli.
2. Recombinant DNA technology: characterization of transformants.
3. Northern blotting
4. Agarose gel electrophoresis and restriction mapping of DNA.
5. Construction of restriction map of plasmid DNA
6. Cloning in plasmid/phagemid vectors.
7. DNA sequencing.
8. Gene expression in E coli and analysis of gene product
9. Demonstration of technique of PCR
10. Demonstration of technique of RT-PCR
11. Replica plating technique.
12. Propagation of viruses.
13. Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.
14. Restriction fragment length polymorphism.
15. Ames test.
16. Quantitation of DNA by various methods.
17. Preparation of plant tissue culture media.
18. Surface sterilization.
19. Organ culture.
20. Callus propagation, organogenesis, transfer of plants to soil.
21. Protoplast isolation and culture.
22. Anther culture: production of haploids.
23. Cytological examination of regenerated plants.
24. Micropropagation of banana, citrus Papaya, Sugarcane etc.
25. Effect of various growth hormones on cell divisions and cell proliferation
26. Isolation, purification and culture of protoplast
27. Artificial seed preparation
28. Cytological examination of regenerated plants
29. Agrobacterium culture and selection of transformants.
30. Hardening of tissue culture raised plants.
31. Transfer of plants to soil.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester III
LAB II (Core Elective A) (Code: 3P2)
Industrial Biotechnology

1. Immobilization of cells/enzymes
2. Determination of rheological constant.
3. Determination of oxygen transfer rate, volumetric transfer coefficient.
4. Microbial production of Alcohol
5. Microbial production of antibiotics
6. Production of microbial products in fermentors / bioreactors
7. Preparation and formulation of microbial biopestisides / biofertilizers.
8. Study of patenting procedure
9. Preparation of proposal for patenting.

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. BIOTECHNOLOGY
Semester III
LAB II (Core Elective B) (Code: 3P2)
Environmental Biotechnology

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of total dissolved solids of water
3. Determination of Hardness and alkalinity of water sample.
4. Determination of dissolved oxygen concentration of water sample
5. Determination of biological oxygen demand of sewage sample
6. Determination of chemical oxygen demand (COD) of sewage sample.
7. Analysis of oligodynamic action.
8. Determine the efficiency of removal of air pollutant using fibrous air filter.
9. Preparation and formulation of microbial biopesticide (bacteria, fungi and viruses
10. Production of microbial fertilizers (Rhizobium, Azotobacter and AMF).

Note: Candidates must perform at least 6 practicals in the semester.

M. Sc. Sem III
Seminar (Code: 3S1)

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M. Sc. BIOTECHNOLOGY
Semester IV
Paper – I (Code: 4T1)
Animal Biotechnology

UNIT I:

- Animal Cell Culture: Equipments and materials for animal cell culture technology. Various systems of tissue culture, their distinguishing features, advantages and limitations.
- Culture medium: natural media, synthetic media, sera. Introduction to balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon di oxide, serum and supplements.
- Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors.

UNIT II:

- Primary Culture: Behavior of cells, properties, utility. Explant culture; suspension culture.
- Established cell line cultures: Definition of cell lines, maintenance and management; cell adaptation.
- Measurement of viability and cytotoxicity. Cell cloning, cell synchronization and cell manipulation. Various methods of separation of cell types, advantages and limitations; flow cytometry.

UNIT III:

- Scaling up of animal cell culture. Cell transformation.
- Stem cell cultures, embryonic stem cells and their applications. Somatic cell genetics.
- Apoptosis: Measurement of cell death. Apoptosis (death domain, role of cytochrome C)

UNIT IV:

- Commercial applications of cell culture: Tissue culture as a screening system; cytotoxicity and diagnostic tests. Mass production of biologically important compounds (e.g. Vaccines). Harvesting of products, purification, and assays.
- Three dimensional cultures and tissue engineering.

M. Sc. BIOTECHNOLOGY
Semester IV
Paper – II (Code: 4T2)
Biostatistics, Bioinformatics, Ethics & Patenting

UNIT I:

Biostatistics

- Measures of central tendency: mean, mode, and median.
- Measures of dispersion: range, mean deviation, standard deviation.
- Methods of sampling, sampling error, non-sampling errors, standard error.
- Chi-square test, meaning of correlation and regression.
- Cluster analysis: phylogenetic clustering by simple matching coefficients.
- Presentation of statistical data: tabulation (simple tables, frequency distribution table); charts and diagrams (bar charts, histograms, pie charts, dendrogram).
- Research designs with basic principles and field layout.

UNIT II:

Bioinformatics

- Computer concept: computer organization, hardware, software, operating system (windows, unix, brief list of computer languages).
- Concept of networking: internet, internet concepts, web browsing, public domain resources in biology.
- Concept of database management: brief idea of data types, data structures, searching, sorting, designing a database, genomic, proteomic, and metabolic pathways databases.

- Computer analysis of genetic sequences: general concepts of sequence analysis, identification of functional sequences, homology, brief idea of BLAST, ENTREZ, and PuBMed.
- Proteomics: basic issues and concepts, protein sequences and alignment, protein structure prediction.
- Bioinformatics tools in drug design.

UNIT III:

Ethics:

- Benefits of biotechnology, ELSI of biotechnology, recombinant therapeutic products for human health care, genetic modifications and food consumption, release of genetically engineered organisms, applications of human genetic rDNA research, human embryonic stem cell research.

UNIT IV:

Patenting

- Patent and Trademark, Biotechnology products and processes, Intellectual property rights, Plant breeders rights, biotechnology in developing countries. Biosafty and its implementation, Quality control in Biotechnology.

M. Sc. BIOTECHNOLOGY

Semester IV

(NOTE: Depending on the Core elective subject chosen in Semester III, Candidates shall pursue the same core elective subject in semester IV)

Paper – III (Core Elective A) (Code: 4T3A)

Industrial Biotechnology II

UNIT I:

Bioprocess Engineering Concepts:

- Mass transfer, heat transfer, mixing, rheology of fermentation fluids, residence time distribution, substrate utilization and yield-coefficients, oxygen transfer and oxygen sag.

UNIT II:

Process Optimization and Control:

- Optimization parameters, medium formulation, process optimization techniques:classical, Plackett-Burman design, ANOVA, central; composite design, response surface methodology with example.; medium formulation: classical, experimental design technique, fractional factorial design with egs.
- Concept of control: turbidostatic and chemostatic control, open loop and feedback control
- Advanced control policies: model predictive control, cascade control, PID control, programmed control

UNIT III:

Scale up & Biosensor Technology:

- basic principles of scale-up
- bases of scale up, scale down
- Biosensors

UNIT VI:

Production of Primary & Secondary Metabolite:

1. Primary Metabolites:

- A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc); amino acids (glutamic acid, phenyalanine, aspartic acid etc.) and alcohols (ethanol, butanol etc.)

2. Secondary Metabolites:

- Brief Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin), aminoglycosides (streptomycin) macrolides (erythromycin), vitamins and steroids.

M. Sc. BIOTECHNOLOGY

Semester IV

(NOTE: Depending on the Core elective subject chosen in Semester III, Candidates shall pursue the same core elective subject in semester IV)

Paper – III (Core Elective B) (Code: 4T3B)

Environmental Biotechnology II
Applied Environmental Biotechnology

UNIT I:
Bioremediation & Phytoremediation: Biofeasibility, applications of bioremediation, Bioreduction, Phytoremediation.
Solid waste pollution and its management: Current practice of solid waste management, composting systems, vermicomposting, sewage treatment.

UNIT II:
Bioabsorption and Bioleaching of heavy metals: Cadmium, Lead, Mercury, Metal binding targets and organisms, Bioabsorption, Metal microbial interaction, Biomethylation of elements (Methylation of mercury and arsenic), Commercial biosorbants, bioleaching, metal precipitation, advantages and disadvantages of bioleaching.

UNIT III:
Waste water Treatment: Biological treatment system (Oxidative ponds, aerobic and anaerobic ponds, facultative ponds, aerated ponds), Biological waste treatment, activated sludge treatment, microbial pollution in activated sludge, percolating filters, waste water treatment by biofilms. Treatment scheme of Dairy, Distillery, Tannery, Sugar, Fertilizers, Refinery, Chemical and Antibiotic waste.

UNIT IV:
Xenobitics in environment: Biodegradation of Hydrocarbons, Substituted hydrocarbons, Surfactant, Pesticides, Lignin, Tannin, Synthetic dyes, Biotransformation: Oxidation reactions: Cytochrome P450 monooxygenase system, Alcohol and aldehyde dehydrogenases, Peroxidases. Reduction reactions: Cytochrome P450 and flavin dependent reactions. Hydrolysis reactions: Carboxyl esterases. Conjugation reactions: Gluthione S transferases. Regulation of biotransformation.

M. Sc. BIOTECHNOLOGY
Semester IV
(NOTE: Candidates of other M. Sc. Subjects can choose this paper from Biotechnology subject)
Paper – IV (Foundation Paper II) (Code: 4T4A)
Basic rDNA Technology

UNIT I:
History of Gene cloning

- Boyer-Cohen-Chang experiment. Patenting of the recombinant DNA technique; Berg's role in gene cloning history, Change in medicinal science after discovery of recombinant DNA technology (brief mention of how we produce human insulin today, somatostatin and other therapeutic products, very brief overview of how we may treat diseases through gene therapy)
- Why do we clone genes? (amplification and/or heterologous gene expression). Basic steps of gene cloning:
- Agarose gel electrophoresis; 2D Electrophoresis; Pulsed field gel electrophoresis; SDS PAGE; 16S rDNA sequencing for bacterial identification; ITS region sequencing for fungal identification; RFLP; RAPD

Unit II:
Basic process of recombinant DNA technology

- Cutting and joining of DNA. Vectors: concept, types of vectors (plasmids, phage, virus), Essential qualities that a vector must possess
- Types of vectors: pBR322, cosmids, lambda phage

Unit III:
Basic process of recombinant DNA technology

- Transformation and Transfection – basic techniques. Selectable markers (antibiotic resistance, lacZ), Selection process, Screening.

Unit IV:

Applications of gene cloning

- Insulin, Somatostatin, BT Cotton, production of human proteins and drugs, recombinant vaccines, agricultural applications, production of transgenic animals, human gene therapy

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M.Sc. Biotechnology (CBCS)
Semester-IV
(Candidate can opt for this paper in their main subject of postgraduation ONLY).
Paper-IV: (Core Subject Centric II) (Code: 4T4B)
Therapeutic Medical Biotechnology

Molecular Therapeutics and Drug Discovery

Unit I

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery. Gene silencing technology; siRNA- Concept, delivery and therapeutic applications in treatment of influenza and HIV/AIDS; Tissue and organ transplantation; Transgenics and their uses; Cloning; Ethical issues

Unit II

Proteomics and drug discovery: High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharamacogenetics and drug development; Toxicogenomics; Metagenomics.

Unit III

Nanobiotechnology for drug discovery, protein and peptide based compounds for cancer and diabetes, drug delivery - nanoparticle based drug delivery, lipid nanoparticles, vaccination, cell therapy, Gene therapy. Ethical, safety and regulatory issues of nanomedicine. Physicochemical characteristics of nanomaterials, Nanoparticle interaction with biological membrane, Neurotoxicology.

Unit IV

Drug Discovery & Clinical research

Introduction and importance of clinical research, Drug Development and phases of Clinical trials, Designing clinical Trials, Protocol designing, Ethical issues in clinical research, ICH-GCP Guidelines, Informed consent process, Role of CRC and CRA in clinical trials, Pharmacovigilance, Standard operating procedures, Guidelines to undertake clinical trials in India schedule Y.

Texts/References:

1. Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.
2. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer, 2008.
3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
4. H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press, 2006.
5. Robert A. Freitas Jr., Nanomedicine, Volume I: Basic Capabilities, Landes Bioscience, Georgetown, TX, 1999.
6. Robert A. Freitas Jr., Nanomedicine, Volume IIA: Biocompatibility, Landes Bioscience, Georgetown, TX, 2003.
7. Kewal K. Jain, The Hand book of Nanomedicine, Humana Press, Springer 2008.
8. Nancy A. Monteiro – Riviere and C. Lang Tran, Nanotoxicology: Characterization, Dosing and Health Effects, Informa Healthcare. 2007.
9. Kumar, Challa S. S. R. (ed.) Nanomaterials - Toxicity, Health and Environmental Issues, Wiley-VCH, Weinheim, 2006.
10. Norris, Deborrah. Clinical Research Coordinator Handbook. Plexus Pub, 2009.
11. Portney, Leslie Gross, and Mary P. Watkins. Foundations of clinical research: applications to practice. Vol. 2. Upper Saddle River, NJ: Prentice Hall, 2000.
12. Stone, Judy. Conducting clinical research: A practical guide for physicians, nurses, study coordinators, and investigators. Mountainside MD Press, 2006.
13. Glasser, Stephen P., and P. Glasser. Essentials of clinical research. Springer, 2008.

Semester IV
LAB I (Code: 4P1)
Animal Biotechnology, Biostastics, Bioinformatics, Ethics & Patenting
And Industrial Biotechnology II or Environmental Biotechnology

Section I: Animal Biotechnology, Biostastics, Bioinformatics, Ethics & Patenting

1. Development of primary cell lines/maintenance of established cell lines
2. Preparation of animal cell culture media.
3. Filter sterilization and sterility test.
4. Media storage, serum inactivation.
5. Cell fusion.
6. Cell transformation by viruses.
7. Lyophilization of local germplasma.
8. Calculation of mean, mode, and median
9. Calculation of standard deviation and standard error
10. Using computer in single user and multiple user environment
11. Designing and management of databases
12. Computer aided statistical analysis
13. Computer presentation of statistical data, charts and diagrams
14. Computer aided visualization of amino acid sequence of protein and its 3D structure.
15. Retrieving metabolic pathway using internet
16. Homology searching using BLAST
17. Base sequence analysis of gene / protein sequence
18. Computer aided survey of scientific literature
19. Field layout based on statistical research designs
20. Determination of rheological constant

Section II: Section A) Industrial Biotechnology OR Section B) Environmental Biotechnology
A) Industrial Biotechnology

1. Demonstration of various bioreactor configuration, parts and integrated process control system.
2. Demonstration of addition of inoculation and sampling in CSTR
3. Determination fo volumetric mass transfer coefficient (KLa) by dynamic method and sulphite oxidation method
4. Preparation of wine from grapes.
5. Preparation and characterization of immobilized cells system
6. To perform cell disruption by ultrasonication
7. To study the settling velocity of solid particles under batch sedimentation

OR

B) Environmental Biotechnology

1. Test for the degradation of a aromatic hydrocarbons by bacteria
2. Survey of degradative plasmids in microbes growing in polluted environment
3. Effect of Sulphur dioxide on crop plants
4. Estimation of heavy metals in water/soil by Atomic absorption spectrophotometry,
5. Estimation of nitrate in drinking water.
6. Role of microorganisms in elevation of heavy metal induced stress in plants.
7. Isolation of xenobiotic degrading bacteria by selective enrichment technique
8. In vitro evaluation of medicinal plants against pathogenic microbes.
9. Effect of mycorrhizal fungi on growth promotion of plants.
10. Study of patenting procedure
11. Preparation of proposal for patenting.
12. Study of RFLP, VNTRs, SNPs

Note: At least 6 practical must be conducted within the semester.

M. Sc. Part II, Sem IV
Project (Code: 4PROJ1)

M. Sc. Part II, Sem IV
Seminar (Code: 4S1)

SYLLABUS for M. Sc. CHEMISTRY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.

The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

Scheme of teaching and examination under semester pattern Choice Based Credit System **(**CBCS**)** for M.Sc. Program in Chemistry

M. Sc. Chemistry Semester I												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
		Th	Pract	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
							External Marks	Internal Ass		Th	Pract
(1T1**)**	Paper 1: Inorganic Chemistry	4	-	4	4	3	80	20	100	40	
(1T2**)**	Paper 2: Organic Chemistry	4	-	4	4	3	80	20	100	40	
(1T3**)**	Paper 3: Physical Chemistry	4	-	4	4	3	80	20	100	40	
(1T4**)**	Paper 4: Analytical Chemistry	4	-	4	4	3	80	20	100	40	
Pract. **(**1P1**)**	Practical 1: Inorganic Chemistry	-	8	8	4	3-8*	100**	-	100		40
Pract. **(**1P3**)**	Practical 2: Physical Chemistry	-	8	8	4	3-8*	100**	-	100		40
Seminar 1 **(**1S1**)**	Seminar 1	2	-	2	1			25	25	10	
	TOTAL	18	16	34	25		520	105	625	170	80

M. Sc. Chemistry Semester II												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks		
		Th	Pract	Total			External Marks	Internal Ass		Th	Pract	
(2T1)	Paper 5: Inorganic Chemistry	4	-	4	4	3	80	20	100	40		
(2T2)	Paper 6: Organic Chemistry	4	-	4	4	3	80	20	100	40		
(2T3)	Paper 7: Physical Chemistry	4	-	4	4	3	80	20	100	40		
(2T4)	Paper 8: Analytical Chemistry	4	-	4	4	3	80	20	100	40		
Pract. (2P2)	Practical 3: Organic Chemistry	-	8	8	4	3-8*	100**	-	100		40	
Pract. (2P4)	Practical 4: Analytical Chemistry	-	8	8	4	3-8*	100**	-	100		40	
Seminar 2 (2S1)	Seminar 2	2	-	2	1			25	25	10		
	TOTAL	18	16	34	25		520	105	625	170	80	

M. Sc. Chemistry Semester III												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
		Th	Pract	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
							External Marks	Internal Ass		Th	Pract
(3T1)	Paper 9: Special – I (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
(3T2)	Paper 10: Special – II (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
Elective 1 (3T3)	Paper 11: A) NuclearChemistry I (3T3A) ORB) Environmental Chemistry I (3T3B) ORC) Polymer Chemistry I(3T3C) ORD) Medicinal Chemisrty I(3T3D)	4	-	4	4	3	80	20	100	40	
Foundation Course 1 / Core Subject Centric 1 (3T4)	Paper 12: Applied AnalyticalChemistry-I / Spectroscopy I	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10 (3P1)	Practical 5: Special (Inorganic/ Organic / Physical / Analytical) Chemistry	-	8	8	4	3-8*	100**	-	100		40
Pract. Core Elective 1 (3P3)	Practical 6: A) Nuclear Chemistry I ORB) Environmental Chemistry I ORC) Polymer Chemistry I ORD) Medicinal Chemisrty I	-	8	8	4	3-8*	100**	-	100		40
Seminar 3 (3S1)	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	18	16	34	25		520	105	625	170	80

M. Sc. Chemistry Semester IV				
Code	Theory / Practical	Teaching scheme	Credits	Examination Scheme

		(Hours / Week)									
		Th	Pract	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
							External Marks	Internal Ass		Th	Pract
(4T1)	Paper 13: Special – I (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
(4T2)	Paper 14: Special – II (Inorganic/ Organic / Physical / Analytical) Chemistry	4	-	4	4	3	80	20	100	40	
Elective 2 (4T3)	Paper 15: A) Nuclear Chemistry II ORB) Environmental Chemistry II ORC) Polymer Chemistry II ORD) Medicinal Chemisrty II	4	-	4	4	3	80	20	100	40	
Foundation Course 2 / Subject Centric 2 (4T4)	Paper 16: Applied Analytical Chemistry II / Spectroscopy II	4	-	4	4	3	80	20	100	40	
Pract. (4P1)	Practical 7: Special (Inorganic/ Organic / Physical / Analytical) Chemistry	-	8	8	4	3-8*	100**	-	100		40
Project (4PROJ1)	Project	-	8	8	4	3-8*	100**	-	100		40
Seminar 4 (4S1)	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	18	16	34	25		520	105	625	170	80

NOTE Sem III & IV:

Foundation Course: Candidate can opt for any one foundation course paper in the semester III and IV. However, Student shall opt for this paper from any other subject other than his / her main subject for postgraduation. If the candidate decides to opt for foundation course papers then he/she shall not be eligible to opt for Core (Subject Centric) papers in their respective subjects.

Core (Subject Centric): Candidate can opt for this paper as shown in the semester III and IV in their main subject of postgraduation only. If the candidate decides to opt for Core (Subject Centric) papers in their main subject of

postgraduation then he**/**she shall not be eligible to opt for foundation course papers neither in their own subject nor in any other subject**).**

- General Scheme for Distribution of Marks in Practical Examination in Chemistry
  Time:8-9h (One day Examination) Marks:100

Exercise-1	- 30 Marks	- Evaluated jointly by Internal and External Examiner
Exercise-2	- 30 Marks	- Evaluated jointly by Internal and External Examiner
Record	-20 Marks	- Evaluated by Internal
Viva-Voce	-20 Marks	- Evaluated by External
Total	**-** 100 Marks	

- General Scheme for Distribution of Marks in Project Examination in Chemisrty
  The project work will carry total 100 marks and will be evaluated by both external and internal examiners in the respective Department / Center/ Affiliated College.
  The examiners will evaluate the experimental project work taking into account the coverage of subject matter, presentation, references etc.

For written Project work	- 40 Marks	-	Evaluated jointly by External and Internal
For Presentation	- 20 Marks	-	Evaluated jointly by External and Internal
ForViva-Voce	- 20 Marks	-	Evaluated by External Examiner
Internal Assessment	- 20 Marks	-	Evaluated by Internal Examiner
Total	**-** 100 Marks		

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SYLLABUS for M. Sc. CHEMISTRY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2015-2016

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Semester I
Paper – I (Code: 1T1)
Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 5h

A) Stereochemistry and Bonding in Main Group Compound:VSEPER-Shape of simple inorganic molecules and ions containing lone pairs, various stereo chemical rules and resultant geometry of the compounds of non-transitional elements, short coming of VSEPR model. Bent's rule and energetics of hybridization.

B) Metal – Ligand Bonding: 10h

Crystal Field Theory: Splitting of d-orbital in tetragonal, square planar and trigonal bipyramidcomplexes. John teller effect, spectrochemical series, nephelauxetic effect. Limitaion of crystal field theory. M.O.Theory for octahedral, tetrahedral & square planar complexes with and without π-bonding.

Unit-II

A) Metal – Ligand Equilibria in Solution: 5h

Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodyanamic origin. Determination of formation constant by :

(1) spectrophotometric method (Job's and Mole ratio method)

(2) Potentiometric method (Irving-Rossotti Method)

B) Reaction Mechanism of Transition metal complexes: 10h

Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution: Acid hydrolysis, factors affecting acid hydrolysis, Stereochmistry of intermidiates in SN^1& SN^2 , Base hydrolysis, Conjugate base mechanism, Direct and indirect evidences in favour of conjugate mechanism, Annation reaction, reaction without metal-ligand bond breaking.

Unit-III: Cluster- I 15h

Boron hydrides: Classification, nomenclature, structure, bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for higher boranes and their utilities. Chemistry of diboranes: Study of Metalloboranes, Carboranes and Metallocarboranes with reference to preparations and structures.

Unit – IV: Cluster-2

A) Metal-Metal bonds: 10h

Occurrence of metal-metal bond, Classification of metal clusters, Binuclear, trinuclear, tetranuclear, pentanuclear and hexanuclear with reference to halide, oxide, alkoxide and acetate clusters.

B) Isopoly, Heteropoly acids and their anions. 5h

List of Books

1) S. F. A. Kettle, J. N. Murral and S. T. Teddler: Valency Theory
2) C. A. Coulson: Valency

3) J. E. Huheey :Inorganic Chemistry
4) F .A. Cottonand G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5thand 6th Editions.
5) A. F. Willims: Theoretical Approach in inorganic chemistry.
6) A. Mannas Chanda: Atomic Structure and chemical Bonding
7) L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
8) J. J. Logowski: Modern Inorganic Chemistry
9) B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
10) J. C. Bailar: Chemistry of coordination compounds.
11) W. L. Jolly: Modern Inorganic Chemistry
12) R. S. Drago: Physical methods in inorganic chemistry.
13) Waddington: Nonaqueous solvents.
14) Sisler: Chemistry of nonaqueous solvents.
15) A. K. Barnard: Therotical Inorganic Chemistry
16) Emeleus and Sharpe: Modern Aspect of Inorganic Chemistry.
17) F. A. Cotton: Chemical Applications of Group theory.
18) Jones: Elementary Coordination chemistry.
19) B. N. Figgis: Introduction to Ligand field.
20) S. F. A. Kettle: Coordination chemistry.
21) M.C.Day and J.Selbin: Theoretical Inorganic Chemistry.
22) J. Lewin and Wilkins: Modern Coordination Chemistry.
23) Gowarikar, Vishwanathan and Sheedar: Polymer science.
24) H. H. Jattey and M. Orchin: Symmetry in chemistry.
25) D. Schonaland: Molecular Symmetry in chemistry.
26) L. H. Hall: Group theory and Symmetry in chemistry
27) H. H. Jattey and M. Orchin: Symmetry in chemistry
28) R.L.Dutta and A.Symal: Elements of magneto chemistry
29) Inorganic Chemistry 4th Edition, P.Atkins, Oxford University Press.
30) Essential Trends in Inorganic Chemistry, D.M.P.Mingos, Oxford University Press.

Semester I

Paper II (Code: 1T2)

Organic Chemistry

60 h (4 h per week): 15 h per unit — 80 Marks

Unit-I: 15 h

A] Nature and Bonding in Organic Molecule**:**Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyper-conjugation, bonding in fullerenes. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons Huckel's rule, energy level of π-molecules orbitals, annulenes, antiaromaticity, homo-aromoaticity. Aromatic character and chemistry of cyclopentadienyl anion, tropylium cation, tropone and tropolone. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes

B] Reactive Intermediates**:** Generation, structure, stability and chemical reactions involving carbocations, carbanions, free radical, carbenes, and nitrenes

Unit-II: 15 h

Streochemistry**:** Conformational analysis of cycloalkanes **(**5**-**8 membered rings**)**, substituted cyclohexanes, mono substituted, disubstituted and trisubstituted cyclohexanes, decalines, effect of conformation on reactivity, Cahn**-**Ingold**-**Prelog System to describe configuration at chiral centers**.** Elements of symmetry, chirality, molecules with more than one chiral center, meso compounds, threo and erythro isomers, method of resolution, optical purity, enantiotopic and distereotopic atoms, groups and faces, prochirality, addition**-**elimination reactions, stereospecific and

steroselective synthesis**.** Asymmetrical synthesis, optical activity in absence of chiral carbon **(**biphenyl and allenes**)**

Unit**-**III**:** 15 h

A**]** Reaction mechanism**:** Structure and Reactivity**:** Types of mechanism, Types of reaction, thermodynamics and kinetics requirements, kinetic and thermodynamic control, Hammond**'**s postulate, Curtin**-**Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects, Hard and soft acids and bases**.**

B**]** Aliphatic nucleophilic substitution**:** The SN^1, SN^2, mixed SN^1, SN^2 and SET and SN_i mechanisms**.** Nucleophilicty, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, phase transfer catalysis

C**]** Concept of neighboring group participation Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen**.** Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migartory aptitude, carbocation rearrangements and related rearrangements in neighboring group participation**.**

Unit IV**:** 15h

A**]** Aromatic Nucleophilic Substitution

A general introduction to different mechanisms of aromatic nucleophilic substitution S_NAr, SN^1, benzyne and $S_{RN}1$ mechanisms, arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter, Sommlet-Hauser and Smiles rearrangements.

B**]** Aromatic electrophilic substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituents, orientation in other ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Reimer-Tieman reaction, Diazonium coupling.

C**]** Effect of Structure on reactivity**:** Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft Equation.

List of books

1] Advanced Organic Chemistry –Reaction mechanism and structure. Jerry March, John Wiley
2] Advanced Organic Chemistry- F.A. Carey and R. J. Sunberg, Plenum
3] A Guidebook to Mechanism in Organic Chemistry-Peter Skyes, Longman
4] Structure and Mechanism in Organic Chemistry-C.K. Gold, Cornell University Press
5] Organic Chemistry, R.T. Morrison Boyd. Prentice Hall
6] Modern Organic Chemistry-H.O. House, Benjamin
7] Principal of Organic Chemistry-R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional
8] Reaction Mechanism in Organic Chemistry-S.M. Mukharji and S.P. Singh, Macmilan
9] Stereochemistry of Organic Compounds- D. Nasipuri, New Age International
10] Stereochemistry of Organic Compounds- P. S. Kalsi, New Age International
11] Frontier Orbitals and Organic Chemical Reactions-I. Fleming
12] Orbital Symmetry – R. E. Lehr and A. P. Marchand
13] Reactive Intermediate in Organic Chemistry-N. S. Isaacs
14] Stereochemistry of Carbon Compounds- E. L. Eliel
15] Physical Organic Chemistry-J. Hine
16] Name Reaction in Organic chemistry –Surrey
17] Advanced Organic Chemistry – L. F. Fieser and M. Fieser.
18] Organic Chemistry Vol. I and II - I. L. Finar
19] Modern Organic Chemistry- J.D. Roberts and M. C. Caserio
20] The Search for Organic Reaction Pathways (Longmann), Peter Skyes

21] Organic Chemistry 5th Edition (McGraw Hill), S. H. Pine
22] Organic Chemistry (Willard Grant Press Botcon), John Mcmurry
23] A Textbook of Organic Chemistry- R. K. Bansal New Age International
24] New Trends in Green Chemistry –V. K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
25] Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford University Press
26] Organic Chemistry, 4th Edition, G Marc Loudon, Oxford University Press

Semester I
Paper III (Code: 1T3)
Physical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT I: CLASSICAL THEMODYNAMICS 15h

A] Recapitulation of Laws of thermodynamics, Exact and inexact differentials, condition of exactness, Ptaff differential expression and equations, Applications of Ptaff differential equations to first and second law of thermodynamics, Carathéodory's principle and its equivalence to the Kelvin Plank and Clausius statement of the Second law of Thermodynamics, Homogeneous functions of degree 0 and 1, extensive and intensive properties, derivation of thermodynamic equations of state, Maxwell's relations.

B] Third law of thermodynamics, Nernst Heat Theorem, unattainability of absolute zero, calculation of entropy based on third law of thermodynamics, residual entropy and its application. Virial equation of state.

UNIT II: GIBBS FUNCTION AND PHASE EQUILIBRIA 15h

A] Partial molar quantities: Determination of partial molar quantities, chemical potential, partial molar volume, Gibbs Duhem equation, Gibbs Duhem Mergules equation, Extent of advancement of reaction (ξ), thermodynamic criteria of chemical equilibrium.

B] Gibbs Phase rule and its derivation, calculation of degrees of freedom, reduced phase rule, construction of phase diagram, one component systems (Helium, carbon), 1st and 2nd order phase transition, lambda line, two component systems forming solid solutions having congruent and incongruent melting point, partially miscible solid phase, three component systems, graphical presentation, influence of temperature, systems with 1, 2, 3 pairs of partially miscible liquids, transition points.

UNIT III: SURFACE PHENOMENA AND MACROMOLECULES 15h

A] Recapitulation of Surface tension, Adsorption: Freundlich adsorption isotherm, Langmuir theory, Gibbs adsorption isotherm, BET theory and estimation of surface area, enthalpy and entropy of adsorption. Surface film on liquids and catalytic activity, Electro-kinetic phenomena, Surface active agents, hydrophobic interactions, micellization, Critical Micelle Concentration (CMC), mass action model and phase separation model of micelle formation, shape and structure of micelles, factors affecting CMC, micro-emulsion and reverse micelles.

B] Macromolecules: Definitions, Number and mass average molecular weights, molecular mass determination by Osmometry, Viscometry, Sedimentation, Diffusion, light scattering method, Numerical.

UNIT IV: CHEMICAL KINETICS 15h

A] Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations, Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates.

B] Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions: Lindeman-Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation.

List of books

1. R. P. Rastogi and R. R. Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010.
2. P. W. Atkins and D. Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010.
3. E. N. Yenemin, Fundamentals of Chemical Thermodynamics, MIR, Publications.
4. G. K. Vemulapalli, Physical Chemistry, Prentice – Hall of India, 1997.
5. S. Glasstone andDe Van No Strand, Thermodynamics for Chemists, 1965.
6. S. M. Blinder, Advanced Physical Chemistry,
7. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
8. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
9. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
10. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
11. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
12. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York.
13. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan IndianLtd., New Delhi (1993)
14. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 1., Elsevier Publications, New York, 1969.
15. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 2., Elsevier Publications, New York, 1969.
16. S. Glasstone, K. J. Laidler and H. Eyring, The Theory of Rate Processes, Mc-Graw Hill, New York, 1941.
17. A. Findley, The Phase Rule and its Applications, Longmans Green and Co., Mumbai.
18. K. S. Birdi, Surface Chemistry Essentials, CRC Press, New York, 2014.
19. Eric Keightley Rideal, An Introduction to Surface Chemistry, Cambridge University Press, 1926.
20. D. M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, NewYork, 1984.
21. A. W. Adamson, A. P. Gasi, Physical Chemistry of Surfaces, Wiley, 2007.
22. P. C. Hiemenz and R. Rajagopalan, Principles of Colloid and Surface Chemistry, CRC Taylor and Fransis, 2007.
23. P. D. Hede and S. P. Beier, Inorganic and Applied Chemistry, e-Book, 2007.
24. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
25. E.M. Mc Cash, *Surface Chemistry*, Oxford University Press, Oxford (2001).
26. G. K. Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill, 1990.
27. N. B. Singh, N. S. Gajbhiye, S. S. Das, Comprehensive Physical Chemistry, New Age International, 2014.
28. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

Semester I

Paper IV (Code: 1T4)

Analytical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Introduction and statistical analysis 15h

Introduction to analytical chemistry: Types of analysis-qualitative and quantitative. Classification of analytical methods- classical and instrumental, basis of their classification with examples.

Statistical analysis and validation: Errors in chemical analysis. Classification of errors-systematic and random, additive and proportional, absolute and relative. Accuracy and precision. Mean, median, average deviation and standard deviation. Significant figures and rules to determine significant figures. Calculations involving significant figures. Confidence limit, correlation coefficient and regression analysis. Comparison of methods: F-test and T-test. Rejection of data based on Q-test. Least squares method for deriving calibration graph. Application of Microsoft

Excel in statistical analysis (statistical functions and spreadsheets in MS-Excel). Validation of newly developed analytical method. Certified reference materials (CRMs). Numerical problems.

Unit II: Separation techniques 15h

*Chromatography:*Definition and Classification. Techniques used in Paper, Thin Layer and Column chromatography. Applications in qualitative and quantitative analysis.

*Ion exchange:*Principle and technique. Types of ion exchangers. Ion exchange equilibria. Ion exchange capacity. Effect of complexing ions. Zeolites as ion-exchangers. Applications.

*Solvent extraction:*Principle and techniques. Distribution ratio and distribution coefficient. Factors affecting extraction efficiency: Ion association complexes, chelation, synergistic extraction, pH. Numericals based on multiple extractions. Role of chelating ligands, crown ethers, calixarenes and cryptands in solvent extraction. Introduction to Solid phase extraction (SPE) and Microwave assisted extraction (MAE), Applications.

Unit III: Classical methods of analysis 15h

Volumetric analysis: General principle. Criteria for reactions used in titrations. Primary standards and secondary standards. Theory of indicators. Types of titrations with examples- Acid-base, precipitation, redox and complexometric. Titration curves for monoprotic and polyprotic acids and bases. Indicators used in various types of titrations. Masking and demasking agents.

Gravimetric analysis: General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibria. Steps involved in gravimetric analysis. Purity of precipitate: Co-precipitation and post-precipitation. Fractional precipitation. Precipitation from homogeneous solution. Particle size, crystal growth, colloidal state, aging and peptization phenomena. Ignition of precipitates.

Unit IV: Electrochemical methods of analysis-I 15h

Conductometry: Concepts of electrical resistance, conductance, resistivity and conductivity. Specific, molar and equivalent conductance and effect of dilution on them. Measurement of conductance. Kohlrausch's law, Applications of conductometry in determination of dissociation constant, solubility product. Conductometric titrations. High frequency titrations. Numerical problems.

Potentiometry: Circuit diagram of simple potentiometer. Indicator electrodes: hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode. Reference electrodes: Calomel electrode and Ag/AgCl electrode. Theory of potentiometric titrations. Acid-base, redox, precipitation and complexometric titrations. Nernst equation, standard electrode potential, Determination of cell potential, n, K_f and K_{sp}. pH titrations. Buffers and buffer capacity. pH of buffer mixtures based on Henderson-Hasselbalch equation.

List of books:

1. Quantitative analysis: Day and Underwood (Prentice-Hall of India)
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry: Gary D. Christian (Wiley, India).
4. Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
6. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
7. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
8. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
9. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
10. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
11. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
12. Fundamentals of Analytical Chemistry: S. A. Skoog and D. W. West
13. Instrumental Methods of Chemical Analysis: G. W. Ewing

Semester I
Practical-I (Code: 1P1)

Inorganic Chemistry

12 h /week Marks:100

I. Preparation of Inorganic Complexes and their characterization by:

Elemental analysis and physico-chemical methods (Electronic and IR Spectra, magnetic susceptibility measurements, Thermal analysis and Molar conductance studies).

1. K_3 [Al $(C_2O_4)_3$]$(H_2O)_3$ 2. [VO (acac) $_2$] 3. Na [Cr $(NH_3)_2(SCN)_4$]
4. $K_3[Cr(SCN)_6]$. 5. [Mn (acac) $_3$] 6. K_3 [Fe $(C_2O_4)_3$]
7. Hg [Co (SCN) $_4$] 8. [Co (Py) $_2$ Cl_2] 9. [Cu_2 $(CH_3COO)_4(H_2O)_2$]
10. [Ni (DMG) $_2$] 11.$[Ni(NH_3)_6]Cl_2$ 12. $[Cu(NH_3)_4(H_2O)_2]SO_4$

II. Quantitative Analysis:

Separation and determination of two metal ions from the following alloys involving:
Volumetric, Gravimetric and Spectrophotometric methods

i) Copper (II) and Nickel (II)
ii) Copper (II) and Zinc (II)
iii) Nickel (II)—Zinc (II) and
iv) Copper (II)—Iron (III)

III. Qualitative analysis of radicals:

Semi-micro Analysis of inorganic mixture containing four cations out of which two will be rare metal ions such as W, Mo,Se,Ti,Zr,Ce,Th,V and U.(Spot Test for individual cations should be performed)

Semester I

Practical-II (Code: 1P3)

Physical Chemistry

12 h /week Marks: 100

It is expected to perform minimum 14 experiments in a semester.

1. To study the variation of volume contraction with mole fraction of alcohol in alcohol -water system
2. To determine the activation parameters of viscous flow for a given liquid.
3. To Determine the critical micelle concentration (CMC) of a given surfactant / soap / shampoo by surface tension measurements.
4. Determination of molecular mass of a polymer by viscometry method.
5. To determine integral heat of KNO_3, at two different conc. and calculation of heat of dilution.
6. Effect of 1% NaCl, 1% succinic acid, 0.5% naphthalene on CST in phenol-water systems.
7. Distribution of succinic acid in H_2O- benzene, H_2O-ether and comparison of distribution coefficient.
8. To construct the phase diagrams of two components system (phenol- urea, diphenyl aminebenzophenone; a-naphtyl amine-phenol) forming compounds with congruent melting points.
9. To study the mutual solubility of glycerol-m-toluidine and to determine congruent points.
10. To study kinetics of hydrolysis of an ester by NaOH reaction.
11. To determine equilibrium constant of the equation $KI+I_2=KI_3$ by distribution method.
12. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
13. Determination of order of reaction of oxidation of ethyl alcohol by acid dichromate.
14. To titrate conductometrically monobasic and dibasic acids with NaOH and determine the strength of given acid.
15. To determine equivalent conductance of weak electrolyte at infinite dilution by kaulrausch's method.
16. Determination of heat of reaction, entropy change and equilibrium constant of the reaction between metallic zinc and Cu^{+2} ions in solution.
17. Determination of thermodynamic constants G, H, S for $Zn^{+2}+H_2SO_4 \rightarrow ZnSO_4+ 2H^+$ by emf measurement.

18. Titration of Ferrous Ammonium Sulphate against ceric sulphate and hence the formal redox potential of $Fe^{2+} \rightleftharpoons Fe^{3+}$ and $Ce^{3+} \rightleftharpoons Ce^{4+}$ systems.
19. To determine the pH of a buffer solutions using a quinhydrone electrode
20. Complexometric titrations (EDTA based)

List of Books

1. Vogel A,IIIrd Edition : A Textbook Of Quantitative Inorganic Analysis, Longman
2. J. B. Yadav, Practical Physical Chemistry
3. Das and Behra, Practical Physical Chemistry
4. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
5. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
6. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
7. Day And Underwood :Quantitative Analysis
8. Merits And Thomas:Advanced Analytical Chemistry
9. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
10. Drago, R.S:Physical Methoods In Inorganic Chemistry
11. Christain G.D:Analytical Chemistry
12. Khopkar S.M.:Basic Concept of Analytical Chemistry
13. Koltath And Ligane:Polorography
14. Braun:Instrumental Methods of Chemical Analysis
15. Willard, Merritt And Dean: Instrumental Methods of Chemical Analysis ,Van Nostrand
16. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
17. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
18. Dilts R.V.: Analytiacl Chemistry
19. Jahgirdar D.V :Experiments In Chemistry
20. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
21. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
22. Akjmetov, N :General And Inorganic Chemistry

Semester I

Seminar-I (Code: 1S1)

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25marks (1credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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M.Sc. Chemistry
Semester II
Paper V (Code: 2T1)
Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

A) Electronic spectra of Transition Metal complexes 10h

Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule, Hole Formulation, Derivation of the term symbol for a d^2 configuration, Electronic spectra of transition metal complexes – Laporte 'orbital' selection rule,spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10Dq, B, β parameters.Tanabe- Sugano Diagrams of octahedral complexes with d^2& d^8 configuration.

B) Magnetic Properties of Transition Metal complexes 5h

Abnormal magnetic properties, orbital contributions and quenching of orbital angular momentum, spin-orbit coupling. Magnetic moment, electronic spectra and structure of tetrahalocobalt(II) complexes, tetrahedral and octahedral Ni(II) complexes. High spin-low spins crossover.

Unit – II 15h

Reaction mechanism of Transition Metal Complexres-II: Substitution reaction in square planer complexes: the trans effect, cis effect, steric effect, solvent effect, effect of leaving group, effect of charge, effect of nucleophile, effect oftemperature. Trans effect theories, uses of trans-effect, mechanism of substitution reactions in Pt(II) complexes.Electron transfer reactions. Types of electron transferreactions, conditions of electron transfer, and mechanism of one-electron transfer reactions, outer sphere and inner sphere mechanisms, two electron transfer reactions complimentary and non-complimentary reactions. Tunneling effect, cross-reaction, Marcus-Hush theory, bridged activated mechanism.

Unit-III: Metal pi-Complexes - I 15h

Metal carbonyls: Structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls.Metal carbonyl clusters with reference to classification, EAN rule, synthesis and structures.

Unit – IV: Metal pi-Complexes – II 15h

Metal nitrosyls: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structureelucidation, important reactions of transition metal nitrosyls, structure and bonding. Dinitrogen and dioxygen complexes. Wilkinson's catalyst and Vaska's compound.

List of Books

1. J.E.Huheey :Inorganic Chemistry
2. F.A.Cottonand G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th and 6th Editions.
3. A.F. Willims: Theoretical Approach in inorganic chemistry.
4. Mannas Chanda: Atomic Structure and chemical Bonding
5. L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
6. J. J. Logowski: Modern Inorganic Chemistry
7. B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
8. J C. Bailar: Chemistry of coordination compounds.
9. W. L. Jolly: Modern Inorganic ChemistryJones: Elementry Coordination chemistry.
10. B. N. Figgis: Introduction to Ligand field.
11. M.C.Day and J.Selbin: Therotical Inorganic Chemistry.
12. J. Lewin and Wilkins: Modern Co-ordination chemistry.
13. Purcell and Kotz: Inorganic Chemistry.

14. D. Banerjea: Co-ordination chemistry, Tata Mc. Graw. Pub.
15. A.F. Wells: Structural inorganic chemistry, 5th Edition, Oxford.
16. S. G. Davies: Organotransition metal chemistry applications to organic synthesis.
17. R. C. Mehrotra: Organometallic chemistry Tata McGraw Hill. Pub.
18. G. S. Manku: Thereotical priciples of inorganic chemistry
19. A. B. P. Lever: Inorganic electronic spectroscopy.
20. R.C.Maurya:Synthesis and charecterisation of novel nitrosyls compounds, Pioneer Pub. Jabalpur2000.
21. R.H.Crabtree:The Organometalic chemistry of Transition metals, John Wiley.
22. D.N.Styanaryan:Electronic Absorption Spectroscopy and related techniques, University Press.
23. R. S. Drago: Physical methods in inorganic chemistry
24. F.Basolo andG.Pearson: Inorganic Reaction Mechanism
25. Organometallics II and I complexes with transition metal- carbon bonds: Manfred Bochmann- Oxford Press.
26. Advanced Inorganic Chemistry Vol I and II – Satyaprakash, Tuli, Bassu and Madan- S Chand.
27. M.Tsusui,M.Nlevy,M.Ichikwa and K.Mori:Introduction to metal pi-complexe chemistry,Plenum press,NY
28. A.E.Martel;Coordination Chemistry-VolIandII,VNR.

Semester II

Paper VI (Code: 2T2)

Organic Chemistry

2T2

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 15 h

A] Addition to carbon-carbon multiple bond: Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry, Addition to cyclopropanes, Hydrogenation of double bond and triple bonds. Hydrogenation of aromatic rings, hydroboration, Michael reaction, Robinson annulation

B] Addition to carbon-hetero atom multiple bond: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles, Addition of Grignard reagents, organozinc and organolithium reagents to carbonyls and unsaturated carbonyl compounds, Wittig reaction, Mechanisms of condensation reactions involving enolates- Aldol, Knoevengel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction, Hydrolysis of esters and amide.

Unit-II 15 h

A] Mechanism of molecular rearrangement: Classification and General mechanistic treatment of electrophilic, nucleophilic and free radical moleculer rearrangement. Mechanism of the following rearrangement –Wagner-Meerwin, Pinacol-Pinacolone, Tiffenev –Demjnov ring expansion, benzil-benzilic acid, Favorski, Wolff, Arndt-Eistert synthesis, Curtius Lossen, Beckman, Hoffman, Schmidt rearrangement.

B] Elimination reactions: The E_1, E_2 and E_1CB mechanisms and orientation of the double bond, Saytzeff and Hoffman's rule, Effect of substrate structure, attacking base, leaving group and medium, Mechanism and orientation in pyrolytic elimination

UNIT-III

Free radical reactions: Generation of free radicals, Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, aliphatic substrate, reactivity at a bridgehead position. Neighbouring group assistance, reactivity for aliphatic and aromatic substrates, reactivity in attacking radicals, effect of solvent on reactivity.Halogenation at an alkyl carbon, allylic carbon (NBS), hydroxylation at an aromatic carbon by means of Fenton's reagent. Auto-oxidation,

chlorosulphonation (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Free radical rearrangement, Hunsdiecker reaction, iododecarboxylation, Barton reaction, Hoffmann-Loefler-Freytag reaction

Unit IV: Green chemistry 15 h

Green chemistry: Basic principles of green chemistry, calculation of atom economy of rearrangements, addition, substitution and elimination reaction with suitable examples, Case study of Bhopal gas tragedy and Seveso disaster, Synthesis involving basic principles of green chemistry-paracetamol, Ibuprofen, hydroquinone, adipic acid, ε-caprolactum, styrene, urethanes, Free radical bromination, Multi-component reactions (Biginelli, Ugi and Passerini reaction), Prevention or minimization of hazardous products, choice of solvents. Sonochemistry, microvave induced reactions, polymer supported reagents, reactions in aqueous medium, zeolites and ionic liquid supported reaction, Solvent free reactions, electrochemical reactions, Biocatalysts in Organic synthesis.

List of books

1] Books as Suggested in Semester I for Organic Chemistry
2] A Textbook of organic chemistry- R.K. Bansal
3] New trends in green chemistry –V.K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
4] Heterocyclic Chemistry, John Joule, Oxford University Press
5] Books as Suggested in Semester I for Organic Chemistry
6] A Textbook of organic chemistry- R.K. Bansal
7] New trends in green chemistry –V.K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
8] Heterocyclic Chemistry, John Joule, Oxford University Press

Semester II

Paper VII (Code: 2T3)

Physical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT I: FORMULATION OF QUANTUM MECHANICS

15h

A] Introduction of Quantum Mechanics, Wave Function, Acceptability of Wave Functions, Normalized and Orthogonal Wave Functions, Operators, Operator Algebra, Eigen Functions and Eigen Values of Quantum Mechanical Properties (e.g. Linear, Angular momentum, etc.), Hermitian Operators, Orbital and generalized Angular Momentum, Postulates of Quantum Mechanics, Problems on Operator algebra, Eigen Values and Average Values of quantities.

B] Application of Schrödinger Wave Equation to Simple Systems: Degeneracy in 3-Dimensional Box, Rigid Rotor, Potential Well of Finite Depth (Tunneling Effect), Simple Harmonic Oscillator, The Hydrogen Atom.

UNIT II: THERMODYNAMICS

15h

A] Ideal and Non-ideal Systems: Concept of fugacity, determination of fugacity, excess functions for non ideal solutions, Entropy of mixing, Enthalpy of mixing, Activity and activity coefficients, Concept of ion atmosphere and electrophoretic effect, Debye Hückel theory for activity coefficients of electrolytic solutions, determination of activity and activity coefficients, ionic strength and dependence of activity coefficients on ionic strength, numericals.

B] Nonequilibrium Thermodynamics: Conservation of mass and energy in time dependent closed and open systems, Thermodynamic criteria of irreversibility, rate of entropy production and entropy exchange in irreversible processes. The generation of the concept of Chemical Affinity and the

extent of advancement of chemical reactions, Thermodynamic constraints on the signs of chemical affinity and the velocity of chemical reaction, application to any one coupled reaction.

UNIT III: SOLID STATE CHEMISTRY 15h

A] Introduction to crystals, Unit Cell and lattice parameters, Symmetry elements in crystals, Absence of fivefold axis, Space groups, The Bravais Lattices, Miller Indices, Bragg's Equation, seven crystal system, Packing in crystals, Hexagonal Closest Packing (HCP) Cubic Closest Packing (CCP), Voids, packing fraction, Numericals.

B] Crystal Defects and Non-stiochiometry: Perfect and imperfect crystals, point defects, line and plane defects. Thermodynamics of Schottky and Frenkel defect formation, colour centers, non-stiochiometry and defects.

UNIT IV: STATISTICAL THERMODYNAMICS AND NUCLEAR CHEMISTRY 15h

A] Statistical thermodynamics: Lagrange's Method of Undetermined Multipliers (Conditional Maximization), Stirling Approximation, Concept of Distribution, Thermodynamic Probability and most probable distribution, Maxwell Boltzmann, Bose Einestein, Fermi Dirac statistics, comparison between three statistics.

B] Nuclear Chemistry: Introduction, radioactive decay and equilibrium, thermonuclear reactions, photonuclear reactions, Radiometric titration, isotopic dilution analysis, NAA. Counters: Proportional counter, GM counter, Scintillation counter, Ionization chamber counter.

List of books

1. Ira .N. Levine, Quantum Chemistry, 5th edition(2000), Pearson educ., Inc.New Delhi
2. A.K.Chandra, Introductory Quantum Chemistry, 4th edition (1994), Tata Mcgraw Hill, New Delhi.
3. M.W.Hanna, " Quantum Mechanics in Chemistry", Benjamin
4. L. Pualing and E. B. Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York (1935).
5. R. K. Prasad, Quantum Chemistry, New Age International, Delhi.
6. R. K. Prasad, Quantum Chemistry through problems and solutions, New Age International, New Delhi, 2009.
7. B. C. Reed, Quantum Mechanics, Jones and Bartlett, New Delhi, 2010.
8. R. P. Rastogi and R. R. Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010.
9. P. W. Atkins'and D. Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010.
10. G. K. Vemulapalli, Physical Chemistry, Prentice – Hall of India, 1997.
11. S. Glasstone, An Introduction to Electrochemistry, East-West Press Pvt. Ltd., New Delhi, 2004.
12. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
13. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
14. N. B. Hanny, Treaties in Solid State Chemistry,
15. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
16. I Prigogine and R. Defay, Chemical Thermodynamics, Longmans, London, 1954.
17. S. R. DeGroot and P. Mazoor, Non-Equilibrium Thermodynamics, North-Holland Co., Amsterdam, 1969.
18. G. Lebon, D. Jou and Casa Vazquez, Understanding Non-equilibrium Thermodynamics, Springer, 2008.
19. I.Prigoggine, "An Introduction to Thermodynamics of Irreversible Processes," Wiley-Interscience.
20. R. P. Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.
21. G. A. Somorjai, Introduction to Surface Chemistry and Catalysis, Wiley, 2010.
22. M. C. Gupta, Statistical Thermodynamics, New Age International.
23. K. Huang, Statistical Mechanics, Wiley, New Delhi, 2003.
24. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
25. C.N.Rao. Nuclear Chemistry

26. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
27. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.
28. C.Kittel, " Introduction to solid state Physics",Wiley
29. L.V.Azaroff, " Introduction to solids", McGraw Hill
30. L. E. Smart and E. A. Moore, Solid State Chemistry-An Introduction, CRC Tylor and Fransis, 2005.
31. D. D. Sood, A. V. R. Reddy, Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, 2007.
32. C. N. R. Rao and Gopalakrishnan, "New Directions in Solid State Chemistry " Second Edition, Cambridge University Press.
33. Anthony R. West, "Solid State Chemistry and its Applications" Wiley India Edition.
34. C. Kalidas and M. V. Sangaranarayana, Non-Equilibrium Thermodynamics.
35. D. K. Chakravorty, Solid State, New Age International.

Semester II

Paper VIII (Code: 2T4)

Analytical Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Sampling and quantification 15h

A] *Sampling and sample treatment*: Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals.Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples.

B] *Detection and quantification*: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques.Units in chemical analysis and their interconversion.

C] *Stoichiometry:* Stoichiometric and sub-stoichiometric reactions and calculations.

Unit-II: Modern separation techniques 15h

A] *Gas Chromatography*: Principle including concept of theoretical plates and van-Deemter equation. Instrumental set up- carrier gas, sampling system, column and detector. Types of columns, their advantages and limitations. Detectors in GC analysis. Temperature programmed GC. Factors affecting retention, peak resolution and peak broadening.

B] *Liquid chromatography*: Principle, Instrumentation, Advantages and applications of HPLC. Types of columns and detectors. Principle and applications of size exclusion, gel permeation, ion retardation, normal phase and reverse phase chromatography.

C] *Supercritical fluid chromatography*: Introduction and applications.

Unit III: Optical methods of analysis-I 15h

A] Spectrophotometry and Colorimetry: Principle of colorimetry. Beer's law, its verification and deviations. Instrumentation in colorimetry and spectrophotometry (single and double beam). Sensitivity and analytical significance of molar extinction coefficient and λ_{max}. Comparison method, calibration curve method and standard addition method for quantitative estimation. Role of organic ligands in spectrophotometric analysis of metal ions. Ringbom plot and Sandell's sensitivity. Photometric titrations. Determination of pK value of indicator. Simultaneous determination. Composition and stability constant of complex by Job's and mole ratio methods. Derivative spectrophotometry. Numerical problems.

B] Flame photometry: Principle. Instrumentation and types of burners. Factors affecting flame photometric determination. Limitations of flame photometry. Interferences in flame photometry. Applications.

Unit-IV: Electrochemical methods of analysis-II 15h

A] *Polarography*: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.

B] Amperometric titrations**:** Principle, types and applications in analytical chemistry.

List of books**:**

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley India**).**
4. Instrumental Methods of Analysis**:** Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Sample Pre-treatment and Separation: R. Anderson (John Wiley and Sons)
6. Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)
7. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
10. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
11. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
12. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
13. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
14. Fundamental of Analytical Chemistry: S. A. Skoog and D. W. West
15. Instrumental Methods of Chemical Analysis: G. W. Ewing
16. Polarography: Koltoff and Ligane
17. Electroanalytical Chemistry: Sane and Joshi (Quest Publications)

Semester II
Practical**-**III **(**Code**:** 2P2**)**
Organic Chemistry

12 h /week Marks: 100

[A**]** Qualitative Analysis**:** Separation, purification and identification of the mixture of two organic compounds (binary mixture with two solid, one solid one liquid and two liquids) using chemical methods or physical techniques.
Minimum 8-10 mixtures to be analyzed.
Purification of the compounds by crystallization, TLC and chromatographic techniques.

[B**]** Organic preparations**:**Student is expected to carry out minimum of 5-6 two stage organic preparation and 5-6 single stage preparation from the following lists.

[1] Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
[2] Benzophenone → benzhydrol
[3] Aldol condensation: Dibenzal acetone from benzaldehyde.
[4] Sandmeyer reaction: *p*- chlorotoluene from *p*-toluidine
[5] Cannizzaro reaction
[6] Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
[7] Benzil → 2,4,5-triphenyl imidizole

[8] Sucrose → Oxalic acid
[9] Methyl acetoacetate → 5-methyl-isoxazol-3-ol
[10] Ethyl acetoacetate →4-aryl-6-methyl-3,4-dihydro-2(1*H*)-pyrimidinone ester
[11] Ethyl acetoacetate → Diethyl 1,4-dihydro-2,6-dimethyl-4-phenylpyridine-3,-5dicarboxylate
[12] Dye prepartion : Sulphanilic acid → Methyl orange
[13] Dye prepartion : p-nitroaniline → p-red
[14] Acetanilide →*p*-nitroacetanilide →*p*-nitroaniline
[15] Aniline → 2,4,6-tribromo aniline → 2,4,6-tribromoacetanilide
[16] Nitrobenzene →*m*-dinitrobenzene →*m*-nitroaniline
[17] toluene →p-nitrotoluene →*p*-nitrobenzoic acid
[18] Glycine → Benzoyl glycine → 4-benzilidene-2-phenyl oxazole

Semester II

Practical-IV (Code: 2P4)

Analytical Chemistry

12 h /week Marks: 100

Section (A): Classical methods and separation techniques: Calibration, validation and computers

1. Calibration of pipette and burette.
2. Statistical analysis of data.
3. Use of MS-Excel in statistical analysis of data and curve fitting.

Volumetry

1. Determination of Na_2CO_3 in washing soda.
2. Determination of NaOH and Na_2CO_3 in a mixture.
3. Estimation of nickel in given solution by direct complexometric titration with EDTA using bromopyrogallol red.
4. Estimation of nickel in given solution by complexometric back-titration with EDTA.
5. Estimation of chloride in given solution by Mohr's titration.
6. Estimation of chloride in given solution by Volhard's titration.
7. Determination of volume strength of commercial hydrogen peroxide by redox titration with $KMnO_4$.
8. Estimation of phenol/ aniline by bromination method.
9. Estimation of glucose.
10. Estimation of acetone.
11. Estimation of formaldehyde.
12. Estimation of Mn in the presence of Fe using masking phenomenon (ferromanganese alloy).

Gravimetry

1. Estimation of barium as barium sulphate.
2. Estimation of calcium as calcium oxalate/ calcium carbonate/ calcium oxide.

Separation techniques

1. Qualitative separation of metal ions by paper chromatography for 2/3 components.
2. Determination of ion-exchange capacity of resin.
3. Separation of ions by ion exchange.

Section (B): Instrumental techniques: Electroanalytical techniques

1. Analysis of commercial vinegar by conductometric titration.
2. Estimation of phenol by conductometric titration with NaOH.
3. Determination of strength of HCl and CH_3COOH in a mixture conductometrically.

4. Determination of strength of HCl and oxalic acid in a mixture conductometrically.
5. Determination of strength of oxalic acid and CH_3COOH in a mixture conductometrically.
6. Determination of degree of dissociation and dissociation constant of acetic acid conductometrically.
7. Estimation of phenol in dilute solution by conductometric titration with NaOH.
8. Determination of strength of HCl and CH_3COOH individually and in a mixture potentiometrically.
9. Determination of Fe(II) by potentiometric titration with $K_2Cr_2O_7$.
10. Determination of three dissociation constants of H_3PO_4 by pH-metric/ potentiometric titration.

Optical methods

1. Determination of pK of indicator by colorimetry.
2. To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.
3. To study the complex formation between Fe(III) and salicylic acid and find the formula and stability constant of the complex colorimetrically (Job's method).
4. To determine the dissociation constant of phenolphthalein colorimetrically.
5. Estimation of iron in wastewater sample using 1,10-phenanthroline.

Note: One experiment from each section should be performed in the examination.

Semester II

Seminar-II (Code: 2S1)

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 Credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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M.Sc. Chemistry
Semester III
INORGANIC CHEMISTRY SPECILIZATION
Paper IX (Code: 3T1)
Special I-Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I 15h

A) Essential and trace metals in biological systems: Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and difficiency of V, Cr, Mn, Fe, Co, Cu,& Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.

B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na^+ /K^+ pump. Role of Ca in transport and regulation in living cells.

C) Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics & related compounds. Metal used for dignosis and chemotherapy with particular reference to anti cancer drugs.

Unit-II 15h

A) Bio-energetics and ATP cycle: DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

B) Electron transfer in Biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit-III

15h

Transport & Storage of Dioxygen: Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins & hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoningand treatment. Vanadium storage and transport.

Unit-IV 15h

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals ini) Zn-enzyme:- Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme:-Catalase Peroxidase & Cytochrome P-450 iii) Cu-enzyme:-Super Oxide dismutase iv) Molybdenum:-Oxatransferase enzymes, Xanthine oxidase,Co-enzyme Vit.B12, Structure of vitamin B12 Co-C bond cleavage, Mutaseactivity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetc model of enzyme action, stability and ageing of enzyme.

List of Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford

8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

Semester III

Paper X (Code: 3T2)

Special II-Inorganic Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 15 h

Crystal Structure of Some Simple Compounds:

i) Ionic Crystals &Their structures, radius ratio rule, effect of polarization on crystals.
ii) Covalent structure type- Sphalerite & Wurtzite.
iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs, reasons for preference for a particular structure in above AB type of compounds.
iv) AB_2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O,,$CdCl_2$, CdI_2 structures.
v) Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

Unit-II 15h

A) AB_2O_4 type- compounds: Normal & inverse,2-3 and 4-2 spinel,packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen,application of charge neutrality principles, site preferences in spinel, distorted spinel.Hausmannite(Jahn-Teller distortions),Factors causing distortion in spinel.

B) Lattice Defects: Per fect &Imperfect crystals, point defects, Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronicproperties of Non-stoichiometric oxides.

Unit-III 15h

Glasses, Ceramics and composite:Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and GlassModifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengtheried and particlereinforced, fibre reinforced Composites, microscopic composites, nanocrystaline phase, preparation procedure, special properties and applications.

Unit-IV

15 h

Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotrpic, planer & schlieren textures twisted nematics, chiral nematics, molecular arrngement insmectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants. Lyotropic phases & their description of ordering in liquid crystals.

List of Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).

5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford
8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).
10. Peter J. Collings, Liquid Crystals-Nature's delicate Phase of Matter, New Age International.
11. S. Chandrasekhar, Liquid Crystals, Cambidge University Press.

Semester III

Practical-V (Code: 3P1)

Inorganic Chemistry Special

12 h /week Marks: 100

A INSTRUMENTAL METHODS

I pH METRY:

1. Stepwise proton ligand and metal ligand constant of complexes by Irving Rossetti method

II COLORIMETRY AND SPECTROPHOTOMETRY

1. simultaneous determination of manganese (KMnO$_4$) and chromium ($K_2Cr_2O_7$)
2. simultaneous determination of cobalt (II) and nickel(II)
3. Determination of composition and stability constant of complexes by Job's method of continuous variation , mole ratio method and slope ratio method

III POTENTIOMETRY

1. Estimation of halide in a mixture by potentiometry
2. Determination of stepwise stability constant of silver thiosulphate complex by potentiometrically

IV CONDUCTOMETRY

1. Estimation of amount of acid in a mixture by conductometric titration

B INORGANIC REACTION MECHANISM

Kinetics and mechanism of following reactions:

1. Substitution reactions in octahedral complexes (acid/base hydrolysis)
2. Redox reactions in octahedral complexes
3. Isomerization reaction of octahedral complexes

C BIOINORGANIC CHEMISTRY (CHLOROPHYLL

1. Extraction and absorption spectral study of chlorophyll from green leaves of student choice
2. separation of chlorophyll and their electronic spectral studies
3. Complexation study of metal ions with biologically important amino acids

List of Books

1. Day And Underwood :Quantitative Analysis
2. Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman
3. Flaschka : Edta Titration
4. Merits And Thomas:Advanced Analytical Chemistry
5. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
6. Drago, R.S:Physical Methoods In Inorganic Chemistry
7. Christain G.D:Analytical Chemistry
8. Khopkar S.M.:Basic Concept Of Analytical Chemistry
9. Koltath And Ligane:Polorography

10. Braun:Instrumental Methods Of Chemical Analysis
11. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
12. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
13. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
14. Dilts R.V.: Analytiacl Chemistry
15. Jahgirdar D.V :Experiments In Chemistry
16. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
17. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
18. Ramesh Rand Anbu M , Chemical Methods For Envirnmental Analysis : Watewr And Sedient , Macmillion India
19. Akjmetov, N :General And Inorganic Chemistry
20. Aylett, B. And Smith , B. :Problems In Inorganic Chemistry
21. Charlot, G. And Bezier, D.: Quantitative Inorganic Analysis (John Wilry)
22. Douglas, B. E. Mcdanirl, D. H. Et Al : Concept Amd Models Of Inorganic Chemistry (4th Ed) J Wiley
23. Dutt P. K.:General And Inorganic Chemistry (Sarat Book House)
24. Fenton, David E.:Biocoordination Chemistry, Oxford
25. Jolly, W. L. :Inorganic Chemistryu (4 Th Ed) Addison-Wesley
26. Bertini, Et Al:Bioinorganic Chemistry (Viva)
27. Katakis, D. And Gordon, G :Mechanism Of Inorganic Reactions (J. Wiley)

Semester III

ORGANIC CHEMISTRY SPECIALIZATION

Paper IX (Code: 3T1)

Special I-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

UnitI: Photochemistry 15 h

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation additon and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, di-pi methane rearrangement, Photo theory reaction of anilides, photochemistry of vision, Applications of photochemical methods in synthesis: Isocomene, Cedrene, Hirsutene

Unit II: Pericyclic Reactions 15 h

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Perturbation of Molecular Orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, Cycloaddition reaction with more emphasis on [2+2] and [4+2], Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolar cycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial, and antarafacial shift involving carbon moieties, retention and inversion of configuration, [3,3] and [3,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction.

Unit III 15 h

A] Oxidation: Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and $PhI(OAc)_2$, Oxidation with SeO_2, Epoxidation of olefins, Synthetic

application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis

a) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS and $(CH_3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer oxidation
b) Oxidation of aldehydes and ketones, Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation , Chemistry and synthetic applications of $Pb(OAc)_4$, Dess-Martin periiodinane, IBX

B**]** Reduction**:** Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.

a) Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis
b) Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and $NaBH_4$, stereochemical aspects of hydride addition, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction with Bu_3SnH., Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes

Unit IV**:** Chemistry of P, S, Si,and Boron compounds 15 h

a) Phosphours and sulphur ylide: Preperation and their synthetic application along with stereochemistry
b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride based generation of acyl anion
c) Organoboranes- preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexyl borane, cyclohexyl borane, $ICPBH_2$, IPC_2BH, Hydrboration-mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC_2BH. Allyl boranes- synthesis, mechanism and uses
d) Organo silicon compounds in organic synthesis, Me_3SiCl, Me_3SiH and Paterson synthesis

List of books

1] Books as suggested in Semester I for organic chemistry
2] Organic Synthesis, The disconnection approach-S. Warren
3] Designing Organic Synthesis-S. Warren
4] Some Modern Methods of Organic Synthesis-W. Carruthers
5] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
6] Protective Group in Organic Synthesis-T. W. Greene and PGM
7] The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren
8] Organo Silicon Compound-C. Eabon
9] Organic Synthesis via Boranes-H. C. Brown
10] Organo Borane Chemistry-T. P. Onak
11] Organic Chemistry of Boron-W. Gerrard
12] Fundamentals of Photochemistry-K. K. Rohatgi-Mukharji, Wiley Eastern Limited
13] Photochemistry-Cundau and Gilbert
14] Aspects of Organic Photochemistry-W. M. Horspoot
15] Photochemistry-J. D. Calvert
16] Photochemistry-R. P. Wayne

Semester III
Paper X (Code: 3T2)
SpecialII-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit – I

15 h

A] Terpenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Geraniol, α-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A Genesis of biological isoprene unit, Biosynthesis (ONLY) of the following tepenoids: myrecene, linalool, geraniol, α-terpeneol, limonene, camphor, α-pinene, β-pinene, farnesol, β-bisabolene and squelene

B] Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll

Unit II 15 h

A] Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants Structure, stereochemistry, and synthesis of the following: Ephedrine, (+)-coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine,
Biosynthesis (ONLY) of the followings: hygrine, tropinone, nicotine, pelletierine, conine

B] Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE_2 and $PGF_{2\alpha}$

Unit-III 15 h

A] Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone.
Biosynthesis of steroids (lanosterol)

B] Plant Pigments: Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin.
Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway

Unit IV: 15 h

A] Carbohydrate: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, Chemistry of starch and cellulose.

B] Amino acids, protein and peptides: Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, Solid phase peptide synthesis, end group analysis.

List of books

1] Chemistry of Alkloids-S. W. Pelletier
2] Chemistry of Steroids-L. F. Fisher and M. Fisher
3] The Molecules of Nature-J. B. Hendricsion
4] Biogenesis of Natural Compound - Benfield
5] Natural Product Chemistry and Biological Significance- J. Mann, R. S Devison, J. B. Hobbs, D. V. Banthripde and J. B. Horborne
6] Introduction to Flavonoids-B. A. Bohm, Harwood
7] Chemistry of Naturally Occurring Quinines-R. H. Thomson
8] The Systematic Identification of Flavonoids- Marby, Markham, and Thomos

9] Text Book of Organic Medicinal Chemistry-Wilson, Geswold
10] Medicinal Chemistry Vol I and II-Burger
11] Synthetic Organic Chemistry -Gurudeep Chatwal.
12] Organic Chemistry of Natural Products Vol I and II-O. P. Agrawal
13] Organic Chemistry of Natural Products -Gurudeep Chatwal
14] A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh
15] Synthetic Dyes Series -Venkatraman
16] Chemistry Process Industries-Shreve and Brink
17] Principal of Modern Heterocyclic Chemistry-L. A. Paquelte
18] Heterocyclic Chemistry-J. Joule and G. Smith
19] Heterocyclic Chemistry-Morton
20] An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson
21] Introduction to Medicinal Chemistry-A. Gringuadge
22] Wilson and Gisvold Text Book of Organic Medicinal and Pharmaceutical Chemistry-Ed. Robert F Dorge
23] An Introduction to Drug Design-S. S. Pandey and J. R. Demmock
24] Polymer Science-V. Govarikar
25] Principle of Polymer Chemistry-P. J. Flory
26] An Outline of Polymer Chemistry-James Q. Allen
27] Organic Polymer Chemistry-K. J. Saunders

Semester III

Practical-V (Code: 3P1)
Organic Chemistry Special)

12 h /week Marks: 100

[A**]** Quantitative Analysis

Student is expected to carry out following estimations (minimum 6 estimations.)

1. Estimation of Vitamin "C" Iodometry.
2. Estimation of Phenol by $KBrO_3$-KBr.
3. Estimation of Amine by Bromate/ Bromide solution.
4. Estimation of Formaldyde by Iodometry.
5. Estimation of Glucose by Benedict's solution.
6. Estimation of given carbonyl compound by hydrazone formation.
7. Estimation of Aldehyde by Oxidation method.
8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

[B**]** Isolation of Organic Compounds from Natural Source **(**Any six**)**

a) Isolation of caffeine from tea leaves.
b) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
c) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)
d) Isolation of nicotine dipicrate from tobacco
e) Isolation of cinchonine from cinchona bark
f) Isolation of piperine from black pepper
g) Isolation of lycopene from tomatoes
h) Isolation of β-carotene from carrots
i) Isolation of cysteine from hair
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid
k) Isolation of eugenol from cloves

l) Isolation of (+) limonine from citrus rinds

[C**]** QUALITATIVE ANALYSIS

Separation of the components of a mixture of three organic compounds (three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two components using chemical methods or physical techniques. Minimum 10-12 mixtures to be analyzed.

Semester III

PHYSICAL CHEMISTRY SPECIALIZATION

Paper IX **(**Code**:** 3T1**)**

Special I**-**Physical Chemistry

60h *(*4h/week*)* 15h/unit 80 Marks

UNIT I **:** STATISTICAL THERMODYNAMICS 15h

A**]** Statistical thermodynamics**:** Atomic and Molecular quantum levels, Significance of Boltzmann Distribution law, partition Functions and ensembles, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical and micro canonical ensembles, corresponding distribution laws using Lagranges method of undetermined multipliers*. Ortho and para hydrogen, principle of equipartition of energy, calculation of average energy*

B**]** Partition function, Translational partition function, Rotational partition function, Vibrational partition function, Electronic partition function, Applications of partition functions, Numericals**.**

UNIT II**:** ELECTROCHEMISTRY OF INTERFACES 15h

A**]** Electrode Interfaces**:** Quantum aspects of charge transfer at electrode**-**solution interfaces, quantization of charge transfer, tunneling**.** Semiconductor interfaces**:** Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces, effect of light at semiconductor solution interface**.**

B**]** Electro catalysis**:** Comparison of electro catalytic activity, importance of oxygen reduction and hydrogen evolution reactions, and their mechanism, volcanoes**.**

C**]** Bio**-**electrochemistry**:** Threshold membrane phenomena, Nernst Plank equation, Hodges Huxley equations, core conductor models, electrocardiography**.**

UNIT III**:** CHEMICAL DYNAMICS **-** I 15h

A**]** Dynamics of complex reactions**:** reversible, parallel, consecutive, concurrent and branching reactions, free radical and chain reactions, reaction between Hydrogen **–** Bromine and Hydrogen **–** Chlorine **(**thermal and photochemical**)**, decomposition of ethane, acetaldehyde, N_2O_5, Rice Herzfeld mechanism, Oscillatory autocatalytic and Belousov**-**Zhabotinsky reactions**.**

B**]** Fast Reactions**:** relaxation methods, flow methods, flash photolysis, magnetic resonance method, relaxation time and numericals**.**

UNIT IV**:** PHOTOCHEMISTRY 15h

A**]** Photophysical phenomenon**:** Introduction, photo and photochemical excitation and de**-**excitation, fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching**:** concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems**.** Stern**-**Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern**-**Volmer equation**.**

B**]** Photochemical reactions**:** photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosenitisation, chemiluminescence, photochemistry of environment**:** Green house effect**.**

List of books:

1. G. M. Panchenkov and V. P. Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, "Chemical Kinetics and Kinetics of Solutions", Academic
3. K. J. Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J. Raja Ram and J. C. Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
5. J.G. Calvert and J.N. Pitts, Jr., *Photochemistry,* John Wiley and Sons, New York (1966).
6. K. K. Rohtagi-Mukherjee, *Fundamentals of Photochemistry,* New Age International, New Delhi(1986).
7. R. P. Wayne, *Principles and Applications of Photochemistry,* Oxford University Press, Oxford(1988).
8. N. J. Turro, *Modern Molecular Photochemistry,* Univ. Science Books, Sansalito (1991).
9. J. F. L. Lakowicz, *Principles of Fluorescence Spectroscopy,* 2nd Edition (1999), PlenumPublishers, NewYork.
10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics".AddisonWesley
11. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
12. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
13. N. J. Turro, V. Ramamurthy and J. C. Scaiano, Principles of Photochemistry – An Introduction, Viva Books, New Delhi, 2015.
14. G. A. Somorjai, Introduction to Surface Chemistry and Catalysis, Wiley, 2010.
15. M. C. Gupta, Statistical Thermodynamics, New Age International.
16. K. Huang, Statistical Mechanics, Wiley, New Delhi, 2003.
17. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
18. B. K. Agarwal and M. Eisner, *Statistical Mechanics*, Wiley Eastern, New Delhi (1988).
19. D. A. McQuarrie, *Statistical mechanics*, Harper and Row Publishers, New York (1976).
20. J.O.M.Bokris and A.K.N.Reddy, "Modern Elcrtrochemistry". Wiley
21. S. Glasstone, "Introduction to Electrochemistry" Affilisated East West Press, New Delhi.
22. D. R. Crow, " The Principle of electrochemistry", Chapman Hall
23. G. K. Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill Pvt., Ltd. 1990
24. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

Semester III

Paper X (Code: 3T2)

Special II-Physical Chemistry

60h *(4h/week)* 15h/unit 80 Marks

UNIT-I: QUANTUM MECHANICS - II 15h

A] Applications of Quantum Mechanics: Approximate methods, variation principle, its application in Linear and non-linear functions, MO theory applied to H_2^+ molecule and H_2 molecule (calculation of energy), perturbation theory, application of perturbation theory to helium atom, generation of the concept of resonance.

B] Electronic structure of atoms: Russel Sanders terms and coupling schemes, Slater determinents, term separation energies of the p^n configuration, term separation energies for d^n configuration, magnetic effects: spin orbit coupling and Zeeman splitting.

C] Hybridization, hybrid orbitals in terms of wave functions of s and p orbitals, sp and sp^2 hybridizations, Simple Hückel theory applied to: ethylene, butadiene, cyclobutadiene, cyclopropenyl radical.

Unit II: SOLID STATE REACTIONS AND NANOPARTICLES 15h

A] Solid State Reactions: General principle, types of reactions: Additive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the solid state reactions. photographic process.

B] Nanoparticles and Nanostructural materials: Introduction, methods of preparation, physical properties, and chemical properties, sol-gel chemistry of metal alkoxide, application of Nanoparticles, Charecterization of Nanoparticles by SEM and TEM. Nanoporous Materials: Introduction, Zeolites and molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation and applications.

UNIT-III: ELECTROCHEMISTRY OF SOLUTION 15h

A] Metal/Electrolyte interface: OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer : Helmholtz-Perrin, Gouy Chapman model, Stern region, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models.

B] Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot

C] Electrical double lever, theories of double layer, electro-capillary phenomena, electro-capillary curve. Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential.

UNIT IV: IRREVERSIBLE THERMODYNAMICS 15h

A] Microscopic reversibility and Onsager reciprocity relation, phenomenological equations, Transformation of generalized fluxes and forces. The cyclic version of Clausius' inequality and its integrated form and their correspondence with time's arrow and irreversibility, Clausius' uncompensated heat. Derivation of the differential form of Clausius' inequality.

B] Rate of entropy production and the concept of Chemical affinity and its application to the cases of chemical reactions, coupled reactions, electrochemical reactions. Derivation of Gibbs relation and its DeDonderian version (time rate form) for spatially uniform chemically reacting closed systems, entropy production in spatially non-uniform systems like heat flow, Electrokinetic effect – Saxen relation.

List of books:

1. Ira .N. Levine, Quantum Chemistry, 5th edition(2000), Pearson educ., Inc.New Delhi
2. A.K.Chandra, Introductory Quantum Chemistry, 4th edition (1994), Tata Mcgraw Hill, New Delhi.
3. M.W.Hanna, " Quantum Mechanics in Chemistry", Benjamin
4. L. Pualing and E. B. Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York (1935).
5. R. K. Prasad, Quantum Chemistry, New Age International, Delhi.
6. R. K. Prasad, Quantum Chemistry through problems and solutions, New Age International, New Delhi, 2009.
7. B. C. Reed, Quantum Mechanics, Jones and Bartlett, New Delhi, 2010.
8. S. Glasstone, An Introduction to Electrochemistry, East-West Press Pvt. Ltd., New Delhi, 2004.
9. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
10. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
11. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
12. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
13. I Prigogine and R. Defay, Chemical Thermodynamics, Longmans, London, 1954.
14. S. R. DeGroot and P. Mazoor, Non-Equilibrium Thermodynamics, North-Holland Co., Amsterdam, 1969.
15. G. Lebon, D. Jou and Casa Vazquez, Understanding Non-equilibrium Thermodynamics, Springer, 2008.
16. I.Prigoggine, "An Introduction to Thermodynamics of Irreversible Processes," Wiley-Interscience.
17. R. P. Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.
18. J.O.M.Bokris and A.K.N.Reddy, "Modern Elcrtrochemistry". Wiley
19. S. Glasstone, "Introduction to Electrochemistry" Affilisated East West Press, New Delhi.
20. D. R. Crow, " The Principle of electrochemistry", Chapman Hall

21. C.Kittel, " Introduction to solid state Physics",Wiley
22. L.V.Azaroff, " Introduction to solids", McGraw Hill
23. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
24. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
25. N. B. Hanny, Solids,
26. Sulbha Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing House, 2011.
27. T. Pradeep, Nano: The Essentials, Tata Mc-Graw Hill, 2012
28. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.
29. N. B. Hanny, "Solid State Chemistry"
30. C. N. R. Rao and Gopalakrishnan, "New Directions in Solid State Chemistry " Second Edition, Cambridge University Press.
31. Anthony R. West, "Solid State Chemistry and its Applications" Wiley India Edition.

Semester III

Practical-V (Code: 3P1)

Physical Chemistry Special

12 h /week Marks: 100

Thermodynamics:

1. Determination of partial molar volume of solute and solvent (ethanol-water, methanol-water, KCl-water mixture)

Solutions:

2. Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients.
3. Determination of temp. dependence of the solubility of a compound in two solvents having similar intermolecular interactions(benzoic acid in water and DMSO – water mixture) and calculation of the partial molar heat of solution.

Phase equilibrium:

4. To study the effect of addition of an electrolyte such as NaCl, KCl,Na_2SO_4,K_2SO_4 etc. on the solubility of an organic acid(benzoic acid or salicylic acid).
5. To determine the heat of crystallization of $CuSO_4$,$5H_2O$
6. To determine the heat of reaction involving precipitation of a salt $BaSO_4$
7. To determine transition temperature of $CaCl_2$ by thermometric method and to determine transition temperature of $CaCl_2$, sodium bromide by solubility method

Kinetics:

8. To determine the activation energy of hydrolysis of an ester by acid.
9. Kinetics of reaction between sodium thiosulphate and KI. Determination of rate constant; study of influence of ionic strength
10. Kinetics of decomposition of H_2O_2 catalysed by iodide ion. Also determination of activation energy of reaction.

Conductometry:

11. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.
12. Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl, KNO_3) at several concentration and hence verify Onsager's equation.
13. Carry out the following precipitation titration conductometrically. a. 50 ml.0.02N $AgNO_3$ with 1N HCl; b.50 ml.0.02N $AgNO_3$ with 1N KCl; c. 50 ml 0.004 N $MgSO_4$ with 0.1 N Ba$(OH)_2$; d. 50 ml 0.002 N $BaCl_2$ with 1 N Li_2SO_4; e. 50 ml.0.02 N $BaCl_2$ with 1N K_2SO_4

Potentiometry:

14. To prepare calomel electrode and to determine the potential of calomel electrode by potentiometry.

15. To determine stability constant of Fe^{3+} with potassium dichromate in presence of dilute sulphuric acid by redox titration.
16. To determine solubility product of Silver chloride by potentiometric method.
17. Determination of redox potential of the couples(**Fe^{2+}/Fe^{3+}**,Co^{3+}/Co^{2+}**,Cr^{3+}/Cr^{2+}**,MnO_4^-/Mn2+(**any two**)** and equilibrium constant.
18. Study of complex formation by potentiometry e.g.Ag^+-$S_2O_3^{-2}$, Fe^{3+}-SCN^-,Ag^+-NH_3(any two) and calculation of stability constant.

Spectrophotometry:

19. To verify Beers law for solution of potassium permanganate and to find molar extinction coefficient.
20. To determine the indicator constant (**pK_{In}**) of methyl orange/red spectrophotometrically.

Polarography:

1. Determination of the half-wave potential of the cadmium ion in 1M potassium chloride solution.
2. Investigation of the influence of dissolved oxygen.
3. Determination of cadmium in solution.
4. Determination of lead and copper in steel.

List of Books

1. Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
5. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood :Quantitative Analysis
7. Merits And Thomas:Advanced Analytical Chemistry
8. Ewing, G. W. : Instrumental Methods of Chemical Analysis, Mcgraw-Hill
9. Drago, R.S:Physical Methoods In Inorganic Chemistry
10. Christain G.D:Analytical Chemistry
11. Khopkar S.M.:Basic Concept Of Analytical Chemistry
12. Koltath And Ligane:Polorography
13. Braun:Instrumental Methods Of Chemical Analysis
14. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
15. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
16. Skoog S.A. And West D. W.:Fundamental of Analytical Chemistry
17. Dilts R.V.: Analytiacl Chemistry
18. Jahgirdar D.V :Experiments In Chemistry
19. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
20. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed

Semester III

ANALYTICAL CHEMISTRY SPECIALIZATION

Paper IX(Code: 3T1)

Special I-Analytical Chemistry

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-I 15h

Radioactivity-Radiation-Units-Curie, Becquerel, Gray, Rad, Sievert, RBE, REM, Half life, mixed half life, branching decay, different types of radiations and their interactions with matter, radioactive

equilibrium, Elementary principles of GM and proportional counters, Gamma Ray Spectrometer, Ionization chamber, HPGe detector, NaI(Tl) detector, calibration using standard sources, resolution, numericals.

Unit-II:Optical methods of analysis-III 15h

Atomic absorption spectroscopy: Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapour and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.

Unit-III: Electrochemical methods of analysis-III 15h

Stripping Voltammetry: Principle and technique in anodic and cathodic stripping voltammetry, applications to metal ion analysis, limitations.

Adsorptive stripping voltammetry: Principle, technique, applications to metal ions and organic analysis. Advantages over anodic stripping voltammetry. Catalytic effects in voltammetry.

Working electrodes: Mercury electrodes, carbon electrodes, film electrodes.

Cyclic voltammetry: Principle and technique. Randles-Sevcik equation. Interpretation of voltammogram- reversible, irreversible and quasi-reversible systems. Applications of cyclic voltammetry in study of reaction mechanism and adsorption processes.

Electrochemical sensors (Chemically modified electrodes): Biosensors, catalytic sensors and gas sensors.Comparison of voltammetry with AAS and ICP-AES.

Unit-IV: Miscellaneous techniques-I 15h

Fluorometry and phosphorimetry: Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications.

Nephelometry and turbidimetry: Principle, instrumentation and applications.

*Photoacoustic spectroscopy:*Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS.

Electrogravimery: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Characteristics of deposits and completion of deposition. Instrumentation. Application in separation of metals.

Semester III

Paper X(Code: 3T2)

Special II-Analytical Chemistry

60h *(4h/week)* 15h/unit 80 Marks

Unit-I: Organoanalytical Chemistry 15h

Elemental analysis: Outline of macro, semi-micro, micro and ultra-micro analysis, semi-micro determination of carbon, hydrogen, halogen, sulphur, nitrogen, phosphorous, arsenic, boron and metals in organic compounds.

Functional group analysis: Semi-micro determination of the following functional groups in organic compounds- hydroxyl, amino, nitro, nitroso, azo, N-acetyl, O-acetyl, methyl, aldehydes, ketones, thio, disulphide, sulphonamide, unsaturation and active hydrogen.

KF reagent: Karl Fischer reagent and its use in analysis of water in organic compounds.

Unit-II: Analysis of ores and cement

15h

Ores: Composition and analysis of the followings ores- Bauxite, Pyrolusite, Dolomite, Chromite.
Portland cement: Composition, raw material, manufacturing processes, characteristics, analysis.

Unit III: 15h

Water pollution and analysis: Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation. Water treatment plants: Sand filters and other types of filters.

Unit-IV: Air pollution and analysis 15h

Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO_2, NO_2, CO, CO_2, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Green house effect, Heat Islands, Acid Rain.

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
4. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
5. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
6. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
7. Vogel's Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Atomic Absorption Spectroscopy: Robinson (Marcol Dekker)
10. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
11. Analysis of Water: Rodier
12. Laboratory manual of water analysis: Moghe and Ramteke (NEERI)
13. Electroanalytical chemistry: Joseph Wang
14. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)
15. Trace analysis: S. Lahiri (Narosa Publishing House)
16. Electroanalytical Chemistry: Bard (Marcel-Dekker)
17. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)

Semester III

Practical-V (Code: 3P1)

Analytical Chemistry Special

12 h /week Marks: 100

pH-metry

1. Determination of percent Na_2CO_3 in soda ash by pH-metric titration.
2. Determination of isoelectric point of amino acid.
3. Determination of three dissociation constants of phosphoric acid.

Conductometry

1. Displacement titration of CH_3COONa with HCl.
2. Precipitation titration of $MgSO_4$ and $BaCl_2$.

3. Titration of mixture of CH_3COOH, H_2SO_4 and $CuSO_4$ with NaOH.

Potentiometry

1. Estimation of Cl^-, Br^- and I^- in a mixture.
2. Determination of percent purity of phenol by potentiometric titration with NaOH.
3. Estimation of acids in mixtures.

Coulometry

1. Estimation of nickel and cobalt by coulometric analysis at controlled potential.
2. Analysis of antimony (III) with I_3^- .

Polarography

1. Determination of $E_{1/2}$ of Cd^{2+} and Zn^{2+} at DME.
2. Estimation of Cd^{2+} and Zn^{2+} in respective solutions by calibration curve and standard addition methods.
3. Determination of composition /stability constant of complex.

Cyclic voltammetry

1. Study of cyclic voltammograms of $K_3[Fe(CN)_6]$.

Electrogravimetry

1. Estimation of nickel and copper individually as well as in mixture.

Polarimetry

1. Inversion of cane sugar in the presence of HCl.
2. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in mixture.

Colorimetry**/**spectrophotometry

1. Simultaneous determination of chromium and manganese in given mixture.
2. Simultaneous determination of two dyes in a mixture.
3. Estimation of Mn in steel.
4. Estimation of Cu/Ni in alloys.
5. Estimation of iron in water sample using 1,10-phenanthroline.
6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

Flame photometry

1. Estimation of Li, Na, K, Ca in rock/ soil / water samples.

Turbidimetry and nephelometry

1. To determine molecular weight of polymer.
2. Estimation of sulphate in water sample by turbidimetry.
3. Estimation of phosphate by nephelometry.

Radioanalytical techniques

1. GM-counter: Plateau, nuclear statistics, half thickness of aluminium absorbers, dead time.
2. Gamma ray spectrometer: Calibration using standard sources, determination of half life (Mn-56, I-128, In-116)
3. Experiments based on radiation chemistry: G-value-$G(NO_2^-)$.

Demonstrations

1. UV-spectrophotometry

Semester III

Paper XI **(**Code**:** 3T3**)**

Elective**-** Nuclear Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit**-I:** Radioactive decay 15h

Various modes of decay, natural radioactivity, successive radioactive decay and growth kinetics, radioactive equilibrium, half life, half life of mixed radioisotopes, decay schemes, its determination by experimental methods, statistical nature of nuclear radiation, treatment of nuclear data and calculation of standard deviation, probability

Unit-II: Nuclear structure 15h

mass-energy relationship, nuclear binding energy, semi-empirical mass formula, nuclear stability rules, nuclear properties, mass size, spin and parity, nature of nuclear forces, liquid drop model, shell model, its evidence and advantages, comparison of the two models, calculations based on above.Energetics of nuclear reaction, cross reaction, comparison with chemical reactions, various types of nuclear reactions, photonuclear, spallation and thermonuclear reaction

Unit-III: Interaction of radiations with matter,detectors 15h

Interaction with matter and detection of gamma rays with matter by photoelectric, Compton and pai production, interaction of beta particles, neutrons and heavy charged particles, various methods of detecting nuclear radiations, gas filled counters, ionization chamber, proportional and GM counters, scintillation detector and solid state detectors- Ge(Li), Si(Li) and HPGe.

Unit-IV: Nuclear fission and Fusion 15h

Probability, mass and charge distribution, release of energy and neutrons, spontaneous fission, nuclear reactors and their uses for power production, brief idea about thermal and fast breeder reactors, reprocessing of nuclear fuel, PUREX process, heavy water- manufacturing and use in reactors. accelerators, nuclear fusion. Production of isotopes by nuclear reactions, production of new elements, radioactive waste management and disposal

Semester III

Practical VI–Elective (Code: 3P3)

Nuclear Chemistry Practical

12 h per week Marks-100

1. Working of GM counter, plateau, statistics, geometry effects, dead time, energy of beta particle, back scattering
2. Working of gas flow proportional counter, plateau, statistics, geometry effects, dead time, energy of beta particle
3. Working with scintillation counter, gamma ray spectra, energy calibration and resolution, half life determination of single and composite nuclei.
4. Radiochemical separation of ^{234}Th from natural uranium salt and its half life determination
5. Experiment on Neutron Activation Analysis by non-destructive method
6. Dose measurement by Fricke and other chemical dosimeters
7. Radiolysis of potassium nitrate, methyl iodide, carbon tetrachloride-iodine systems
8. Szilard-Chalmers reactions with inorganic and organic systems, potassium permanganate and methyl iodide
9. Some trace experiments like partition coefficient, solubility product, isotopic exchange, isotope dilution analysis, radiochromatography, ion exchange.

List of books:

1. H. J. Arnikar - Essentials of Nuclear Chemistry (Willey Eastern Ltd)
2. G. Friendlander, J. W. Kennedy,E. S. Macias and J. M. Miller-Nuclear and Radiochemistry (Wiley Intersciences, New York)
3. G. R. Choppin and J. Rydberg- Nuclear Chemistry-Principles and Applications(Pergamon press, London)
4. B. G. Harvey-Introduction to Nuclear Physics and Chemistry(Prentice Hall of India)
A. N. Nesmeyanov - Radiochemistry- (Mir Publications)
5. M. N. Sastry-Introduction to Nuclear Science, Affiliated East-West Press, New Delhi
6. G. Hughes- Radiation Chemistry- Oxford University Press, London

7. V. Verschinskii and A. K. Pikeav-Introduction to Radiation Chemistry, Israel Publication, Jerusalem-Robinson (Marcol Dekker)
8. Farhat Aziz and M. A. J. Radgers-Radiation Chemistry-Principles and Applications, VCH Publishers FRC.
9. M. Hassinsky-Nuclear Chemistry and its application, Addison Wesley

Semester III

Paper XI (Code: 3T3)

Elective- Environmental Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I: Concept and scope of Environmental Chemistry 15 h

Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification,types of ecosystems. Biogeochemical cycles- carbon, nitrogen, phosphorous, oxygen, hydrogen, sulphur, iron, sodium, potassium, magnesium, cobalt, mercury, lead, zinc and cadmium.
Thermal pollution—sources, harmful effects and prevention of thermal pollution.
Noise pollution --- sources, effects and control of noise pollution.

Unit-II: Water 15 h

Origin, physico-chemical properties of water, sources of water, hydrological cycle, criteria ofwater quality, Water management- water shed management, rain water harvesting, waterpollution-sources, consequences and harmful effects of water pollution, strategies for waterpollution control.

Unit-III: Air 15 h

Major regions of the atmosphere, composition of the atmosphere, temperature inversionand air pollution episodes, photochemistry of the atmosphere, depletion of the stratosphericozone, green house effect, green house gases, remedial measures for reversion of green house effect, acid rain, photochemical smog, particulate matter.

Unit-IV: 15 h

Soil: Chemical and mineralogical composition of soil, classification of soil, types of soil- saline and alkaline, physical properties – texture, bulk density, permeability, chemical properties—Ion exchange capacity, soil pH and micro and macro nutrient availability. Soil management—Management of saline and alkaline soil, soil indicator plants,
Radioactive Pollution: Introduction to radiation chemistry, sources of radioactive pollution, effects of radioactivepollution, nuclear disasters in the two decades, protection from radiation, control of radiation.

Semester III

Practical VI–Elective (Code: 3P3)

Environmental Chemistry Practical

12h per week Marks-100

WATER ANALYSIS

1 Sampling of water-tap water, overhead storage tank water, pond water and lake water
2 Physico –chemical and organoleptic characteristics of the above water sample
3 Statistical evolution of the data obtained for optimization of result
4 Determination of total solids, total dissolved solids and total suspended solids and its significance
5 Determination and comparison of chlorine content in tap water, storage tank and swimming pool
6 Determination of acidity and alkalinity in water samples
7 Determination of total, permanent and temporary hardness of water sample
8 Determination of DO, COD, and BOD of water sample

9 Analysis of chemicals used in water and waste water treatment-alum, bleaching powder, activated carbon
10 Analysis iron and manganese in water sample by visual titrimetry
11 Analysis of copper and nickel in water sample by Spectrophotometry
12 Analysis of phenol in water sample by Spectrophotometry
13 Analysis of nitrite in water sample by Spectrophotometry
14 Analysis of chromium in water sample
15 Analysis of chloride in water sample
16 Analysis of sulphate in water sample
17 Determination of turbidity of a given water sample
18 Estimation of Na, K, by flame photometry in given water

AIR ANALYSIS

1 Determination of SOx and NOx and TSPM **(**total suspended particulate matter**)** and RSPM in ambient air

SOIL ANALYSIS

1 Analysis of different types of soil like pH, conductivity, alkalinity etc**.**
2 Determination of N,K, P of soil by flame photometry
3 Analysis of nutrients**-**nitrogen **(**total, ammonia, nitrite & nitrate **)**, phosphate total
4 Determination of macro &micro nutrients in soil

List of books

1. Water analysis : J. Rodier
2. A Text book of Inorganic Analysis : A.I.Vogel
3. Colorimetric Determination of metals : E.B.Sandell
4. Environmental Chemistry : Moore J W and Moore E A. Academic Press, New York, 1976.
5. Environment and Man Vol VII: The Chemical Environment Edited by J Lenihar and W Fleecher Vlackie Publication, 1977.
6. The Chemistry of Environment: R A Horne, Wiley Interscience Publication 1978.
7. Fundamentals of Air Pollution: A C Stern
8. Instrumental Methods of Analysis: Willard,Merrit and Dean
9. Analytical Chemistry: Meites and Thomas
10. Standard Methods for Examination of water and waste water: A E Greenberg, A D Eaton, APHA, AWWA,WEF
11. Chemistry for Environmental Engineering and Science: C N Sawyer, P L McCarty and G F Parkin
12. Laboratory Manual for the Examination of Water, waste water and soil: H H Rupa and H Krist, V C H Publication
13. Manual on Water and Waste water analysis: D S Ramteke and C A Moghe, NEERI
14. Environmental Chemistry: B K Sharma and H Kaur
15. Environmental Chemistry: A K De
16. Environmental Pollution- Management and control for sustainable Development: R K Khatoliya
17. Environmental Chemistry: A K Bhagi and G R Chatwal

Semester III

Paper XI **(**Code**:** 3T3**)**

Elective**-** Polymer Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Introduction to polymers 15h

Nomenclature and classification of polymers, Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization and their mechanisms, Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers.Stereoregular polymers- atactic, syndiotactic and isotactic.

Unit-II: Molar mass and its determination 15h

Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase), light scattering, gel permeation chromatography, sedimentation and ultracentrifuge, viscosity method and end-group analysis.

Unit III: Physical characteristics of polymers 15h

Morphology and order in crystalline polymers. Configuration of polymer chains, crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. The glass transition temperature (Tg), relationship between T_g and T_T, Effect of molecular weight, dilments, chemical structure, chain topology, branching and cross linking. Methods of determination of glass transition and crystallinity of polymers.

Unit IV: Commercial polymers 15h

A) Organic polymers: Commercial polymers, synthesis and and application of polyethylene, Cellulose Acetate, PMMA, polyaimdes, polyesters, Urea resins and eposy resins.

B) Functional polymers: Fire retarding polymers and conducting polymers, biomedical polymers.

Semester III

Practical VI – Elective (Code: 3P3)

Polymer Chemistry Practical

12h per week Marks-100

1. Synthesis of polymers:
   a) Synthesis of Thiokol rubber (condensation)
   b) Urea-formaldehyde (condensation)
   c) Glyptal resin: glycerine phthalic acid (crosslinked Polymer Chemistry)
   d) Polyacryonitril (bulk polymerization)
   e) Polyacryonitril (emulsion polymerization)
   f) Polymethylomethacrylate (emulsion of suspension Polymer Chemistry)
   g) Nylon-66 (interfacial polycondensation)
   h) Coordination polymers
   i) Conducting polymer (electro- or peroxodisulphate oxidation)
2. Characterization of polymers:
   a) End-group analysis
   b) Viscosity and molecular mass
   c) Density of polymer by flotation methods
   d) IR spectra.
3. Purification and fractionation of polymer, polystyrene, Nylon 66, PMMA.
4. Magnetic and electrical properties of polymers, magnetic susceptibility and electrical conductivity of coordination and conducting polymers.
5. Thermal analysis and degradation of polymers:
   i. TGA: Isothermal and non-isothermal;
   ii. DTA: Glass transition temperature and melting point
6. Crystallinity of polymers by density measurement.
7. Swelling and solubility parameters of polymers.
8. Synthesis of Graft-Polymers and its characterization by density and IR spectra.
9. Dielectric behavior of polymers.
10. Kinetics of polymerization:
    a) Polycondensation
    b) Peroxide initiation polymerization.

List of books:

1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.
2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.

3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.
4. Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.
5. Principles of polymer Chemistry: Flory, Cornell Univ. press.
6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.
7. Principles of polymerization: Odian.
8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.
9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.
10. A practical course in polymer chemistry: S.J. Punea , Pergamon Press.

Semester III

Paper XI Elective (Code: 3T3)

Medicinal Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT-I: 15 h

Drug Design:

Development of new drugs, factors affecting development of new drugs, sources of lead compounds, serendipity and drug development. Concept of QSAR, QSAR methods and parameters, procedure followed in drug design, structure activity relationship (SAR) method, Free and Wilson analysis, Hansch analysis, concept of prodrugs and softdrugs, SOFT DRUGS, isosterism, bioisosterism, drug receptors, theories of drug action, types of reversible enzyme inhibitors, some special inhibitors and design of inhibitors.

UNIT-II: 15 h

A] **Pharmacokinetics and pharmacodynamics:** Indroduction drugs absorption, distribution and disposition of drugs, excretion and elimination, Pharmacokinetics of elimination and Pharmacokinetics in drug development process.
Pharmacodynamics: Introduction, enzyme stimulation, enzyme inhibition, membrane active drugs, drugs metabolism, biotransformation and significance of drug metabolism

B] **Diuretics:** Introduction, mode of action, loop diuretics. Synthesis of Bumetanide, Frusemide, Ethacrynic acid, clorexolone Quinethazone.

C] **Analgesics and Antipyretics:** Introduction, mode of action, evaluation of analgetic agents.Synthesis of: Aspirin, salsalate, phenacetin, phenylbutazone, Indomethacin, Analgin.

UNIT-III: 15h

A] **Cardiovascular Drugs:** Introduction, cardiovascular diseases, Synthesis and uses of cardiovascular drugs; amyl nitrate, diltiazem, varapamil, methyldopa, atenolol, sorbitrate, quinidine, oxyprenolol

B] **Antineoplastic Agent:** Introduction, mechanism of tumor formation, treatment of cancer, types of cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer, carcinolytic antibiotics, mitotic inhibitors, harmones, natural products. Synthesis of melphalan , thiotepa, lomustine

UNIT-IV: 15 h

A] **Psychoactive drugs:** Introduction, neurotransmitters, structure of nerve cell, chemical transmitters, CNS depressants, sedative and hypnotics, Synthesis of Barbiturates, Phenobarbital, thiopental sodium, diazepam, lorazepam, bromazepam, ethosuximide, general anaesthetic: Antianxiety drugs, synthesis of oxazepam, alprazolam, puspirone, antipsychotic drugs and antidepressant drugs, MAO inhibitors, antimanic drugs, synthesis of thiopental sodium, ethiosuxmide, glutethimide, trimethadione, phenytoin.

B] Coagulant and Anticoagulants: Introduction, factors affecting coagulant and anti-coagulant. Mechanism of Blood coagulation and Anticoagulation. Structure of Vitamin K1, Vitamin K2 and heparin. Synthesis of Coumarins and indanediones.

Semester III

Practical VI–Elective (Code: 3P3)

Medicinal Chemistry Practical

12 h per week Marks-100

1. Volumetric estimation of Ibuprofen.
1. Estimation of aspirin by volumetric and instrumental methods.
2. Analysis of ascorbic acid in biological/tablet sample.
3. Determination of paracetamol by colorimetry.
4. Analysis of ampicillin trihydrate.
5. Determination of vitamin B12 in commercial sample by spectrophotometry.
6. Determination of phenobarbitone in given cough syrup.
7. Determination of tetracycline in given capsule.
8. Determination of iron, calcium and phosphorus from milk or drug sample.
9. To perform I.P. monograph of tablet.
10. Estimation of chloride in serum and Urine.
11. Separation and determination of sulpha drugs in tablets or ointments.

Preparation of Drugs: Synthesis, purification and identification of (8-10) of the following drugs.

1. Benzocaine from p-nitrobenzoic acid.
2. Dapsone from diphenyl sulphone.
3. Paracetamol from p-nitro phenol.
4. Uracil from sulphanil amide.
5. Diphenyl hydantion from benzoin.
6. Aluminium asprin from salicylic acid.
7. 4,6-diphenyl-thiazine from chalcone.
8. 6/8 nitro coumarin from resorcinol.
9. Copper aspirin from salicylic acid.
10. N-acetyl parabanic acid.
11. Nerolin from 2-naphthol
12. Phenothiazine from diphenylamine
13. Umbelliferon from resorcinol
14. Benzylidene from benzaldehyde and aniline
15. 1-phenyl-1,2-pentadine-3-one from benzaldehyde
16. 1,5 diphenyl-1,3-pentadiene-2-one from benzaldehyde
17. 1,3-diphenyl-prop-2-ene-1-one
18. 3-methy pyrazol-5-one from ethylacetoacetate
19. 6-methyl uracil
20. Sulphanilamide from acetanilide

List of books:

1. Text book of organic medicinal chemistry-Wilson,Geswold
2. Medicinal chemistry Vil I and II-Burger
3. A textbook of pharmaceitical chemistry-Jayshree Ghosh
4. Introduction to medicinal chemistry-A Gringuadge
5. Wilson andGisvold text book of organic medicinal and pharmaceutical chemistry-Ed.Robert F Dorge
6. An introduction to drug design-S S Pandey,and JR Demmock
7. Goodman and Gilmans pharmacological basis of therapeutics- Stragies for organic drug sythesis and design-D Lednicer

8. Textbook of Medicinal Chemistry- A. Kar
9. Medicinal Chemistry – D Sriram and P. Yogeeswari

Semester III

Paper XII (Code: 3T4)

Foundation Course - IApplied Analytical Chemistry– I

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Analysis of Pesticides and Fertilizers 15h

Pesticides: General introduction, analysis of pesticides in general with reference to DDT, Dieldrin, Malathion, Parathion, BHC by different analytical methods such as titrimetric, colorimetric, chromatography and electroanalytical methods.

Fertilizers: Sampling and sample preparation, determination of water, total nitrogen, urea, total phosphates, potassium, acid or base forming quality.

Unit-II: Forensic chemistry 15h

Introduction. Classification of poisons on the basis of physical states, mode of action and chemical properties with examples of each type. Methods of administration. Action of poisons in body. Factors affecting poisoning. Study of some common poisons used for suicide. Signs and symptoms of As, Pb, Hg and cyanide poisoning. Poisonous effects of kerosene and cooking gas.

Unit-III:Analysis of petroleum and petroleum products 15h

Introduction, determination of flash and fire point, Pensky Marten's apparatus, cloud and pour point, aniline point, drop point, viscosity and viscosity index, Redwood and Saybolt viscometer, API specific gravity, water and sulphur in petroleum products, carbon residue, corrosion stability, decomposition stability, emulsification, neutralization and saponification number.

Unit-IV: Analysis of alloys 15h

Definition of alloy. phase diagrams of Fe-C, Pb-Sn, Pb-Ag systems and their applications. Types of steel: hypoeutectic, hypereutectic steels, mild steel, and stainless steel. Uses of steel. Composition and uses of brass, bronze and soldering alloy. Analysis of iron, nickel, chromium and manganese in steel. Analysis of copper and zinc in brass, lead and tin in soldering alloy. Industrial applications of alloys.

OR

Semester III

Paper XII (Code: 3T4)

Core Subject Centric - I: Spectroscopy– I

60 h (4 h per week): 15 h per unit 80 Marks

Unit - I: Symmetry properties of molecules and group theory: 15h

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C_{2v}, C_{3v} and C_{2h}. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H_2O and NH_3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II: 15h

A] Mass spectrometry: Theory, ion production(EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, N-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, Mclaffferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry, problem based on mass spectral data

B] Mössbauer spectroscopy: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction,

applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit **-** III**:** 15h

A**]** Microwave spectroscopy: Classification of molecules on the basis of M.I., rigid and non rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass and nuclear quadrupole moment.

B**]** ESR spectroscopy: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4-semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV**:** 15h

A**]** Infrared spectroscopy: Diatomic molecules: 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero point energy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone and combination frequencies. Structure determination of organic molecules by IR spectroscopy, problem based on IR spectral data

B**]** Raman Spectroscopy: Rayleigh scattering. Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra, rotational fine structure. Selection rules, coherent antiStokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Organic Spectroscopy-RT Morrison and RN Boyd
7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
9] Fundamentals of Molecular Spectroscopy-CN Banwell
10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
11] Photoelectron Spectroscopy-Baber and Betteridge
12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
13] NMR –Basic Principle and Application-H Guntur
14] Interpretation of NMR spectra-Roy H Bible
15] Interpretation of IR spectra-NB Coulthop
16] Electron Spin Resonance Theory and Applications-W gordy
17] Mass Spectrometry Organic Chemical Applications, JH Banyon

Semester III

Seminar**-**III **(**Code**:** 3S1**)**

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 Credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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M.Sc. Chemistry Semester IV
INORGANIC CHEMISTRY SPECIALIZATION
Paper XIII(Code: 4T1)
Special I-Inorganic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15h

A) Nanoparticals & Nanostructural materials :Introduction, methods of preparation, physical properties, and chemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metal alkoxide, hybrid organic-inorganic compounds. Nanoporous Materials: Introduction, Zeolites & molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation & applications.

B) Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factors influencing reactivity, photographic process.

Unit-II 15h

A) Coordination Polymers:Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use of polymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.

B) Characterization of coordination polymers on the basis of:
i) Spectra (UV, Visible, IR and NMR)
ii) Magnetic and thermal (TGA,DTA and DSC) studies

Unit-III 15h

Catalysis: Basic principles, thermodynamic and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous and heterogeneous catalysis .Introduction, types & characteristics of substrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbital symmetry and reactivity. Catalytic reactions of coordination and Organometallic compounds including polymerization activation of small molecules, addition to multiple bonds, hydrogenation Zeigler-Natta polymerization of olefins, hydroformylations, oxidations, carbonylations and epoxidation.

Name organic reaction involving inorganic compounds: Suzuki Coupling, Heck Reaction, Negishi reaction and Sonogirhra reaction

Unit-IV 15h

A) Optical sensor for metal Ions: Chelates ligand (Multidentates, Ruthenium bipyridyls, calixarenes, Lanthanide ion); Macrocyclic ligands (Flexible Macrocycles, Azamacrocycles, Cryptands, porphyrins); Crown ether and Cryptands(Napthalene and Anthracene crowns, Cryptands, structural features)

B) Thin films and languir-Biodgett films: Preparation technique, evaporation/spultering, chemical processe MOCVD, solgel etc. Languir-Biodgett(LB) film, growth techniques, photolithography properties and applications of thin and LB films.

List of books:

1. Barsoum ,M.W.,Fundamentals of Ceramics,McGraw Hill ,New Delhi
2. Ashcroft ,N.W. and Mermin,N.D.,SolidStaePhysics,Saunders College
3. CallisterW.D.,Material Science and Engineering, An Introduction,Wiley
4. Keer,H.H,Principals of Solid State,Wiley Eastern
5. Anderson J.C.,LeverK.D.,Alexander J.M and Rawlings,R.D.,ELBS
6. GrayG.W.Ed.Thermotropic Liquid Crystals,John Wiley
7. Kelkar and Hatz Handbook of Liquid Crystals,ChemieVerlag.
8. Kalbunde K.I.,Nanoscale Materials in Chemistry,JohnWiley,NY.
9. Shull R.D.,McMichael R.D. and SwartzendrubL.J.,Studies of Magnetic Properties of Fine particles and their relevance to Mataerials Science, Elsevier Pub. Amsterdam

10. Optoelectronic Properties of Inorganic Compounds, D. Max Roundhill and John P. Fakler, Jr. Plenum Press, New York

Semester IV

Paper XIV(Code: 4T2)

Special II-Inorganic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15 h

A) Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energy dissipation by radiative and no-radiative processes, absorption spectra Frank-Condon principles; photochemical stages-primary & secondary processes.

B) Properties of excited states: Photochemical kinetics,Calculation of rates of radiative processes.

C) Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations, metods for obtaining charge transfer spectra.

Unit-II 15h

A] Photophysical and photochemical properties of Gold(I) complexes: Introduction, Binuclear and trinuclear complexes, Mixed metal Systems, Photochemical reactivity, Solid state studies, Mononuclear Gold(I) complexes, Mononuclear three coordinate Gold(I) complexess

B) Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction & strong interaction – exciplex formation, conditions of excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthroline complexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lie time of these processes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants in to highenergy products, chemical energy in to light.

Unit-III 15h

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability &decomposition pathways of alkyls & aryls of transition metals. Organocopper in Organic synthesis. Compounds of Transition Metal –Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes & carbynes–synthesis, nature of bond, structural characteristics, nucleophilic & electrophilic reactions on ligands, role inorganic synthesis.

Unit-IV 15h

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics & synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes, allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediates in oraganic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.

List of books:

1. ElschenbroichCh.andSalzer A.: Organometallics, VCH,Weinheim, NY.
2. BalzaniVandCavassitiV.:Photochemistry of Coordination compounds,AP,London
3. Purcell K.F.andKotzJ.C., An Introduction to Inorganic Chemistry,HoltSounder,Japan.
4. RohtagiK.K.andMukharjee,Fundamentals of Photochemistry,Wiley eastern
5. CalvertsJ.G.and Pits.J.N., Fundamental of Photochemistry, John Wiley
6. Wells, Inorganic Solid State Chemistry, Oxford University, Vth , Edition
7. Paulson,OrganometallicChemistry,Arnold
8. Rochow,OrganometallicChemistry,Reinhold
9. Zeiss,OrganometallicChemistry,Reinhold
10. Gilbert A.andBaggott,J,Essential of Molecular Photochemistry,BlackwellSci.Pub.
11. TurroN.J.and Benjamin W.A.,Molecular Photochemistry

12. CoxAandCamp,T.P.IntroductoryPhotochemistry,McGraw-Hill
13. KundallR.P.andGilbertA,Photochemistry, Thomson Nelson Coxon J and HaltonB.,Organic Photochemistry, Cambridge University Press.
14. Optoelectronic Properties of Inorganic Compounds, D. Max Roundhill and John P. Fakler, Jr. Plenum Press, New York

Semester IV

Practical-VII (Code: 4P1)

Inorganic Chemistry SpecialPractical

12 h /week Marks: 100

A Preparation and characterization of following complexes/organometallic compound including their structural elucidation by the available physical methods.(element analysis molecular weight determination, conductance and magnetic measurement and special studies)

1 Preparation of mercury tetrathiocyanotocobaltate(II)
2 Preparation of Iron (II) oxalate & potassium trioxalatoferrate (III) trihydrate
3 Preparation of cis & trans potassium dioxalatodiaquochromate (III)
4 Preparation of hexa-aminecobalt(III) chloride
5 Preparation of hexa-aminenickel(II) chloride
6 Preparation of tris (acetylacetonato) manganese (III)
7 Preparation of N-N bis (salicyldehyde) ethylene diaminonato nickel (II)
8 Preparation of trinitrotriaminocobalt(III)
9 Preparation of chloropentammine cobalt (III) chloride
10 Preparation of potassium trioxalatochromate (III)
11 To prepare copper (II) acetylacetonate complex
12 To prepare cis and trans bis (glycinato) Cu II monohydrate complex
13 To prepare dipyridineiodine (I) nitrate
14 Preparation of ammonium nickel(II) sulphate

B SOLID STATE

1 Preparation of oxides and mixed oxides(MnO_2 , NiO, Cu_2O,Fe_3O_4,$ZnFe_2O_4$,$ZnMn_2O_4$,$CuMnO_4$and $NiFe_2O$)
2 Preparation of silica and alumina by sol –gel technique
3 To study the electrical conductivity of ferrites, magnetite's, doped oxides and pure samples and determine band gap

C SEPARTION AND QUANTITATIVE ESTIMATION OF BINARY AND TERNARY MIXTURE BY THE USE OF FOLLOWING TECHNIQUES:

1 Paper and thin layer chromatography
2 Ion exchange
3 Solvent extraction

D INORGANIC PHOTOCHEMISTRY

1. Synthesis of potassium ferrioxalate and determination of intensity of radiation
2. Photo oxidation of oxalic acid by UO^{2+}sensitization
3. Photo decomposition of HI and determination of its quantum yield

List of books:

1. Practical Inorganic Chemistry - Pass
2. Practical Inorganic Chemistry - Marr & Rocket
3. Basic Concept Of Analytical Chemistry - Khopkar S. M.
4. Synthesis And Characterisation Of Inorganic Compounds – W. L. Jolly, Prentice Hall
5. Inorganic Experiments – J. Derck Woollins, Vch.
6. Practical Inorganic Chemistry – G. Marrand, B.W. Rockett, Van Nostrand
7. A Text Book Of Quantitative Inorganic Analysis – A.I. Vogel, Longoman.
8. Edta Titration – F. Laschka

9. Instrumental Methods Of Analysis – Willard, Merit And Dean (Cbs, Delhi)
10. Inorganic Synthesis – Jolly
11. Instrumental Methods Of Chemical Analysis – Yelri Lalikov
12. Fundamental Of Analytical Chemistry- Skoog D .A. And West D. M. Holt Rinehart And Winston Inc.
13. Experimental Inorganic Chemistry7 – W.G. Palmer, Cambridge
14. Solid Stst Chemistry – N.B. Hanney
15. Introduction To Thermal Analysis , Techniques And Applications – M. E. Brown, Springer
16. Preparation And Properties Of Solid State Materials – Wilcox, Vol I&Ii, Dekker
17. The Structure And Properties Of Materials – Vol Iv, John Wulff,Wiley Eastern

Semester IV

ORGANIC CHEMISTRY SPECIALIZATION

Paper XIII (Code: 4T1)

Special I-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit I:

A] Carbanions in organic Chemistry 15 h

Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, keto-enol equilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism, geometry of carbanions, kinetic and thermodynamic control in the generation of enolates, LDA, hydrolysis of haloforms, use of malonic and acetoacetic esters, Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoin condensation, Julia olefination, alkylation of enolates and stereochemistry thereof, Conjugate additions, enamines in organic synthesis

B] Organometallic reagents -I

Synthesis and applications of organo Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester, epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition to carbonyl compounds, *o*-metallation of arenes using organolithium compounds.

Unit II: 15 h

A] Organometallic reagents-II:Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction.

Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragnocuprates, Gilman's reagent. Organo Hg and Cd reagents in organic synthesis.

B] Transition metals in organic synthesis: Transition metal complexes in organic synthesis-Introduction-oxidation states of transition metals, 16-18 rule, dissociation, association, insertion, oxidative addition, reductive elimination of transition metal

Organopalladium in organic synthesis-Heck reaction, carbonylation, Wacker oxidation, coupling reactions: Kumada Reaction, Stille coupling, Sonogashira, Negishi and Suzuki coupling reactions and their importance

Applications of $Co_2(CO)_8$, $Ni(CO)_4$, $Fe(CO)_5$ in organic synthesis. Wilkinson catalyst of Ruthenium and Rhodium – synthesis and uses its use in hydrogenation reactions-deallylation, C-C, C-O, C-N bond cleavages. Olefin metathesis by I^{st} and II^{nd} generation catalyst, reaction mechanism and application in the synthesis of homo and heterocyclic compounds

Unit III: 15 h

A] Advanced Stereochemistry: Conformation of sugars,monosaccharides, disaccharides, mutorotation, Recapitulation of Stereochemical concepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, regio-, diastereo- and enantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesis use of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation,

B] Protection and Deprotection of functional groups: Protection and deprotection of functional groups like, hydroxyl, amino, carbonyl and carboxylic acids groups, Solid phase peptide synthesis.

Unit IV: Designing the synthesis based on retrosynthetic analysis 15 h

A) Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis

B) One Group C-C Disconnections: Alcohols andcarbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis

C) Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annelation, Methods of ring synthesis, Linear and convergent synthesis

List of books

1] Principle of Organic Synthesis R. O. C. Norman and J. M. Coxon
2] Modern Synthetic Reaction. H. O. House and W. A. Benjamin
3] Organic Synthesis: The Disconnection Approach-S. Warren
4] Designing Organic Synthesis-S. Warren
5] Some Modern Methods of Organic Synthesis-W. Carruthers
6] Advance Organic Reaction. Mechanism and Structure-Jerry March
7] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
8] Organic Reaction and their Mechanism-P. S. Kalsi
9] Protective Groups in Organic Synthesis-T. W. Greene
10] The Chemistry of Organo Phosphorous-A. J. Kirbi and S. G. Warren
11] Organo Silicon Compound-C. Eabon
12] Organic Synthesis via Boranes-H. C. Brown
13] Organo Borane Chemistry-T. P. Onak
14] Organic Chemistry of Boron-W. Gerrard

Semester IV

Paper XIV(Code: 4T2)

Special II-Organic Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit I: Enzyme chemistry 15h

A] Enzymes: Introduction, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Nomenclature and classification, Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Baker's yeast catalyzed reactions

B] Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

C] Co-Enzyme Chemistry: Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, biotin as CO_2 carrier. Mechanisms of reactions catalyzed by the above cofactors.

Unit II: Heterocycles 15h

A*]* Azoles**:** Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages, Carbonyldiimidazole as coupling agent

B*]* Benzofused heterocycles**:** Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

C*]* Diazines**:** Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.

D**]** Synthesis of following bioactive compounds**:** Vitamin B_6, Ondansetron, Serotonin, Indometacin, Cyanamid, fentiazac, trimethoprim, papaverine

Unit III**:** 15h

A*]* Nucleic Acids**:** Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structure and function of mRNA, tRNA and rRNA. Purines and pyrimidine bases of nucleic acids and their preparation.

B**]** Lipids**:** Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerophospho lipids, spingolipids, lipoproteins, composition and function, role in atherosclerosis
Properties of lipid aggregates, micells, bilayers, liposomes and their biological functions, biological membranes, fluid mosaic model of membrane structure, Lipid metabolism, β-Oxidation of fatty acids

C**]** Vitamins**:** Structure determination, and synthesis of vitamin A, E and H.

Unit IV**:** 15h

A**]** Dyes**:** General Introduction, classification on the basis of structure and methos of application dying mechanism, methods of dying, such as direct dying, vat dying, dispersive dying, formation of dye in fibre, dying with reactive dyes, study of quinoline yellow, cyamine dye, ethyl red, methylene blue, Alizarin, cyamine-green, fluorescein, cosin, erythrosine, Rhodomines and Indigo.

B**]** Pharmaceutical chemistry**:**
History, medical terms in pharmaceutical chemistry, classification of drugs, antibacterial and antifungal drugs, specific clinical applications, Synthesis and applications of: Benzocaine, Methyl dopa, dilantin, ciprofloxacin, acyclovir, terfenadine, salbutamol

C**]** Polymer chemistry**:** Importance of polymers, Basic concepts: monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization and their mechanisms, Polymerization in homogeneous and heterogeneous systems. Ziegler-Natta polymerization with mechanism, Stereo regulated polymers, syndiotactic, isotactic and atactic polymers

List of books

1] Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley
2] Polymer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern
3] Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite
4] Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag
5] Understanding Enzymes, Trevor Palmer, Prentice Hall
6] Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
7] Enzyme Structure and Mechanism, A. Fersht, W. H. Freeman
8] Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
9] Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert F. Dorge
10] Burger's Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley
11] Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley
12] The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press

Semester IV
Practical-VII (Code: 4P1)
Organic Chemistry Special Practical

12 h /week Marks: 100

A] Quantitative Analysis based on classical and instrumental technique (any 9-10)

1] Estimation of nitrogen.
2] Estimation of halogen.
3] Estimation of sulphur.

Spectrophotometric/calorimetric and other instrumental methods of estimation

1] Estimation of streptomycin sulphate.
2] Estimation of vitamin B-12.
3] Estimation of amino acids.
4] Estimation of proteins.
5] Estimation of carbohydrates.
6] Estimation of Ascorbic acid.
7] Estimation of Aspirin.
8] Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the same oil.

B] Organic multi-step preparations (Two/Three steps): Minimum 10-12 preparations

[1] Aniline → Diaminoazobenzene → p-aminoazobenzene
[2] Benzoin → Benzyl → Dibenzyl
[3] Aniline → acetanilide →*p*-bromoacetanilide →*p*-bromoaniline
[4] Aniline → Acetanilide →*p*-nitroacetanilide →*p*-nitroaniline
[5] Benzaldehyde (thiamine hydrochloride) → benzoin → benzil → benzilic acid
[6] *p*-Nitrotoluene →*p*-nitrobenzoic acid→ PABA →*p*-iodobenzoic acid
[7] *p*-Cresol →*p*-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone
[8] Benzaldehyde → benzilidene acetophenone → 4,5-dihydro-1,3,5-triphenyl-1*H*-pyrazole
[9] Aniline → phenylthiocarbamide → 2-aminobenzthiazole (Microwave in step I)
[10] Chlorobenzene → 2,4- Dinitrochlorobenzene → 2,4- Dinitrophenylhydrazine.
[11] Acetophenone → acetophenone phenyl hydrazone → 2-phenylindole
[12] Benzion → benzoin benzoate → 2,4,5-triphenyl oxazole
[13] Benzophenone → benzpinacol → benzopinacolone (Photochemical preparation)
[14] Benzophenone → Benzophenone oxime → Benzanilide → Benzoic acid + aniline
[15] Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
[16] Aniline → N-arylglycine → indoxyl → indigo
[17] Phthalimide → Anthranilic acid → Phenyl glycine-o-carboxylic acid → Indigo
[18] Phalic anhydride → Phthalimide → Anthranilic acid → o-chlorobenzoic acid
[19] Phalic anhydride → Phthalimide → Anthranilic acid →Diphenic acid
[20] Ethyl acetoacetate → 3-methyl-pyrazol-5-one → 4,4-dibromo-3-methyl-pyrazol-5-one Butanoic acid
[21] Biosynthesis of ethanol from sucrose
[22] Enzyme catalyzed reactions

[C] SPECTRAL INTERPRETATION

Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, ^{1}H and $^{13}CNMR$ and Mass) (Minimum 12 compounds are to be analysed during regular practicals).

Semester IV
PHYSICAL CHEMISTRY SPECIALIZATION

Paper XIII(Code: 4T1)
Special I-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT-I CHEMICAL DYNAMICS - II 15h

A] Overview of Arrhenius rate law, Non-conventional equilibrium between reactants and activated complexes. Potential energy surfaces and reaction coordinate. Derivation of transition state theory based equation for rate constant of bimolecular reaction. Prediction of rate constant using partition function and comparison with that given by collision theory. Arrhenius equation and activated complex theory. Transmission coefficient, quantum mechanical tunneling,

B] Reactions in solution: Cage effect, diffusion controlled reactions, volume of activation its determination and correspondence with entropy of activation, Ionic reactions: Primary (Ionic strength) and Secondary salt effect and their nature.

UNIT II CORROSION AND CORROSION ANALYSIS 15h

A] Scope and economics of corrosion, causes (Change in Gibbs free energy), Electrochemical Series and Galvanic series, dry (atmospheric) and wet (electrochemical) corrosion, other types of corrosion- Pit, Soil, chemical and electrochemical, inter-granular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

B] Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, polarization methods), passivity and its breakdown, corrosion prevention (electrochemical inhibitor and coating methods).

UNIT – III: RADIATION CHEMISTRY 15h

A] Interaction of radiation with matter, radiation track spurs and □-rays. Linear energy transfer, Bathe's equation for linear energy transfer, Bresstrahlung effect, Passage of neutron through matter, Interaction of □-radiation with matter, photoelectric effect and Compton effect, pair production phenomena, units of measuring radiation absorption, Radiolysis of water, Radiolysis of some aqueous solutions. Effect of radiation on biological substances, genetic effects, Radiation effects on organic compounds and Polymers.

UNIT IV: ELECTRICAL AND THERMAL PROPERTIES OF SOLIDS 15h

A] Classical free electron theory, electrical conductivity, thermal conductivity, Wiedemann-Franz Law, Lorenz number, Electronic distribution in solids using Fermi Dirac Statistics, The Fermi Distribution function and effect of temperature, Quantum theory of free electrons, periodic potential, The Kronig-Penney Model, Brillouin Zones, Distinction between metals, insulators and intrinsic semiconductors based on above theory.

B] Thermal Properties: Specific heat of solids, Classical theory, Einstein's theory of heat capacities, Debye theory of heat capacities or Debye T-cubed law

Books Sugggested:

1. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
3. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan IndianLtd., New Delhi (1993)
5. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 1., Elsevier Publications, New York, 1969.
6. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, Vol 2., Elsevier Publications, New York, 1969.

7. S. Glasstone, K. J. Laidler and H. Eyring, The Theory of Rate Processes, Mc-Graw Hill, New York, 1941.
8. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
9. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
10. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
11. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
12. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
13. C.Kittel, " Introduction to solid state Physics",Wiley
14. L.V.Azaroff, " Introduction to solids", McGraw Hill
15. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
16. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
17. N. B. Hanny, "Solid State Chemistry"
18. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
19. C.N.Rao. Nuclear Chemistry
20. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
21. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.
22. W. Loveland, D. Morrissey and G. Seaborg, Modern Nuclear Chemistry, Wiley-Interscience, 2006.
23. P. P. Milella, Fatigue and Corrosion in Metals, Springer, 2013.
24. Corrosion- Understanding the Basics, asminternational.org, 2000.
25. H. H. Uhlig, Corrosion and Corrsion Control – 3rd edn, John Wiley & sons, New York.
26. J. W. T. Spinks and R. J. Woods, An Introduction to Radiation Chemistry, John Wiley and sons., New Yoek, 1975.
27. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

Semester IV

Paper XIV (Code: 4T2)

Special II-Physical Chemistry

60h *(4h/week)* 15h/unit 80 Marks

UNIT I: SOLID STATE AND THEIR MAGNETIC PROPERTIES 15h

A] Solid State Chemistry: Metals, Insulators and Semiconductors, Electronic structure of solids—band theory. Band structure of metals, Insulators and Semiconductors, Intrinsic and Extrinsic Semiconductors, p-n junction, energy band formation, forward bias and reversed bias p-n junction, their applications, Superconductors— types, Meissner effect, BCS theory, Low Temperature Superconductor (LTSC) and High Temperature Superconductor (HTSC), Conventional and organic Superconductors, their applications.

B] Magnetic Properties: Behaviour of substances in magnetic field, effect of temperature, Curie and Curie-weiss law, calculation of magnetic moments, magnetic materials, their structure and properties, Applications, structure/ property relations, numericals.

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES 15h

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization, Debye equations, limitation of the Debye theory, Clausius-Mossotti equation. electrostatic of dielectric medium, molecular basis of dielectric behavior, structural information from dipole moment measurements, use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment and ionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids and in solutions. The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction. Dispersion, dielectric loss and refractive index. Lennard-Jones potential.

Unit III: LIQUID STATE AND INTERFACES 15h

A] Theory of liquids: - Theory of liquids, partition function method or model approach, single cell models, communal energy and entropy, significant structure model.

B] Liquid gas and liquid interfaces: Surface tension, methods of determination of surface tension, surface tension across curved surfaces, vapor pressure of droplet (Kelvin equation), surface spreading, spreading coefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

Unit IV: IONIC LIQUIDS AND BATTERY TECHNOLOGY 15h

A] Supercooled and ionic liquids: Supercooled and ionic liquids, theories of transport properties, non Arrhenius behavior of transport properties, Cohen-Turnbull free volume model, configurational entropy model, Macedo- litovitz model, glass transition in supercooled liquids.

B] Battery Technology: basic concept, classification of batteries, primary, secondary and reserve batteries, Construction, working and application of Acid Storage batteries, Lithium - MnO_2 batteries, Nickel- Metal hydride batteries, Fuel Cells, Construction and working of $H_2O_2$and methanol-O_2 Cell.

List of books

1. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
2. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
3. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
4. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
5. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
6. A. Kokorin, Ionic Liquids: Theory, Properties and New Approaches, Intech, Croatia, 2011.
7. Gholam-Abbas Nazri, Gianfranco Pistoia, Lithum Batteries-Science and Technology, Springer, 2003.
8. N. H. March and M. P. Tosi, Introduction to Liquid State Physics, World Scientific, London, 2002.
9. George Kackson, Liquid State Theory,
10. C.Kittel, " Introduction to solid state Physics",Wiley
11. L.V.Azaroff, " Introduction to solids", McGraw Hill
12. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
13. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
14. N. B. Hanny, Solids,
15. H. Y. Erbil, Surface Chemistry of Solid and Liquid Interfaces, Blackwell Publishing, 2013.
16. N. B. Hanny, "Solid State Chemistry"

Semester IV

Practical-VII (Code: 4P1)

Physical Chemistry Special Practical

12 h /week Marks: 100

Adsorption:

1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hence determine the limiting cross section area of alcohol molecule.

Kinetics:

5. Clock reaction- activation energy of bromide-bromate reaction.
6. Temp dependence of persulfate-iodide reaction by iodine clock method and calculation of thermodynamic and Arrhenius activation parameters. Study of ionic strength effect on persulfate-iodide reaction.
7. Kinetics of B-Z reaction; Kinetics of modified B-Z reaction
8. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
9. Determination of pKa value of a weak acid by chemical kinetic method (formate-iodine reaction)

Potentiometry:

10. Transport number by potentiometry.

11. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by potentiometry method.
12. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
13. Complexation between Hg^{2+} and I^- conductometrically.

Conductometry:

14. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by conductometric method.
15. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
16. Complexation between Hg^{2+} and I^- conductometrically.
17. To determine solubility product of lead chromate.
18. Kinetic study of saponification ethyl acetate by conductometry.

Spectrophotometry:

19. To determine the stability constant of reaction between Ferric ion solution and SCN^- ion solution by Job's method.
20. To determine the stability constant between Fe^{3+} and SCN^- ion solution by Ostwald & Frank method.

Transport Number:

21. To determine transport number by Hittorff's method
22. To determine the transport number by moving boundary method

List of Books

1. Vogel A, 3rd Edition : A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
5. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood :Quantitative Analysis
7. Merits And Thomas:Advanced Analytical Chemistry
8. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
9. Drago, R.S:Physical Methoods In Inorganic Chemistry
10. Christain G.D:Analytical Chemistry
11. Khopkar S.M.:Basic Concept Of Analytical Chemistry
12. Koltath And Ligane:Polorography
13. Braun:Instrumental Methods Of Chemical Analysis
14. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
15. Strouts,Crifi;Llan And Wisin: Analytiacl Chemistry
16. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
17. Dilts R.V.: Analytiacl Chemistry
18. Jahgirdar D.V :Experiments In Chemistry
19. Chondhekar T.K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
20. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
21. Ramesh Rand Anbu M, Chemical Methods For Envirnmental Analysis : Watewr And Sedient , Macmillion India

Semester IV

ANALYTICAL CHEMISTRY SPECIALIZATION

Paper XIII(Code: 4T1)

Special I-Analytical Chemistry

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-II 15h

Preparation of some commonly used radioisotopes (^{22}Na, ^{60}Co, ^{131}I, ^{65}Zn, ^{32}P), Use of radioactive isotopes in analytical and physico-chemical problems, Industrial applications, Neutron sources, Neutron Activation Analysis, Isotope Dilution Analysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits), Radiochromatography, Carbon dating, Numericals based on above.

Unit-II: Optical methods of analysis-IV 15h

Inductively coupled plasma-atomic emission spectroscopy: Principle, atomization and excitation. Plasma source and sample introduction. Instrumentation. Comparison of ICP-AES with AAS. Applications.

X-ray fluorescence spectroscopy: Principle. Instrumentation: wavelength and energy dispersive devices. Sources and detectors. Comparison between wavelength and energy dispersive techniques. Sample preparation for XRF. Matrix effects in XRF. Applications in qualitative and quantitative analysis.

*Particle induced X-ray emission (PIXE):*Basic principle, Instrumentation and applications.

*Electron microscopy:*Principle, instrumentation and applications of scanning electron microscopy (SEM) and transmission electron microscopy (TEM)

Unit-III:Electrochemical methods of analysis-III 15h

Ion selective electrodes: Theory of membrane potential. Types of ion-selective electrodes. Construction of solid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes, Selectivity coefficients, Glass electrodes with special reference to H^+, Na^+ and K^+ ions. Applications of ISE in analysis of environmentally important anions like F^-, Cl^-, Br^-, I^-, NO_3^- and CN^-. Advantages of ISE.

Coulometry: Principle. Coulometry at constant potential and constant current. Instrumentation. Applications and advantages of coulometric titrations.

Electrochemical microscopy: Introduction to scanning probe microscopy (SPM), scanning tunneling microscopy (STM), atomic force microscopy (AFM) and scanning electrochemical microscopy (SECM).

Unit-IV: Thermal methods of analysis 15h

Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistatic thermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750, Thermogram, Factors affecting thermogram, Applications of thermogravimetry, Differential Thermal Analysis (DTA)- Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis, Differential Scanning Calorimetry (DSC)- Introduction, Instrumentation, DSC curves, factors affecting DSC curves, applications, Thermogravimetric titration-Theory, Instrumentation and applications.

Semester IV

Paper XIV(Code: 4T2)

Special II-Analytical Chemistry

60h (4h/week) 15h/ unit 80 Marks

Unit-I: Pharmaceutical and clinical analysis 15h

Requirements of a quality control laboratory for pharmaceutical units.

Structures, category, identification (qualitative) and assay (quantitative) of following drugs

1. Antibiotics: Amoxycillin, Azithromycin, Cefixime, Levofloxacin

2. Antihistamine: Cetirizine, Cinnarizine
3. Vitamins: Thymine hydrochloride (Vitamin-B_1) Riboflavin (Vitamin-B_2), Ascorbic acid (Vitamin-C)
4. Analgesics: Diclofenac, paracetamol, Aspirin.

Composition of blood, sample collection for blood and urine, clinical analysis, Immuno Assay-RIA, Setting up of RIA and applications, Fluorescence Immunoassay, Enzyme immunoassay, Blood gas analyzer, Trace elements in the body.

Unit-II: Soil analysis and coal analysis 15h

Soil analysis- Classification and composition, pH and conductivity, analysis of constitutents such as nitrogen, phosphorous, potassium and microconstitutents (Zn and Cu).

Coal analysis- Proximate analysis (moisture content, ash content, volatile matter, fixed carbon). Ultimate analysis (carbon, hydrogen, sulphur, nitrogen, oxygen content). Combustion of carbonaceous fuel- Flue gas. Calorific value and its units, Bomb calorimeter.

Unit-III: Corrosion and corrosion analysis 15h

Definition, draw backs and theories of corrosion-dry and wet corrosion, Different types of corrosion-Pit, Soil, chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

Unit-IV: Automation in analytical chemistry 15h

Automation in the laboratory, Principle of automation, automated instruments, classification, continuous analyzer, automatic instruments, semiautomatic instruments GeMSAEC Analyzer, Flow Injection Analysis (FIA), Dispersion coefficient, Factors af fecting Peak Height, microprocessor based instruments, Numericals based on above.

Hyphenated techniques: Introduction to GC-MS, LC-MS, ICP-MS and MS-MS (Tandem) spectrometry.

Semester IV

Practical-VII (Code: 4P1)

Analytical Chemistry Special Practical

12 h /week Marks: 100

A. Organoanalytical chemistry

1. Estimation of sulphur, nitrogen, phosphorous,chlorine in organic compound.
2. Estimation of phenol.
3. Estimation of aniline.

B. Separation techniques

Ion exchange

1. Separation and estimation of zinc and magnesium/cadmium in a mixture on anion exchanger.
2. Separation and estimation of chloride and iodide in a mixture on anion exchanger.
3. Determination of total cation concentration in water.

Solvent extraction

1. Estimation of Copper using Na-DDC.
2. Estimation of Iron using 8-hydroxyquinoline.
3. Estimation of Nickel using DMG.
4. Estimation of Cobalt using 8-hydroxyquinoline.
5. Estimation of Nickel by synergistic extraction with 1,10-phenanthroline and dithizone.

Paper chromatography

1. Separation and estimation of copper and nickel in a mixture.
2. Separation and estimation of cobalt and nickel in a mixture.

Thin layer chromatography

1. Separation and estimation of bromophenol blue, congo red and phenol red in a mixture.

2. Separation and estimation of metal ions in mixture.

C. Water analysis

1. *Mineral analysis*: Ttemperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphate, hardness
2. *Demand analysis*: DO, COD
3. *Heavy metals*: Fe, Cd and Pb

D. Demonstrations

1. Gas chromatography
2. HPLC

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Thermal analysis: Blazek (translated by J. F. Tyson, Van Nostrand)
4. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
5. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
6. Vogel's Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
7. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
8. Atomic Absorption Spectroscopy: Robinson (Marcel Dekker)
9. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
10. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
11. Analysis of Water: Rodier
12. Ion selective electrods: Koryta (Cambridge University Press)
13. Instrumentation in analytical chemistry: Borman (American Chemical Society)
14. Industrial Chemistry: Arora and Singh (Anmol Publications)
15. Diffraction Methods: John Wormald (Clarendon Press)
16. Electroanalytical Chemistry: Bard (Dekker)
17. Analytical Chemistry by Open Learning (Wiley)
18. An Introduction to Electron Diffraction: Beeston (North Holand Publishing Co.)
19. Material Science and Engineering: V. Raghavan (Printice-Hall of India)
20. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)
21. Indian Pharmacoepia, Vol-I, II and III.

Semester IV

Paper XV (Code: 4T3)

Elective- Nuclear Chemistry

60 h (4 h per week): 15 h per unit — 80 Marks

Unit-I: Radiation Chemistry, Radiolysis — 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions, calculation of absorbed dose-various types of dosimeters, chemical dosimeters (Fricke, Ceric sulphate and FBX), experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions, hydrated electron,

Effect of radiation on biological substances, genetic effects, radiation effects on organic compounds (Halides-carboxylic acids), polymers, nitrates and solid thermoluminescence.

Unit-II: Hot Atom Chemistry and Radiochemistry — 15h

Recoil energy and calculations, Szilard Chalmers effects, Kinetics, primary and secondary retention-effect of various factors on retention and its uses, Mossbauer effect- principle, instrumentation and chemical applications,

Unit-III: Radioanalytical techniques — 15h

Neutron sources, Neutron activation analysis, principle, methodology and application for trace analysis, Isotope dilution analysis-principle and application, Isotopic exchange reaction, mechanism

and application in use of radioisotopes and tracers, radioactive dating based on carbon-14 and lead isotopes.

Unit-IV: Radiopharmaceuticals 15h

Radioimmunoassay (RIA), discovery, principle, set up of RIA, Principle of Immunoradiometric assay (IRMA), principle and set up, Radiopharmaceuticlas, classification of products, preparations, quality control aspects, ^{99}Mo-^{99m}Tc generator, Cylotron based products, PRT studies, Therapeutic applicatyions , Radiotherapy

Semester IV

Paper XV (Code: 4T3)

Elective- Environmental Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water Pollution 15h

Pollutants- Types of pollutants, sources of water pollution, sampling, preservation and storageof water sample, physico –chemical, organoleptic and chemical analysis of water, electro-analytical,optical (UC-visible spectrophotometry, AAS, flame photometry, XRF, ICPAES), chromatographic (GC and HPLC) and neutron activationmethods of analysis of Co, Ni, Cu, Fe, Mn, Zn, Cd, Pb, Hg, As, Cl^- ,F^-, $SO4^{--}$,PO_4^-, NO_3^-. Historical development of detergents, chemistry of soaps and detergents.

Unit-II: Air Pollution 15h

Natural versus polluted air, air quality standards, air sampling, analysis and control of Particulates, Chemistry and analysis of SOx, NOx, CO, ozone, hydrocarbons, CFCs.Chemistry of gaseous, liquid and solid fuels- gasoline and additives, antiknock agents.Air pollution control—control of automobile emission and control measures in thermal power stations.

Unit-III: Soil Pollution 15h

Types and sources of soil pollution, classification of soil pollutants, impact of soil pollutionon air quality, Specifications for disposal of sewage and effluent on land for irrigation andground water recharge. Methodology of waste water disposal on land in India. Impact of usage of land for solid waste disposal both municipal solid waste and industrial solid wastes (fly ashfrom thermal power station, lime sludge from paper and pulp industry), cause of soil erosion,effects of soil erosion, conservation of soil, control of soil pollution.

Unit-IV: Solid waste pollution 15h

Sources, types and consequences, classification of wastes- domestic, industrial, municipal, hospital, nuclear and agricultural and their methods of disposal. Transfer and transport,Recycle, reuse, recovery, conversion of solid wastes -energy / manure.Analysis and monitoring of pesticides.

Impact of toxic chemicals on enzymes, Biochemical effects of As, Cd, Pband Hg, their metabolism, toxicity and treatment.

Semester IV

Paper XV (Code: 4T3)

Elective- Polymer Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Polymerization 15h

Types of polymerization, addition-chain, free radical, ionic polymerization, step polymerization, electropolymerization, ring-opening polymerization.

Unit II: Techniques of polymerization 15h

Techniques of polymerization-suspension, emulsion and bulk polymerization, coordination, polymerization mechanism of Ziegler Natta polymerization, stereospecific polymerization, interfacial polycondensation, mechanism of polymerization.

Unit III: Characterization of polymers 15h

Electronic, IR and NMR spectral methods for characterization of polymers (Block and Graft)

Thermal methods-TGA, DTA, DSC, thermomechanical and X-ray diffraction study, Block and Graft copolymers, random, block, graft co-polymers, methods of copolymerization.

Unit IV: Specific polymers 15h

A) Biomedical polymers: Contact lens, dental polymers, artificial heart, kidney and skin.

B) Inorganic polymers: Synthesis and application of silicon, phosphorous and sulphur containing polymers.

C) Coordination polymers: Synthesis and applications of coordination polymers.

Semester IV

Paper XV (Code: 4T3)

Elective- Medicinal Chemistry

60 h (4 h per week): 15 h per unit 80 Marks

UNIT-I: 15 h

A] Drug rules and drug acts, Overview of Intellectual property right, Indian and International framework for patent protection.

B] Statastical method: For sampling and interpretation of results, Statastic in quality control, T-Test, F-Test, Validation of analytical methods as defined proceeding USP Radio immune analysis, Investigational drugs.

C] Antidiabetic Agents- Type-I and Type-II diabetes, Insulin, thiazolidinediones, Synthesis of ciglitazone.

UNIT-II: 15 h

A] Anti-Viral agents: Inroduction, viral diseases, viral replication, and transformation of cells, investigation of antiviral agents,. Chemotherapy for HIV. Synhesis of: Idoexuidine, acyclovir ,amantadine and cytarabin.

B] Anti-malarial agents: Introduction, malarial parasite, and its life cycle, development of antimalarials, chemotherapy of malaria. Synthesis of: Chloroquin, primaquin, proguanil, and Quinacrine

C] Local Anti-infective drug: Introduction and general mode of action. Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone ,amino salicylic acid, isoniazid, ethionamide, ethambutal, econozole, griseofulvin.

UNIT-III: 15 h

A) Histamines and Antihistamic agents: Introduction, histamine H1-receptor antagonists. Inhibitors of histamine release. Synthesis of: alkyl amines, phenothiazines, piperzines derivatives.

B) Antibiotics: Introduction, β-lactam antibiotics, classification, SAR and chemical degradation of penicillin, cephalosporins-classification , tetracycline antibiotics-SAR,miscellaneous antibiotics. Synthesis of ampicillin, cephradine, methacycline,chloramphenicol

UNIT-IV: 15 h

A) Anthelminitics and antiamoebic drugs: Introduction to Helminthiasis, Anthelminitics, drugs used in cestode infection, drugs used in trematode infection, origin of antiamoebic drug, drugs used in nematode infection. Synthesis of: Clioquinol, Iodoquinol, Haloquinol, Dichlorphen, Niclosamide.

B) Anti-inflammatory drugs: Introduction, etiology of inflammatory diseases. The inflammatory response, biochemical response. Synthesis of: Phenyl butazone and its derivatives, pyrazolone derivatives, pyrole and indole acetic acid derivatives.

Semester IV

Paper XVI (Code; 4T4)

Foundation Course–IIApplied Analytical Chemistry-II

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water treatment 15h

Hardness of water and types of hardness. Problems due to hardness. Removal of hardness by lime-soda process, Zeolite process and synthetic ion-exchange resins. Principle, instrumentation and comparison of these three processes. Numericals based on hardness removal. Desalination of sea-water.

Unit-II: Polymer chemistry and leather analysis 15h

Polymer chemistry: Definition, classification, co-polymers, conducting polymers, determination of acid value, saponification value, iodine value, molar mass by end group analysis- amide and hydroxyl, molecular weight by viscosity method, glass transition temperature of polymers, TGA and DTA studies of polymers.

Analysis of leather: Determination of moisture, acid, free sulphur, total ash, chromic oxide in leather, tensile strength and stretch of leather.

Unit-III: Metallurgy

Ores and minerals, General principles of extraction of metals from ores. Steps involved in metallurgical extraction. Purification and concentration of ores. Extraction of crude metal from concentrated ore-pyrometallurgy, hydrometallurgy and electrolytic processes. Refining of metal. Thermodynamic aspects of metallurgical processes and Ellingham diagram. Furnaces in metallurgy. Metallurgy of Cu, Ag, Au, Al and Fe.

Unit-II: Clinical analysis 15h

General composition of blood, Collection and storage of blood samples, Estimation of chloride, calcium, sodium, potassium and bicarbonate in blood sample. Qualitative tests for reducing sugar. Estimation of blood glucose, urea, uric acid, blood urea-nitrogen, total serum protein, serum albumin, serum creatinine, serum phosphate, serum bilirubin, serum cholesterol. Radioimmunoassay (RIA).

OR

Semester IV

Paper XVI (Code: 4T4)

Core Subject Centric –IISpectroscopy – II

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: 15 h

A] Ultraviolet and visible spectroscopy: Natural line width, line broadening, transition probability, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. General nature of band spectra. Beer- Lambert Law, limitations, Frank-Condon principle, various electronic transitions, effect of solvent and conjugation on electronic transitions, Fiesher Wooodward rules for dienes, aldehydes and ketones. Structure differentiation of organic molecules by UV Spectroscopy

B] Photoelectron spectroscopy: Basic principles, photoelectric effect, ionization process, Koopman theorem, PES and XPES, PES of simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy.

Unit II: Nuclear magnetic Resonance Spectroscopy 15 h

Magnetic properties of nuclei, resonance condition, NMR instrumentation, chemical shift, spin spin interaction, shielding mechanism, factors affecting chemical shift, PMR spectra for different types of organic molecules, effect of deuteration, complex spin spin interaction(1^{st} order spectra), stereochemistry, variations of coupling constant with dihedral angle, electronegativity, Karplus equation etc., classification of molecules as AX, AX_2, AMX, A_2B_2, Shift reagents. NMR studies of ^{13}C, chemical shift in aliphatic, olefinic, alkyne, aromatic, heteroatomic and carbonyl compounds, ^{19}F, ^{31}P. Structure determination of organic molecules by NMR spectroscopy

Unit III: 15 h

A] Application of NMR spectroscopy: FT-NMR, advantages of FT-NMR, two dimensional NMR spectroscopy-COSY, HETCOR, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques, Nuclear overhauser effect, use of NMR in medical diagnosis

B] Problems based on structure determination of organic molecules by using NMR (^{1}H and ^{13}C nuclei) data, Structure elucidation using combined techniques including UV, IR, NMR and mass spectrometry (based on data and copies of the spectra)

Unit IV**:** Diffraction techniques 15 h

X ray diffraction: Braggs condition, Miller indices, Laue method, Bragg method, Debye Scherrer method, identification of unit cells from systematic absences in diffraction pattern, structure of simple lattices and x-ray intensity, structure factor and its relation to intensity and electron density, absolute configuration of molecules.

Electron diffraction: scattering intensity vs scattering angle, Wierl equation, measurement techniques, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces.

Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques, elucidation of structure of magnetically ordered unit cell.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
7] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
8] Fundamentals of Molecular Spectroscopy-CN Banwell
9] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
10] Photoelectron Spectroscopy-Baber and Betteridge
11] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
12] NMR –Basic Principle and Application-H Guntur
13] Interpretation of NMR spectra-Roy H Bible
14] Interpretation of IR spectra-NB Coulthop
15] Electron Spin Resonance Theory and Applications-W gordy
16] Mass Spectrometry Organic Chemical Applications, JH Banyon
17] Spectroscopy- H. Kaur

Semester IV

Practical VIII **(**Code**:** 4PROJ1**)**

Project

12 h/week 100 Marks

Project is a part of practical examination. Project should be carried out by the student under the supervision of Guide/Teacher. The examination shall be conducted by External and Internal Examiners. Students are supposed to present their work either on LCD Projector / OHP or blackboard.

The division of marks will be as follows**:**

For written Project Work	: 40 Marks	- Evaluated jointly by External and Internal Examiners
Presentation	: 20 Marks	- Evaluated jointly by External and Internal Examiners
For Viva-Voce	: 20 Marks	- Evaluated by External Examiner
Internal Assessment	: 20 Marks	- Evaluated by Internal Examiner

Note**:** One external examiner shall be appointed for evaluation of group of 6 students**.**

Semester IV

Seminar**-**IV **(**Code**:** 4S1**)**

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 Credit). Seminar should be delivered by the student under the guidance of concerned teacher on thetopic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

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SYLLABUS for M. Sc. Physics
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
With effect from 2018-19

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.
The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

Table of Contents

Revised Syllabus to be implemented from 2018-19
Choice Based Credit System(CBCS)

Subject Scheme of Revised Syllabus 2015-2016 Semester Pattern
Syllabus for Each theory paper is based on 60 clock hours of teaching.

M.Sc. Physics Semester I
1. (Core 1)Paper 1: Mathematical Physics
2. (Core 2) Paper 2: Complex Analysis and Numerical Methods
3. (Core 3) Paper 3: Electronics
4. (Core 4)Paper 4: Electrodynamics I

M.Sc. Physics Semester II
1. (Core 5) Paper 5: Quantum Mechanics-I
2. (Core 6) Paper 6: Statistical Physics
3. (Core 7) Paper 7: Classical Mechanics
4. (Core 8) Paper 8: Electrodynamics II

M.Sc. Physics Semester III
1. (Core 9) Paper 9: Quantum Mechanics-II
2. (Core 10) Paper 10: Solid State Physics and Spectroscopy
3. Any one of the Elective papers from the following list. Paper 11 (Core Elective 1)
E1.1 Materials Science I **E1.2. X-ray I**
E1.3Nanoscience and Nanotechnology I **E1.4. Atomic and Molecular Physics I**
E1.5Applied Electronics I

4. Foundation course 1
Paper 12 (Not for Physics Students) : Physics I (Classical Physics)

Subject Centric Core Course which can be taken in lieu of Foundation course 1.
S1.2 Nanoscience and Nanotechnology **S1.3 Quantum Computing**
S1.4 Digital Electronics and Microprocessor
M.Sc. Physics Semester IV
1. (Core 11) Paper 13: Nuclear and Particle Physics
2. (Core 12) Paper 14: Solid State Physics
3. One of the elective papers from list below Paper 15 (Core Elective 2)
E2.1 Materials Science II **E2.2 X-ray II**
E2.3 Nanoscience and Nanotechnology II **E2.4 Atomic and Molecular Physics II**
E2.5 Applied Electronics II

4. Foundation course 2
Paper 16 (Not for Physics students) : Physics II (Modern Physics)

Subject Centric Core Course which can be taken in lieu of Foundation course 2.
S2.2 Experimental Techniques in Physics S2.3 Communication Electronics
S2.4 Electroacoustics

Semester I Paper 1 (Core 1) 1T1 Mathematical Physics

Unit I

Curvilinear co-ordinate Systems, Physical ideas about gradient, divergence and Curl, Fourier Series : Definition, Dirichlet's condition, Convergence, Fourier Integral and Fourier transform, Convolution theorem, Parseval's identity, Applications to the solution of differential equations,

Unit II

Elementary ideas about tensors, Cartesian tensors, differential of Cartesian tensors, gradient, divergence and curl , Laplacian of Cartesian tensors. Non-Cartesian tensors.Tensor densities and capacities. Differentiation of Non-Cartesian tensors, Chrisoffel symbols. gradient, divergence and curl , Laplacian of Non-Cartesian tensors

Laplace transform of elementary functions – Inverse Laplace transforms – Methods of finding Inverse Laplace transforms – Heaviside expansion formula – Solutions of simple differential equations

Unit III

Linear vector spaces - linear independent bases, Dimensionality, inner product, matrices, linear transformation, Matrices- Inverse, Orthogonal and Unitary matrices, Cayley Hamilton theorem, eigen vectors and eigen value problem, Diagonalization, Complete orthonormal sets of function.

Unit-IV

Linear differential equations, Special Function- Laguerre, Hermite, Legendre polynomials, Special Bessel's function, Spherical harmonics, Generating Function and recursion relations, differential and integral form.

1.Matrices and Tensor in Physics: A.W.Joshi
2. Mathematical Physics: H.K.Dass
3. Vector analysis – Newell
4. Rajput B S, Mathematical Physics, PragatiPrakashan (Meerat) 1999

Semester I Paper 2 (Core 2) 1T2 Complex Analysis and Numerical Methods

Unit I

Definition of Complex Numbers, Equality of Complex Number, Complex Algebra, Conjugate Complex Numbers, Geometrical representation of Complex Number, Geometrical representations of the sum, difference, product and quotient of Complex Number, Cauchy-Rieman Conditions, Analytic functions, Multiply connected regions, Cauchy Theorem, Cauchy Integration formula, Derivatives, problems (Rajput – 283 – 314).

Unit II

Singularities- Poles, Branch Points, Calculus of Residues-Residues Theorem, Cauchy Principle value, Pole Expansion of Meromorphic Functions, Product expansion of entire Functions, problems (Rajput 326 – 384).

UNIT III

Methods for determination of zeros and linear and non-linear single variable algebraic and transcendental equations, (Bisection method, false position method, iteration method, Newton-Raphson method, secant method), Finite differences. Newton's formulae (no proofs)

Unit IV

Lagrange's interpolation, Divided differences. Numerical integration, trapezoid rule, simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule, Linear least squares.

Euler and RungeKutta methods for solving ordinary differential equations. (No proofs)

References:

1. Rajput B S, Mathematical Physics, PragatiPrakashan (Meerat) 1999
2. Introductory Methods of Numerical Analysis: S SSastry
3. Computer Oriented Numerical Methods: V Rajaraman
4. R. V. Churchill, Complex variables and Applications, 7th Edition McGraw Hill
5. Computer oriented Numerical Methods: R.S.Salaria
6. Mathematical Physics: H.K.Dass
7. Higher Engineering Mathematics : B. S. Grewal

Semester I Paper 3 (Core 3) 1T3 Electronics

Unit I

Electronics Semiconductor discrete devices (characteristic curves and physics of p-n junction), Schottky, Tunnel and MOS diodes, Bipolar junction transistor, junction field effect transistor (JFET),Metal-oxide-Semiconductor Field effect transistor (MOSFET), unijunction transistor(UJT) and sillicon controlled rectifier (SCR), Opto-electronic devices (Photo-diode, solar cell, LED, LCD and photo transistor), Diffusion of impurities insillicon, growth of oxide.

Unit II

Applications of semiconductor devices in linear and digital circuits- Zener regulated power supply, Transistor (bipolar, MOSFFT, JFET) as amplifier, coupling of amplifier stages (DC, RC and Transformer coupling), RC-coupled amplifier, dc and power amplifier Feedback in amplifiers and oscillators (phase shift, Hartley, Colpitts and crystal controlled) clipping and clamping circuits. Transistor as a switch OR, AND and NOT gates (TIL and CMOS gates).

Unit III

Digital integrated circuits- NAND and NOR gates building block, X-OR gate, simple combinational Circuits -Half and full address, Flip-Flops, Multivibrators (using transistor) and sweep geneator (using transistors, UJT and SCR). shift registers, counters, A/D and D/A coverters, semiconductor memories (ROM, RAM, and EPROM, basic, architecture of 8 bit microprocessor (INTEL 8085). Linear integrated circuits-Operational amplifier and its applications-Inverting and noninverting amplifier, adder, integrator, differentiator, waveform generator, comparator and Schmittrigger, Butterwoth active filter, phase shifter,

Unit IV

Communication Electronics-Basic principle of amplitude frequency and phase modulation. Simple circuits for amplitude modulation and demodulation, digital (PCM) modulation and demodulation. Fundamentals of optical communication, Microwave Oscillators (reflex, klystron, megnetron and Gunn diode), Cavity resonaters. Standing wave detector.

Textbooks:

1. A. Malvino and D. J. Bates: Electronic Principles (Mc Graw Hill Education, India)
2. Boylstad&Neshishkey, “Electronic devices & circuits” , PHI
3. Milliman, J. Halkias, “integrated elctronics”, Tata McGraw Hill
4. J. J. CatheySchaum’s Outlines “Electronic Devices & Circuits” Tata McGraw Hill.
5. J. D. Ryder,” Electronics Fundamentals and Applications”, John Wiley-Eastern Publications.
6. A. P. Malvino, D.P. Leach, “Digital Principles and Applications”, McGraw Hill Book Co., 4th Edition (1986).
7. Ramakant A. Gayakwad, “Op-amps and Linear Integrated Circuits” PHI
8. Anil Maini, Varsha Agrawal, “ Electronic Devices and acircuits” Wiley
9. George Kennedy, “ Electronic Communication Systems”, Tata McGraw Hill.
10. Dennis Roddy, John Coolen, “Electronic Communication Systems ”, Pearson.

Semester I Paper 4 (Core 4) 1T4 Electrodynamics I

Unit I

Electrostatics: Coloumb's law, Electric field, Charge distribution, Dirac delta function, Field lines, Gauss's law and applications, Differential form of Gauss's law, Electric potential, Poisson and Laplace's equations, Electrostatic potential energy.

Unit II

Electrostatics: Boundary value problems, Uniqueness theorems, Green's theorem, Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion.

Unit III

Magnetostatics: Biot-Savart law, Ampere's law, Differential form of Ampere's law, Vector potential, Magnetic field of a localized current distribution, magnetic moment, Magnetostatics boundary conditions, Magnetic Shielding.

Unit IV

Time varying fields: Faraday's law, Maxwell's displacement current, Maxwell's equations, Maxwell's equations in matter, Scalar and vector potentials, Gauge Transformation, Wave equations, Poynting's theorem, Conservation laws.

Text Books:

1.Introduction to Electrodynamics, David J. Griffith, Prentice Hall of India Private Limited.
2. Classical Electrodynamics, John D. Jackson, Wiley Eastern Limited.
3. Classical Electrodynamics, Tung Tsang, World Scientific Publishing Private Limited.

Semester I Practical 1P1 and 1P2

Practical 1 (core 1 and 2)

1. To find the largest or smallest of a given set of numbers.
2. Bubble sort.
3. To generate and print first hundred prime numbers.
4. Matrix multiplication.
5. To generate and print an odd ordered magic square.
6. Other exercises involving conditions, loop and array
7. Lagrange Interpolation.
8. Method of successive approximation
9. Bisection Method
10. Newton-Raphson Method.
11. Gaussian Elimination
12. Linear Least Squares Fit.
13. Simpson's rule integration.
14. Computation of special functions

Practical 2 (Core 3 and 4)

1. Design of a regulated power supply.
2. Characteristics and applications of silicon controlled rectifier.
3. Design of common emitter Power transistor amplifier.
4. Experiments on bias stability.
5. Negative feedback (Voltage series / shunt and current series / shunt).
6. Astable, Monostable and Bistablemultivibrator.
7. Experiment on FET and MOSFET characterization and application as an
8. amplifier.
9. Experiment on Uni-junction transistor and its application.
10. Digital – I: Basic, TTL, NAND and NOR.
11. Digital – II: Combinational logic.
12. Flip-Flops.
13. Study of modulation (FM, AM, etc.).
14. Operational Amplifier.
15. Differential Amplifier.
16. Microprocessor.
17. Verification of Biot-Savart law.
18. Verification of Faraday's Law

Semester II Paper 5 (Core 5) 2T1 Quantum Mechanics I

Unit- I

Time dependent and time-independent Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states.

Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest's theorem, momentum eigen functions in the coordinate representation, box normalization and Dirac delta function.

Coordinate and momentum representations, Schrodinger equation in momentum representation,

Unit-II

Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, eigen values and eigen vectors, hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations.

Matrix representation of operators, change of basis, unitary transformations,

quantum dynamics, Schrodinger, Heisenberg and interaction picture.

Unit-III

Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method.

Angular momentum operator, commutation relations, expression for L^2 operator in spherical polar coordinates, Role of L^2 operators in central force problem, eigen value problem for L^2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator.

Unit-IV

Generalized angular momentum, raising and lowering operators, matrices for J^2, Jx, Jy, Jzoperators,Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions.

Text and Reference Books:

1. Quantum mechanics: E. Merzbacher
2. Quantum mechanics: L.I.Schiff
3. Quantum mechanics: Mathews and Venkatesan
4. Quantum mechanics :Ghatak and Loknathan
5. Quantum mechanics: B.Craseman and J.D.Powell
6. Modern quantum mechanics: J.J.Sakurai
7. Quantum Theory D. Bohm, (Asia Publishing House)
8. Quantum Mechanics: 500 problems with Solutions: Aruldhas (PHI)

Semester II Paper 6 (Core 6) 2T2 Statistical Physics

Unit I

Fundamentals of classical statistical mechanics, microstate and macrostate, distribution function, Liouville's theorem, Gibbs Paradox, ensembles (micro-canonical, canonical and grand-canonical), partition function, free energy and connection with thermodynamic quantities, energy and density fluctuations

Unit II

Fundamentals of quantum statistical mechanics, BE and FD Statistics, Symmetry of wave functions, Boltzmann limit of Bosons and Fermions, Ideal Bose system: Bose-Einstein condensation, Behaviour of ideal Bose gas below and above Bose temperature, Photons and liquid helium as bosons.

Unit III

Ideal Fermi system: Weak and strong degeneracy, Fermi function, Fermi energy, Behaviour of ideal Fermi gas at absolute zero and below Fermi temperature, Fermionic condensation, Free electrons in metals as fermions, Electronic specific heat,
Cluster expansion for classical gas, Virial equations of states.

Unit IV

Phase transition: Phase transition of first and second order, Landau theory of phase transition, Ising model, Order parameter, Critical exponents, Scaling hypothesis, Random walk, Brownian motion, Langevin theory, Correlation function and fluctuation-dissipation theorem, Fokker-Planck equation. Weiss theory of ferromagnetism.

Text and Reference Books:

1. Fundamentals of Statistical Physics: B. B. Laud
2. Statistical Mechanics: R. K. Pathria
3. Statistical Mechanics: S. K. Sinha
4. Statistical and Thermal Physics: F. Reif
5. Statistical Mechanics: K. Huang
6. Statistical Mechanics: Loknathan and Gambhir
7. Statistical mechanics: R. Kubo
8. Statistical Physics: Landau and Lifshitz

Semester II Paper 7 (Core 7) 2T3 Classical Mechanics

Unit-I

Survey of elementary principles of mechanics of a particle, Dynamical systems, Phase space dynamics, stability analysis, constraints & their classifications, D'Alemberts Principle, Variational Principle, Lagrange's equation, Hamilton's Principle

Unit-II

Conservation theorems and symmetry properties, Hamiltonian formalism, Hamiltons equations, Routh's procedure for cyclic coordinates, conservation laws
Canonical transformations, Poisson brackets and Poisson theorems, Hamilton-Jacobi Theory

Unit-III

Central force motion, reduction to one body problem, equations of motions and first integrals , classification of orbits for inverse square central forces. Two body collisions, Rutherford scattering in laboratory and centre-of-mass frames;

Unit-IV

Rigid body dynamics, Euler's angles, Euler's theorem, moment of inertia tensor, eigen values and principal axis transformation, non-inertial frames and Pseudo forces, Periodic motion,: small oscillations, normal modes.

Text and Reference books:

1. Classical Mechanics: H. Goldstein
2. Classical Mechanics: N.C.Rana and P.S.Joag
3. Classical Mechanics : J. C. Upadhyaya (Himalaya Publishing House)

Semester II Paper 8 (Core 8) 2T4 Electrodynamics II

Unit-I

Scalar waves : Plane waves, spherical waves, phase and group velocities and wave packets Vector waves : Electromagnetic plane waves, harmonic plane waves, elliptic linear and circular polarization, Stokes parameters (iii) Reflection and refraction of plane waves, Fresnel polarization on reflection and refraction, (iv) Propagation in dielectric films.

Unit-II

Symmetries of Maxwell equations : Lorentz transformations, Covariance of electrodynamics, Lorentz gauge condition, equation of continuity and Maxwell equations, electrodynamics field tensor and its transformation.

Unit-III

Motion of a charge in EM fields : Lorentz force, motion in uniform, static, electric and magnetic fields and combined static EM fields.

Electric dipole, electric quadrupole and magnetic dipole radiation, Radiation by a moving charge :Lienard-Wiechert potentials of a point charge, Larmor's formula, Angular distribution of radiation. Fields and radiation of a localized oscillating source, Bremstrahlung, Synchrotron radiation.

Unit-IV

Wave guides : fields on the surface and within a hollow metallic conductor,TE, TM, TEM modes in a rectangular and cylindrical wave guide, Resonant Cavities, Dielectric waveguides.

Reference Books

1.Introduction to Electrodynamics: David Griffiths (PHI)
2. Electrodyanamics J. D. Jackson
3. Introduction to Electrodynamics, A. Z. Capri and P. V. Panat (Narosa)
4. Classical theory of fields, Landau &Lifshitz
5. Electrodynamics, W. Panofsky and M. Phillips
6. Principles of Optics, M. Born & E. Wolf Pergamon Press
7. Electromagnetism and Classified Theory, A. D. Barut, Dover

Semester II Practical 2P1 and 2P2

Practical 3 (C5 and C6)

1. Study of B-H Curve
2. Determination of e/m of electron by normal Zeeman effect using Febry Perot Etalon.
3. Determination of Lande's factor of DPPH using ESR spectrometer
4. Determination of e/m by Thomson method.
5. Determination of e/m by Busch's helical beam method.
6. Study of paramagnetic to ferromagnetic phase transition.
7. Study of Paramagnetic salt by Guoy's balance
8. Differential scanning Calorimetry
9. Determination of Plank's constant.
10. Determination of Stephan's constant.
11. Simulation of Ising model.
12. Location of critical point in Ising model using Binder cumulant.
13. Simulation of random walk.
14. Simulation of mean field model of para-ferro transition.
15. Numerical solution of particle in a box.
16. Simulation of Maxwell's velocity distribution.

Practical 4 (core 7 and 8)

1.Study of Focault pendulum
2.Study of Bifilar pendulum
3.Fibre optics
4.Study of waveguide
5.Thickness of thin wire with lasers
6.Measurement of wavelength of He-ne laser light using ruler.
7.To study Faraday effect using He-Ne laser.
8.Simulation of simple pendulum
9.Simulation of compound pendulum
10. Simulation of planetary motion.

Semester III Paper 9 (Core 9) 3T1 Quantum Mechanics II

Unit- I

Time independent perturbation theory, First order perturbation theory applied to non-degenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic oscillator.

Unit II

Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission, atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein's A and b coefficients and their calculations.

Approximation methods: W. K. B. method and its application to barrier penetration.

Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential.

Unit III

System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.

Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule.

Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential, Partial wave method, phase shifts and their importance, scattering by a square well potential and a perfectly rigid sphere, resonance scattering.

Unit IV

Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac's relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac's theory, negative energy states and their qualitative explanations.

Text and References Books:

1. E. Merzbacher, Quantum Mechanics (Wiley and Sons-Toppon)
2. J. L. Powell and B. Crasemann, Quantum mechanics (B I Publications)
3. L. I. Schiff, Quantum Mechanics (McGraw-Hill)
4. Quantum Mechanics: Aruldhas
5. Pauling and Wilson, Introduction to Quantum Mechanics
6. A.K. Ghatak and Lokanathan, Quantum Mechanics (Macmillan, India)
7. Quantum Mechanics: 500 problems with Solutions: Aruldhas (PHI)

Semester III Paper 10 (Core 10) 3T2 Solid State Physics and Sprectroscopy

Unit I: Order in Solids-Crystal classes and system, 2d and 3d lattices, Space groups, b Concept of point group, bonding of common crystal structure; reciprocal lattice, diffraction and structure factor, Miller and Bravais indices, Bonding, diffraction and structure factor in solids, short and long range order in liquids and solids, liquid crystals, quasicrystals and glasses

Unit II

Defects: Vacancies, Point defects, line defects and stacking faults, Burgers vector and Burger circuit, presence of dislocation, dislocation motion, perfect and imperfect dislocations, slip planes and slip directions, dislocation reactions

Dielectric Properties: -Polarization mechanisms, Clausius-Mossotti equation, piezo, pyro and ferroelectricity

Unit III

Atomic Structure and Atomic Spectra : Quantum states of an electron in an atom. Electron spin.Spectrum of helium and alkali atom. Some features of one-electron and two electron atoms, Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Inner shell vacancy, X-rays and Auger transitions.chemical shift. Frank-Condon principle.

Unit IV

Molecular Structure and Molecular Spectra : Types of molecules, Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule, PQR branches. Elementary discussion of Raman, ESR and NMR spectroscopy, chemical shift

Reference Books: 1. Physics of Atoms and Molecules: Bransden and Joachain.
2. Introduction to Atomic Spectra: H.E. White.
3. Solid State Physics, Charles Kittel, John Willey & Sons
4. Molecular Spectra and Molecular Spectroscopy (Vol. 1), G. Herzberg
5. Introduction to Atomic Spectra: HG Kuhn
6. Fundamentals of molecular spectroscopy, C.B. Banwell
7. Introduction to molecular Spectroscopy , G. M. Barrow
8. Introduction to Solid State Physics: C. Kittle
9. Materials Science and Engineering: V. Raghavan
10. Solid State Physics: S. O. Pillai (New Age International 2006)
11. Ferroelectricity Jona and Shirane

Semester III Practical 3P1

Practical 5 (Core 9 and Core 10).

1.Determination of ionization potential of lithium
2.X-ray diffraction by TELEXOMETER.
3.Study of emission spectra of iron (Iron arc).
4.Determination of Dissociation Energy of Iodine Molecule by photography of the absorption band of Iodine in the visible region.
5.Study of Stark effect
6.Study of Molecular Spectra
7.Determination of Rydberg's constant
8.Determination of Plank's constant
9. Study of Crystals
10. Study of line spectra

Semester III Paper 11 (Core Elective E1.1) 3T3 Materials Science I

Unit- I

Equilibrium and kinetics: Stability and metastability, Basic thermodynamic functions, Statistical nature of entropy, Kinetics of thermally activated process.

Phase diagrams: The phase rule, free energy composition diagram, correlation between free energy and phase diagram, calculation of phase boundaries, thermodynamics of solutions, single component system (water), two component system containing two phases and three phases, Binary phase diagrams having intermediate phases, Binary phase diagrams with eutectic system. Lever principle, maximum, minimum, super lattice, miscibility gap, microstructure changes during cooling, application to zone refining.

Unit – II

Phase transformations: Time scale for phase changes, peritectic reaction, eutectoid and eutectic transformations, order disorder transformation, transformation diagrams, dendritic structure in alloys, transformation on heating and cooling, grain size effect on rate of transformation at constant temperature and on continuous cooling, grain size effect on rate of transformation, nucleation kinetics, growth kinetics, interface kinetics leading to the crystal growth.

Unit-III

Diffusion in solids: Fick's laws and their solutions, the Kirkendall effect, mechanism of diffusion, temperature dependence of diffusion co-efficient, self diffusion, interstitial diffusion, the Snoek effect in diffusion, diffusion in ionic crystals, diffusion path other than the crystal lattice, thermal vibrations and activation energy, diffusion of carbon in iron.

Solid State Ionics: Definition, classification and characteristic properties of solid electrolytes. Complex impedance spectroscopy, Arrhenius theory of ionic conductivity. Chemical sensors: Nernst equation, potentiometer and amperometric sensors for various gases, electrochemical redox-reaction, advantages of electrochemical sensors.

UNIT-IV

Solid state energy devices: Fundamental of Solar cells, Primary and secondary solid state cells, advantages of lithium batteries, ion intercalation compounds for secondary cell, open circuit voltage and short circuit current, intercalation compounds for secondary cell, open circuit voltage and short circuit current, Energy density, power density. Fuel cells –advantages and disadvantages, classification, efficiency- emf of fuel cells, hydrogen/oxygen fuel cell, criteria for the selection electrode and electrolyte, methanol fuel cell, solid oxide fuel cells, phosphoric acid fuel cells, molten carbonate fuel cell, proton exchange membrane fuel cell, biochemical fuel cell.

Text and Reference books:

1. Vanvellak: Materials Science.
2. V. Raghvan: Materials Science.
3. D. Kingery: Introduction to ceramics.
4. R. E. Reedhil: Physical metallurgy.
5. Martin Start Sharger: Introductory materials.
6. Sinnot: Solid state for engineers.
7. Kelly and Groves: Crystal and defects.
8. Kittel: Solid state physics, Vth edition.
9. M. A. Azaroff: Elements of crystallography
9. Introduction to solid state theory: Modelung.
10. Fuel Cells – A. Mcdougall, Macmillan 1976 Ch 3,5,7,8 and 11.

Semester III Paper 11 (Core Elective E1.2) 3T3 X-ray I

Unit I

Production of X-rays: Continuous and characteristic X-ray spectra. X-ray emission from thick and thin targets. Efficiency of X-ray production.Various types of demountable and sealed X-ray tubes.

Basics of high-tension circuits and vacuum systems used for the operation of X-ray tubes.

Synchrotron radiation: Production and properties of radiation from storage rings, Insertion devices.

Unit II

Absorption of X-rays: Physical process of X-ray absorption. Measurement of X-ray absorption coefficients.Units of dose and intensity.Radiography, Microradiography and their applications.

X–ray fluorescence: Fluorescence yield. Auger effect.X–ray fluorescence analysis and its applications.Techniques and applications of Photoelectron spectroscopy and Auger electron spectroscopy.

Unit III

X-ray spectroscopy: Experimental techniques of wavelength and energy dispersive x-ray spectroscopy.

Bragg and double crystal spectrographs.Focusing spectrographs.Dispersion and resolving power of spectrographs, Photographic and other methods of detection, resolving power of detectors.

X–ray emission and absorption spectra.Energy level diagram. Dipole and forbidden lines, Satellite lines and their origin, Regular and irregular doublets. Relative intensities of X-ray lines.

Unit IV

Chemical Effects in X-ray Spectra: Chemical effects in X-ray spectra. White line, Chemical Shifts of absorption edges, Fine structures (XANES and EXAFS) associated with the absorption edges and their applications.

Dispersion Theory: Dispersion theory applied to X-rays, Calculation of the dielectric constant, Significance of the complex dielectric constant, Refraction of X-rays, Methods for measurement of refractive index

Text and Reference Books:

1. A. H. Compton and S. K. Allison: X-rays in Theory and Experiment
2. J. A. Nielsen and D. Mc. Morrow: elements of Modern X-ray Physics.
3. M. A. Blokhin: X-ray Spectroscopy.
4. E. P. Bertin: Principles and Practice of X-ray Spectrometric Analysis.
5. C. Bonnelle and C. Mande: Advances in X-ray Spectroscopy.
6. D. C. Koningsberger and R. Prins: X-ray Absorption Principles, Applications, Techniques of EXAFS, SEXAFS and XANES.
7. C. Kunz: Synchrotron Radiation.

Semester III Paper 11 (Core Elective E1.3)3T3 Nanoscience and Nanotechnology I

Unit I:

Introduction to Nanoscience:

Free electron theory (qualitative idea) and its features, Idea of band structure, Density of states for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size, Structure property relation, Size dependence properties. Determination of particle size, Increase in width of XRD peaks of nano-particles, Shift in photoluminescence peaks, Variation on Raman spectra of nano-materials.

Unit II:

Synthesis of Nanomaterials:

Physical methods**:** High energy Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Laser ablation, Laser pyrolysis, Sputter deposition, Electric arc deposition, Photolithography.

Chemical methods**:** Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Microemulsions, Sol-gel method, Combustion method, Wet chemical method

Unit III:

Nanomaterials Characterizations:

X-ray diffraction, UV-VIS spectroscopy, Photoluminescence spectroscopy, Raman spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Scanning Tunnelling Electron Microscopy, Atomic Force Microscopy, Vibration Sample Magnetometer, Spintronics

Unit IV:

Special Nanomaterials and Properties:

Carbon nanotubes, Porous silicon, Aerogels, Core shell structures. Self assembled nanomaterials. Metal and semiconductor nanoclusters

Mechanical, Thermal, Electrical, Optical, Magnetic, Structural properties of nanomaterials

Text and Reference books:

1. Nanotechnology: Principles &Practicals. Sulbha K. Kulkarni ,Capital Publishing Co.New Delhi.

2. Nanostructures & Nanomaterials Synthesis, Properties & Applications**.** Guozhong Cao, Imperials College Press London.

3.Nanomaterials: Synthesis, Properties & Applications**.** Edited by A.S. Edelstein &R.C.Commorata.Institute of Physics Publishing, Bristol & Philadelphia.

4. Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student ed.

5. Nano: The Essentials. T.Pradeep , McGraw Hill Education.

6. Handbook of Nanostructures: Materials and Nanotechnology. H. S. Nalwa Vol 1- 5, Academic Press, Bostan.

7. Hand Book of Nanotechnology, Bhushan

8. Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng

Semester III Paper 11 (Core Elective E1.4) 3T3 Atomic and Molecular Physics I

Unit I

Quantum states of an electron in an atomic Electron spin, spectrum of hydrogen, Helium and alkali atoms, Relativistic corrections for energy levels of hydrogen; Basic principles of interaction of spin and applied magnetic field.

Concepts of NMR spectroscopy concepts of spin-spin and spin-lattice relaxation, chemical shift; spin-spin coupling between two and more nuclei; chemical analysis using NMR.

Mossbauer effect-Recoil less emission of gamma rays, chemical shieft, magnetic hyperfine interaction,

Unit II

electron spin resonance, experimental setup, hyperfine structure and isotopic shift,width of spectral lines, LS & JJ coupling, Zeeman, Paschen Back & Stark effect. Spontaneous and Stimulated emission, Einstein A & B Coefficients; LASERS, optical pumping, population inversion, rate equation, modes of resonators and coherence length, Role of resonant cavity, three and four level systems, Ammonia MASER, ruby, He-Ne, CO_2, dye and diode lasers, Lasers applications

Unit III

Rotational, vibrational and Raman spectra of diatomic molecules, Quantum theory, Molecular polarizability, Intensity alteration in Raman spectra of diatomic molecules, Experimental setup for Raman spectroscopy in the structure determination of simple molecules. polyatomic molecules, symmetric top asymmetric top molecules. Hunds rule.

Unit IV

Electronic spectra of diatomic molecules, Born Oppenheimer approximation, Vibrational Coarse structure of electronic bands, intensity of electronic bonds, Franck Condon principle, and selection rules,dissociation and pre dissociation, dissociation energy, rotational fine structure of electronic bands. General treatment of molecular orbitals, Hund's coupling cases.

Text Book and References:

1. Molecular Spectroscopy: - Jeane L. McHale.
2. Mossbauer spectroscopy –M. R. Bhide.
3. NMR and Chemistry – J. W. Akitt.
4. Structural Methods in inorganic chemistry, E.A V.Ebsworth, D. W. H.Rankin, S.Crdock.
5. Introduction to Atomic Spectra – H. E. White.
6. Fundamental of Molecular Spectroscopy – C. B. Banwell.
7. Spectroscopy Vol. I, II and III, Walker and Straghen.
8. Introduction to Molecular Spectroscopy – G. M. Barrow.
9. Spectra of diatomic molecules – Herzberg.
10. Molecular spectroscopy – Jeanne L. McHale.
11. Molecular spectroscopy – J. M. Brown.
12. Spectra of Atoms and Molecules – P. F. Bemath.
13. Modern Spectroscopy – J. M. Holkas.
14. Laser spectroscopy and instrumentation- Demtroder

Semester III Paper 11 (Core Elective E1.5) 3T3 Applied Electronics I

Unit – I

Operational Amplifiers, Block diagram of a typical operational amplifier, analysis, open loop configuration, inverting and non-inverting amplifiers, operational amplifier with negative feedback,voltage series feedback, effect of feedback on close loop gain, input resistance output resistance bandwidth and output offset voltage, voltage follower. Practical operational amplifier, input offset voltage, input bias current, input off set current, total output off set voltage, CMRR, frequency response, dc and ac amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, integrator and differentiator.Application of Op-Amp as fixed and variable voltage regulator. Oscillators principles- Barkhausen criterion for oscillations, The phase shift oscillator, Weinbridge oscillator, LC tunable oscillator, multi-vibrators, mono-stable and astable, comparators, square wave and triangular wave generators

UNIT II

Communication electronics: Amplitude modulation , generation of AM waves, demodulation of AM waves, DS BSC modulation, generation of DSBSC waves, coherent detection DSBSC wave, SSB modulation, generation and detection of SSB waves, Vestigial sideband modulation, frequency division multiplexing (FDM).

Microwave communication: Advantage and disadvantage of microwave transmission, loss in free space propagation of microwaves, atmospheric effect on propagation, Fresnel zone problem, ground refection,fading sources, detector components, antennas used in microwave communication systems

Unit – III

Microprocessor: Introduction to microcomputers, Memory. Input-output devices, interfacing devices.8085 CPU, architecture, bus timing, de-multiplexing, the address bus, generating control signals,instruction set, addressing modes, illustrative programmes, assembly language programmes, looping, counting and indexing, counters and timing delay, stack and sub routings. read only memory (ROM) and applications. Random access memory (RAM) and applications,

Digital to analogue converters. Ladder and weighted register types, analog to digital converters, ,successive approximations and dual slop converters, application of DAC and ADC,

Unit – IV

Microwave devices: Klystrons, magnetrons, and travelling wave tubes, velocity modulation, basic principle of two cavity klystrons and reflex klystrons, principle of operation of magnetrons, Helix travelling wave tubes, wave modes, transferred electron devices, gunn effect, principle of operation,modes of operation, read diode, IMPATT diode, TRAPATT diode..

Text and Reference Books:

1. Electronic devices and circuit theory: RobortBoylested and L. Nashdsky (PHI, New Delhi).
2. OP-Amps and linear integrated circuits: Ramakanth A. Gayakwad (PHI 2nd Edn).
3. Digital principles and Applications: A. P. Malvino and D. P. Leach (Tata Ma-Graw Hill).
4. Microprocessor architecture, programming and Application with 8085/8086, Ramesh S. Gaonkar(Wiley-Estern).
5. Microelectronics: Jacob Millman (Mc-Graw Hill International).

6. Optoelectronics: Theory and Practices: Edited by Alien Chappal (Mc Graw Hill).
7. Microwaves: K. L. Gupta (Wiley Ester New Delhi).
8. Advanced electronics communication systems: Wayne Tomasi (Phi Edn).
9. Fundamentals of microprocessors and Micro-computers: B. Ram. (Dhanpat Rao and Sons.).

Semester III Paper 12 (Foundation course F1.1) 3T4 Physics I

(Classical Physics)

Unit 1

Kinetic Energy and Work, Work done by gravitational force, Work done by spring, Work done by general variable force, power.

Potential energy, path independence of conservative force, determining potential energy, conservation of mechanical energy, work done on system by force, conservation of energy.
(Ch. 7 and 8 of Ref. 1)

Unit 2

Rotation, nature of angular quantities, kinetic energy of rotation, Newton's second law for rotation, Work and rotational energy.
Rolling as translation and rotation, kinetic energy of rolling, forces of rolling, torque, angular momentum, Newton's second law in angular form. Angular momentum of system of particles, angular momentum of rigid body rotation about a fixed axis. Conservation of angular momentum
(Ch. 10 and 11 of Ref. 1)

Unit 3

Equilibrium, requirements of equilibrium. Centre of gravity, examples of static equilibrium, indeterminate structures.

Fluids, density and pressure, measuring pressure, Archimedes principle, Paskal's principle, ideal fluids in motion, equation of Continuity, Bernoulli's equation.
(Ch. 12 and 14 of Ref. 1)

Unit 4.

Avogadro's number, ideal gases, pressure temperature and rms speed, translated kinetic energy, molar specific hear, adiabatic expansion of ideal gas
Irreversible process and entropy, changes in entropy, second law of thermodynamics, examples of entropy in real world, efficiencies of real engines, statistical view of entropy.
(Ch. 19 and 20 of Ref. 1)

References:

1. Halliday, Resnick and Walker “Principles of Physics” International Students Version 9^{th} Ed.

Semester III Practical 3P2 for elective papers

Practical 6 (elective)

Materials Science

1. Crystal structure determination by powder diffraction.
2. Study of microstructures of metal alloys.
3. Dislocation in alkali halide crystals.
4. Crystal growth from slow cooling of the melt.
5. Thermal analysis of binary alloy.
6. Differential thermal analysis of $BaTiO_3$-$PbTiO_3$ solid solution.
7. To study electrochemical method of corrosion control.
8. Dielectric behaviour of $LiNbO_3$ and $BaTiO_3$ in crystals and ceramics.
9. Electrical conductivity of ionic solids.
10. To test hardness of a material by Brinell hardness tester.
11. Photo elasticity study.
12. Multiple beam interferromentric study of surfaces.
13. Thermal conductivity of bad conductor. 14. Thermal expansion coefficient of metals.
15. Study of transport property in solid electrolytes.
16. Verification Nernst law/Oxygen sensor.
17. Determination of Thermoelectricity Power.

X-Rays

1. Study of Crystal Models.
2. X-ray Diffraction Photograph of a Metal Foil by transmission (Hull Method).
3. X-ray Diffraction Photograph of a Metal Foil by Back Reflection.
4. Powder Photograph by Debye Scherrer Method, Computer Analysis.
5. Laue Photograph and Gnomonic Projection.
6. Rotation oscillation Photograph.
7. Diffraction of X-rays by Liquids.
8. Bragg's Spectrometer: Uhler and Cooksey's method. 55
9. Bent Crystal (Cauchois) Transmission Type Spectrograph: Study of K and L Absorption Edges.
10. Bent Crystal (Cauchois) Transmission Type Spectrograph: Study of K and L emission Spectra.
11. Measurement of Intensities of Emission Lines, Computer Analysis.
12. Study of Satellite Lines. 13. Analysis of XANES Spectrum, Computer Analysis.
14. Analysis of EXAFS Spectrum, Computer Analysis.
15. Determination of Planck's constant by X-rays.
16. X-ray Fluorescence Spectrum Analysis.
17. Absorption Coefficient for X-rays by G. M. / Scintillation Counter.
18. Characteristics of G. M. tube.
19. Compton Effect.
20. Operation of a Demountable X-ray Tube.

Nanoscience and Nanotechnology

1. Synthesis of metal oxide nanoparticles by wet chemical method.
2. Deposition of thin films by spray pyrolysis technique.
3. Synthesis of inorganic nanomaterials by combustion method.

4. Synthesis of nanomaterials by sol-gel method.
5. Synthesis of conducting polymer nanofibres by chemical oxidation method.
6. Study of optical absorption of nanoparticles.
7. Determination of particle size of nanomaterials from x-ray diffraction.
8. Study of photoluminescence of well known luminescent nanoparticles.
9. Deposition of thin films by spin coating method.
10. Thermoluminescence study of nanomaterials.
11. Deposition of thin films by dip coating technique.
12. Study of particle size effect on luminescence.
13. Electrical characterization of nanostructured materials.
14. Synthesis of metal oxide nanoparticles by hydro-thermal method.
15. Deposition of thin film in vacuum.
16. Electrical resistivity of nanomaterials using four probe method
17. Photoluminescence study of prepared red/blue/green luminescent nanomaterials.
18. Characterization of nanomaterials using SEM/TEM.
19. Computer modelling methods for studying materials on a wide variety of length and time scales.

Atomic and Molecular Physics

1. Study of line spectra on photographed plates/films and calculation of plate factor.
2. Verification of Hartman's dispersion formula.
3. Study of sharp and diffuse series of potassium atom and calculation of spin orbit interaction constant.
4. Determination of metallic element in a given inorganic salt.
5. To record the spectrum of CN violet bands and to perform vibrational analysis.
6. To record the visible bands of ALO and to perform vibrational analysis.
7. To photograph and analyse the reddish glow discharge in air under moderate pressure.
8. To photograph the analyse the whitish glow discharge in air under reduced pressure.
9. To perform vibrational analysis of a band system of N2.
10. To perform vibrational analysis of band system of C2
11. To photograph and analyse the line spectrum of Calcium atom.
12. To record/analyse the fluorescence spectrum of a sample.
13. To record/analyse the Raman spectrum of a sample.
14. Study of Hyperfine structure of the green line of mercury.
15. To photograph the (O, O) band of CuH and to perform rotational analysis.
16. Flashing & quenching in Neon Gas.
17. E/m of electron.
18. Experiments on Prism/Grating Spectrometer.
19. Wavelength of laser light.
20. Faraday effect with laser.
21. Michelson interferometer.
22. Analysis of ESR Spectra of transition metals.
23. Analysis of H-atom spectra in minerals.
24. Measurements of dielectric constant of polymer sheet at low frequency.
25. E.S.R. of DPPH.
26. To measure the dielectric constant and polarisation of unknown liquid.
27. To measure the dielectric constant of unknown wood at microwave frequency
28. To measure the ultrasonic velocity in unknown liquid.

29. He-Ne Layer
30. To study polarisation of sodium light
31. To study polarisation of light using Babinet compensator

Semester III (Subject Centric Core Course S1.2) 3T4 Nanoscience and Nanotechnology

Unit I: Introduction to Nanoscience

Introduction to quantum physics, electron as waves, wave mechanics, Schrödinger equation and particle in a box, Free electron theory (qualitative idea) and its features, Idea of band structure, Density of states for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size, Size dependence properties. Determination of particle size, Increase in width of XRD peaks of nano-particles, Shift in photoluminescence peaks, Variation on Raman spectra of nanomaterials.

Unit II: Nanomaterials Synthesis

Physical methods**:** High energy ball milling, Physical vapour deposition, Ionised cluster beam deposition, Laser ablation, Laser pyrolysis, Sputter deposition, Electric arc deposition, Photolithography.

Chemical methods**:** Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Microemulsions, Sol-gel method, Chemical bath deposition, Wet chemical method.

Unit III: Nanomaterials Characterizations

X-ray diffraction, UV-VIS spectroscopy, Photoluminescence spectroscopy, Raman spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Scanning Tunnelling Microscopy, Atomic Force Microscopy, Vibration Sample Magnetometer.

Unit IV: Special Nanomaterials and Properties:

Special Nanomaterials: Carbon nanotubes, Porous silicon, Aerogels, Core shell structures. Self assembled nanomaterials.

Properties of nanomaterials: Mechanical, Thermal, Electrical, Optical, Magnetic, Structural.

Text and Reference books:

a. Nanotechnology: Principles & Practicals. Sulbha K. Kulkarni ,Capital Publishing Co.New Delhi.
b. Nanostructures & Nanomaterials Synthesis, Properties & Applications**.** Guozhong Cao, Imperials College Press London.
c. Nanomaterials: Synthesis, Properties & Applications**.** Edited by A.S. Edelstein & R.C.Commorata. Institute of Physics Publishing, Bristol & Philadelphia.
d. Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student Edition.
e. Nano: The Essentials. T.Pradeep , McGraw Hill Education.
f. Handbook of Nanostructures: Materials and Nanotechnology. H. S. Nalwa Vol 1-5, Academic Press, Bostan..
g. Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng
h. Hand Book of Nanotechnology, Bhushan

(This course cannot be offered to students opting for elective Nanoscience and Nanotechnology E1.3 and E2.3)

Semester III (Subject Centric Core Course S1.3) 3T4 Quantum Computing

Unit 1 Introducing quantum mechanics:
Quantum kinematics, quantum dynamics, quantum measurements.Single qubit, multiqubits, gates. Density operators, pure and mixed states, quantum operations, environmental effect, decoherence. Quantum no-cloning, quantum teleportation.

Unit 2 Introduction to quantum algorithms.
Deutsch-Jozsa algorithm, Grover's quantum search algorithm, Simon's algorithm. Shor's quantum factorization algorithm.

Unit 3 Quantum Cryptography:

Cryptography, classical cryptography, introduction to quantum cryptography. BB84, B92 protocols. Introduction to security proofs for these protocols.

Unit 4 Quantum Entanglement:

Quantum correlations, Bell's inequalities, EPR paradox.

Theory of quantum entanglement. Entanglement of pure bipartite states.

Entanglement of mixed states. Peres partial transpose criterion. NPT and PPT states, bound entanglement, entanglement witnesses

Textbook

Nielsen, Michael A., and Isaac L. Chuang. *Quantum Computation and Quantum Information.* Cambridge, UK: Cambridge University Press, September 2000. ISBN: 9780521635035.

N. David Mermin “Quantum Computer Science: An introduction” Cambridge University Press (2007).

Semester III (Subject Centric Core Course S1.4) 3T4 Digital Electronics and Microprocessor

Unit–I:

Logic gates: Characteristics of TTL, ECL, CMOS circuits with reference to fan in / out noise, speed, power dissipation with suitable examples. Simplifying logic circuits: Algebric method SOP (minterm) and POS (maxterma) forms. Karnaugh mapping Fundamental products, pairs, gaurds, octats, Don□t□s care conditions.

Complementary Karnaugh map. Diagonal adjacencies. NAND-NAND and NOT-NOR networks. Applications of K maps to half adder, full adder. Arithmetic circuits: Number representation. Binary point, negative numbers, sign and magnitude. 1s and 2 s complement adder, parallel binary adder, BCD addition, parallel BCD adder, binary multiplication and division

Unit – II

Multiplexers, demultiplexers : IC 74150 multiplexer and IC 74154 demultiplexer.

Tristate buffers, their use in bus organization. Key board encoders, BCD, octal, Hex and scanned matrix keyboard.

A/D and D/A converters: Weighted resistor and R-2R ladder D/A converters. A/D converter –parallel comparator and Application. ADC 0808, 08116/08117, DAC 0800, look up table, measurement of electrical and physical quantities.

Unit -III:

Memories Allied Devices: Design consideration of Bipolar RAM, MOS memory and dynamic RAM, ROM, EXROM and CCD. Read/Write operation. Expanding memory sizewordsize and word capacity. FIFO and LIFO. Study of 7489 RAM and 745370 RAM and other chip. Magnetic bubble memories. Floppy disks-track and sector organization, data format Winchester disk (hard disk).

Unit – IV:

Microprocessor Architecture: Introduction to architecture, pin configuration etc. of 8086, The parts of up. CPU, memory requirements, numerical data,representation of characters, microprocessor instructions, program storage, instruction execution fetch and execute cycles, addressing modes including simple memory paging, direct scratch and pad addressing. The instruction set including memory reference, immediate conditional jump-shift, change control, stack and program counter, subroutines, flow charts, masking, simple programs.

I/O Systems: Program interrupts including multiple interrupt priorities. Interfacing memory mapping, memory mapped and I/P mapped I/O. Use of decoders, I/O posts. ic 8212.

, IC 8155 and IC8255 (with block diagram of internal circuits) Typical programs using these ICS.

Text and Reference Books

1. Design of Digital Systems : P. C. Pitman (Galgotia Pub).
2. Digital Computer Electronics :A. P. Malvino (TMH).35
3. Digital Fundamentals: T. L. Floyd (Universal Book Stall).
4. Theory and Problems of Digital Principles : R. L. Tokheim (TMH).
5. Modern Digital Electronics : R. P. Jain (TMH).
6. Introduction to UP : A. K. Mathur (PHL).
7. Up and Small Digital Computer Systems for Scientist and Engineers L G. A. Korn, (McGraw Hill).
8. An Introduction to Micro-computer: Adam Osborne(Galgotia).
9. Introduction top 4 bit and 8 bit UP : Adam Osborne

(This course cannot be offered to students opting for elective Applied Electronics E1.5 and E2.5)

Semester IV Paper 13 (Core 11) 4T1 Nuclear and Particle Physics

UNIT 1 ;

Basic nuclear properties; size, radii, shape, and charge distribution, spin, parity, mass, binding energy, semi-empirical mass formula, liquid drop model, nuclear stability, laws of radioactive decay. Nature of nuclear force, elements of deuteron problem, n-n scattering, charge independence and charge symmetry of nuclear forces.Electric and magnetic moments of nuclei.Evidence for nuclear shell structure, single particle shell model-its validity and limitations.

UNIT 2 :

Elementary properties of alpha-, beta-, and gamma-, decay of nuclei, their classification, characteristics and selection rules. Elementary theories of alpha-, beta-, and gamma-, decay. Nuclear reactions- conservation laws, mechanism, and cross section. Nuclear reaction mechanism, compound nucleus, direct reactions. Fission and fusion reactions, nuclear energy, elements of nuclear power.

UNIT 3 :

Interaction of charged particles and electromagnetic radiation with matter. Principles of nuclear radiation detectors: G-M counter, proportional counter, Na(Tl) scintillation detector, semiconductor detectors. Elementary principles of particle accelerators: linear accelerators, Van de Graaf, cyclotron, betatron, synchrocyclotron, ion beam accelerators.

UNIT 4 :

Classification of elementary particles, strong, weak and electromagnetic interaction.Gellmann-Nishijima formula Properties of hadrons, baryons, mesons, leptons, and quarks- their quantum numbers, charge, mass, spin, parity, iso-spin, strangeness etc. Symmetry and conservation laws.Elements of quark model and standard model.Higgs boson.

Text-books recommended:

1) Introductory Nuclear Physics,: Kenneth S Krane, Wiley, New York ,1988.
2) Nuclear and Particle Physics: Brian Martin.
3) Atomic and Nuclear Physics: S.N. Ghoshal.
4) Introduction to Particle Physics : D. Griffiths.
5) Introduction to Nuclear Physics: F. A. Enge, Addison Wesley (1975)
6) Introductory Nuclear Physics: Burcham

Semester IV Paper 14 (Core 12) 4T2 Solid State Physics

Unit I: Band Theory: Bloch theorem, the Kronig- Penney model, construction of Brillouin zones, extended and reduced zone schemes, effective mass of an electron, tight binding approximation. Fermi surface.

Magnetic Properties:

Quantum theory of paramagnetism, magnetism of iron group and rare earth ions,.exchange interactions. Pauli paramagnetic susceptibility

Unit II

Lattice Dynamics: Energy of atomic motions, adiabatic principle, harmonic approximation, cyclic boundary condition.Lattice vibrations of linear monoatomic and diatomic chains.Dispersion relations, acoustic and optical phonons.

Theories of lattice specific heat, Dulong and Petit'slaw, Einstein and Debye models, T^3 law, Born procedure, anharmonicity and thermal expansion.

Unit III: Free Electron Theory: Electrons moving in one and three dimensional potential wells, quantum state and degeneracy, density of states, electrical and thermal conductivity of metals, relaxation time and mean free path, the electrical resistivity of metals, thermonic emission. Seebeck effect, thermoelectric power.

Semiconductors: Free carrier concentration in semiconductors, Fermi level and carrier concentration in semiconductors, effect of temperature on mobility, electrical conductivity of semiconductors, Hall effect in conductors and semiconductors.

Unit IV

Superconductivity, Type I and II super conductors, Meissner effect, isotope effect, London equation, coherence length, elements of B. C. S. theory, tunnelling DC and AC Josephson effect, Ginzberg-Landau Theory macroscopic quantum interference. Josephson junction.high temperature superconductor (elementary).

Text and Reference books:

1. C. Kittle: Introduction to Solid State Physics (2nd and 4th Edition).
2. A. J. Dekker : Solid State Physics.
3. Kubo and Nagamiya : Solid State Physics.
4. Feynman Lectures: Vol. III.
5. Board and Huano : Dynamical Theory of Crystal Lattice.
6. N. W. Ashcroft and D. Mermin: Solid State Physics.

Semester IV Practical 4P1 for core papers

Practicals based on core 11 and core 12

1. Measurement of resistivity of a semiconductor by four probe method at two different temperatures and determination of band gap energy.
2. Measurement of Hall coefficient of given semiconductor: identification of type of semiconductor and estimation of charge carrier concentration.
3. Determination of Hall life of 'In".
4. Determination of range of Beta-rays from Ra and Cs.
5. G-M counter
6. Magnetoresistance by Hall effect
7. Determination of Dielectric constant
8. Random decay of nuclear disintegration using dice (or simulation)

In all 7 practicals, instructor can introduce new and relevant experiments which are not in the list.

Semester IV Paper 15 (Core Elective E2.1) 4T3 Materials Science II

Unit –I

Mechanical response of Materials : Elasticity, model of elastic response, inelasticity, viscoelasticity, stress-strain curves, concept of various mechanical properties such as hardness, yield strength, toughness, ductility, yield toughness, ductility, brittleness, stiffness, young modulus, shear modulus, shear strength, Frenkel model, Peierls-Nabarro relation, Plastic deformation,

Corrosion and degradation of materials – electrochemical considerations – passivity forms of corrosion – corrosion inhibition.

Spintronics and Photonics: Spin glass, magnetic bubbles, domain walls, magnetic multilayers, magnenites, GMR and CMR, DMS materials. Photonic band gap materials.

Unit – II

Concept of Synthesis: Concept of equilibrium and nonequilibrium processing and their importance in materials science.

Synthesis of materials: Physical method – Bottom up: cluster beam evaporation, Ion beam deposition, Gas evaporation, Chemical method – Hydrothermal, combustion, bath deposition with capping techniques and top down: Ball milling. Solvated metal atom dispersion – thermal decomposition – reduction methods – colloidal and micellar approach.

Unit-III

Processing of materials: Metallic and non metallic, Ceramics and other materials. Only basic elements of powder technologies, compaction, sintering calcination, vitrification reactions, with different example, phenomenon of particle coalescence, porosity.Quenching : concept, glass formation

structural characterization:

Diffraction techniques: interpretation of x-ray powder diffraction patterns, Identification & quantitative estimation of unknown samples by X-ray powder diffraction technique Electron and neutron diffraction.

Unit –IV

Structural determination by fluorescent analysis. Theory and method of particle size analysis. Integral breadth method, Warren-Averbach's Fourier method, profile fitting method.

Microscopic techniques –TEM, SEM & STEM.AFM, EDX and XPS.

Text and Reference Books:

1. Basic Solid State Chemistry, 2nd Edition, Anthony R. West, John Wiley & Sons, 1996.
2. New Directions in Solid State Chemistry, C. N. R. Rao and J. Gopalkrishnan, Cambridge University Press, Cambridge, 1986.
3. Chemical approaches to the synthesis of inorganic materials, C. N. R. Rao Wiley Eastern Ltd.1994.

4. Materials Science and Engineering – An Introduction, W. D. Callister Jr. John Wiley & Sons,1991.
5. Materials Science, J. C. Anderson, K. D. Leaver, R. D. Rawlings and J. M. Alexander, 4th Edition, Chapman & Hall (1994).
6. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press (1998).

Semester IV Paper 15 (Core Elective E2.2) 4T3 X-ray II

Unit I

Space lattice and unit cell of a crystal, Choice of a unit cell, Crystal systems, Bravais lattices, Crystal faces and internal arrangement, Miller indices, Law of rational indices, Indices of a direction. Point groups, Space groups.

Perspective projections: Gnomonic projection, Stereographic projection, Orthographic projection.

Reciprocal lattice concept: Graphical construction, Relation to interplanar spacing, Interpretation of Bragg's law.

Unit II

Scattering of X-rays: Thomson scattering, Compton scattering, Wave mechanical treatment of scattering, Scattering by a pair of electrons, Theory of scattering by a helium atom, Scattering by many electrons, Experiments on scattering by monatomic and polyatomic gases, liquids and amorphous solids.

Unit III

Physical Basis of X-ray Crystallography: Atomic and crystal structure factors, Structure factor calculations, The integrated intensity of reflection. Different factors affecting the intensity of diffraction lines in a powder pattern.Dynamical theory X-ray diffraction.

The Fourier Transform, electron density projections in crystals, Application to X-ray diffraction.

Unit IV

Experimental Methods of Structure Analysis: Laue method, Debye-Scherrer method, rotation Oscillation method, Weisenberg camera, The sources of systematic errors and methods of attaining precision.

Principles of energy dispersive and time analysis diffractometry.

Methods of detecting and recording diffraction patterns.

Structures of metals and alloys. Phase transformations, Order-disorder phenomenon. Super lattice lines.Determination of grain size.

Other Diffraction Techniques: Electron and neutron diffraction tsechniques and their applications. Comparison with X-ray diffraction.

Text and Reference Books:

1. A. H. Compton and S. K. Allison: X-rays in Theory and Experiment.
2. N. F.M. Henry, H. Lipson and W. A. Wooster: The interpretation of X-ray Diffraction Photographs.
3. K. Lonsdale: Crystals and X-rays.
4. B. D. Cullity: elements of X-ray Diffraction.
5. M. M. Woollfson: X-ray Crystallography.
6. M. J. Buerger: X-ray Crystallography.
7. Bacon: Neutron Physics.

Semester IV Paper 15 (Core Elective E2.3) 4T3 NanoScience and Nanotechnology II

Unit – I:

Nanophotonics:

Fundamentals of photonics and photonic devices, Lasers, CFLs, LEDs, OLEDs, Wall paper lighting, Display devices, X-ray imaging nanophosphers, Photo therapy lamps and its applications, Nanomaterials for radiation, Dosimetery special for thermoluminescence. Optical stimulated luminescence, Luminescence solar concentration.

Unit – II:

Nanomagnetics:

Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics.

Unit – III:

Nanoelectronics:

Top down and bottom up approach, CMOS Scaling, Nanoscale MOSFETs, Limits to Scaling, System Integration, Interconnects;

NanoDevices: Nanowire Field Effect Transistors, FINFETs, Vertical MOSFETs, Other Nanowire Applications, Tunneling Devices, Single Electron Transistors, Carbon nanotube transistors, Memory Devices,

Unit – IV:

Nanocomposites:

Classification of nanocomposites, Metallic, ceramic and polymer nanocomposites, Tribology of polymeric nanocomposites, Nano ceramic for ultra high temperature MEMS, Optimizing nanofiller performance in polymers, Preparation techniques, Graphene/Fullerene/Carbon nanotube (CNT) polymer nanocomposites, One dimensional conducting polymer nanocomposites and their applications

Text and reference books:

1. H.S.Nalwa; Hand book of Nanostructure materials and nanotechnology; (Vol.1-5), Acad. Press, Boston, 2000
2. C.P.Poole Jr., F.J.Owens; Introduction to Nanotechnology, John Wiley and sons, 2003
3. C. Furetta; Hand book of thermoluminescence; World Scientific Publ.
4. S.W.S. McKEEVER; Thermoluminescence in solids; Cambridge Univ. Press.
5. Alex Ryer; Light measurement hand book; Int. light Publ.
6. M.J.Weber; Inorganic Phosphors; The CRC Press.
7. T.J.Deming; Nanotechnology; Springer Verrlag, Berlin, 1999
8. W.D.Kalister Jr., Materials Science and Engineering, 6th Eds, WSE Wiley, 2003
9. Gusev; Nanocrystalline Materials
10. C. Delerue, M.Lannoo; Nanostructures theory and Modelling
11. Fausto, Fiorillo ; Measurement and Characterization of Magnetic materials
12. Bhushan; Hand Book of Nanotechnology
13. Janos H., Fendler; Nanoparticles and Nanostructured Films
14. T.Pradip; Nano: The Essentials

15. Liu; Hand Book of Advanced Magnetic Materials (4 Vol.)
16. Lakhtakia; Nanometer Structure
17. Banwong, Anurag Mittal; Nano CMOS Circuit and Physical Design
18. G.W.Hanson: Fundamental of Nanoelectronics
19. Edward L. Wolf (2nd Ed.), *Nanophysics & Nanotechnology: An Introduction to Modern Concepts in Nanoscience*, WILEY-VCH, 2006
20. S. Sakka; Sol-gel science and technology processing, characterization and applications; Kluwer Acad. Publ.
21. Goser et al, "*Nanoelectronics&Nanosystems: From Transistor to Molecular & Quantum Devices"*
22. SupriyoDatta, "*From Atom to Transistor*"
23. John H. Davies, *The Physics of Low Dimensional Semiconductors: An Introduction"*, Cambridge University Press, 1998.
24. Hari Singh Nalwa, "*Encyclopedia of Nanotechnology*"
25. A. A. Balandin and K. L. Wang, "*Handbook of Semiconductor Nanostructures &Nanodevices*"
26. Cao Guozhong, "*Nanostructures &Nanomaterials - Synthesis, Properties & Applications*

Semester IV Paper 15 (Core Elective E2.4) 4T3 Atomic and Molecular Physics II

Unit I

Time dependence in quantum mechanics, Time dependent perturbation theory, rate expression for emission, perturbation theory, calculation of polarizability.Quantum mechanical expression for emission rate.

time correlation function and spectral Fourier transform pair, properties of time correlation functions and spectral time shape,

Fluctuation dissipation theorem rotational correlation function and pure rotational spectra, Re-orientational spectroscopy of liquids.

Unit II

Saturation spectroscopy, Burning and detection of holes in Doppler broadened two level systems, Experimental methods of saturation spectroscopy in laser, Ramsey fringes, Saturation techniques for condensed matter application,

Laser optogalvanicspectroscopy.Two photon absorption spectroscopy, Selection rules, Expression for TPA cross section –photo acoustic spectroscopy, PAS in gaseous medium, Roseneweig and Greshow theory, Thermally thin, thick samples, Typical experimental set up, Application in Spectroscopy,

Unit III

Stimulated Raman scattering, Quantum mechanical treatment, Raman Oscillation Parametric instabilities, Electromagnetic theory of SRS.Vibronic interaction, Herzberg Teller theory, Fluorescence spectroscopy, Kasha's rule, Quantum yield, Non-radioactive transitions, Jablonski diagram, Time resolved fluorescence and determination of excited state lifetime.Light detectors, Single photon counting technique, Phase sensitive detectors.

Unit IV

Matrix isolation spectroscopy, Fourier transforms spectroscopy, Laser cooling. Molecular symmetry and group theory, Matrix representation of symmetry elementsof a point group, Reducible and irreducible representations, and character tables specially for C_{2v} and C_3 point group molecules, Normal coordinates normal modes, Application of group theory to molecular vibrations.

Text Book and References:

1. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.
2. Quantum electron – A. Yariv.
3. Introduction to non-linear laser spectroscopy – M. D. Levenson.
4. Photoacoustics and its applications, Roseneweig.
5. J. M. Hollas, High resolution spectroscopy.
6. Cotton, Chemical Applications of Group Theory.
7. Herzberg, Molecular spectra and molecular structure II and III.
8. Demtroder, Laser spectroscopy and instrumentation.
9. King, Molecular spectroscopy.
10. Lakowicz, Principles of fluorescence spectroscopy.
11. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.

Semester IV Paper 15 (Core Elective E2.5) 4T3 Applied Electronics II

Unit – I:

An Overview of Electronic Communication system ; block diagram of an digital electronic Communication system, Pulse modulation systems, sampling theorem, lowpass and band-pass signals,PAM channel bandwidth for a PAM signal, Natural sampling, flat top sampling, signal recovery throughholding, quantization of signals, quantization, differential PCM delta modulation, adoptive delta modulation CVSD. Digital modulation techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK. Mathematical representation of noise, sources of noise, frequency domain representation of noise, Noise in Pulse Code and Delta modulation system, PCM transmission, calculation of quantization of noise, out pit signal power effect of thermal noise, outr signal to noise ratio in PCM, DM, quantization noise in DM, out put signal power, DM oput-put, signal to quantization noise ratio, effect of thermal noise in delta modulation, output signal to noise ratio in DM.

Unit – II

Computer communication systems: Types of networks, design features of communication network,examples, TYMNET, ARPANET, ISDN, LAN.Mobile radio and satellite - time division multiplex access (TDMA) frequency division multiplex access(FDMA) ALOHA, Slotted ALOHA, Carrier sense multiple access (CSMA) Poisson distribution protocols.

Unit – III

Microprocessor and Micro-computers: Microprocessor and architecture, Pin out and pin functions of 8086/8088 Internal microprocessor architecture, bus buffering and latching ,Bus timings, ready and wait states, minimum mode versus and maximum mode. Real and protected mode of memory addressing, memory paging, addressing modes, data addressing modes, programme memory addressing mode, stack memory addressing modes, instruction sets, data movement instruction, arithmetic and logic instruction, programme control instruction, clock generator (8284A),

Unit –IV

Memory and I/O Interface : Memory devices, ROM,RAM.,DRAM, SRAM, Address decoding , 3 to 8 line decoder 74LS138, 8086, and 80386(16 bits) Memory interface, , Introduction to I/O interface , Interfacing using 8255, Introduction to PIT 8254, Basic Communication device(UART) pin diagram and functioning of 16550 Interrupts: Basic interrupt processing, Hardware interrupt, expanding the interrupt structure, 8259A PIC.

Text and Reference books.

1. Principles of communication systems :Taub and Schilling (ii Edn THM ,1994)
2. Principles of communication systems: Taub and Schilling GoutamSaha Third Edition
3. Communication systems : Simon Haykin (iii Edn John Wiley & Sons)
4. The intel microprocessors 8086/80188,80386,80486, Pentium and Pentium processor architecture, programming and interfacing : Barry B. Brey (PHI iv Edn, 1999)
5. Microprocessor and interfacing ,programming and hardware : Douglas V. Hall (ii Edn, Mc GrawHill International edn. 1992)
6. The 80x86 IBMPC compatible computer: Muhammad Ali Maxidi and J .G. Mazidi (ii Edn.Prentice –Hall International.)

Semester IV Paper 16 (Foundation course F2.1) 4T4 Physics II

(Modern Physics)

Unit 1
Relativity: Postulates,, Measuring an event,, Relativity of simultaneity, Relativity of time, Relativity of length, Lorentz transformations, consequences of Lorentz equations, relativity of velocities, doppler effect, how momentum changes.

(Ch. 37 of Ref. 1)

Unit II

Photon, quantum of light, photoelectric effect, photons have momentum, light as a probability wave, electrons and matter waves, Schrodinger's equation, Heisenberg's uncertainty principle.

Sring waves and matter waves, energies of trapped electron, wave functions of trapped electrons, electron traps in various dimensions, Bohr Model, Schrodinger equation and Hydrogen atom

(Ch. 38 and 39 of Ref. 1)

Unit III
Nuclear Physics and Nuclear Energy: Discovering nucleus, nuclear properties, radioactive decay, alpha decay, beta decay, radioactive dating, nuclear model.
Nuclera fission: Basic process, Model for fission, nuclear reactor, natural nuclear reactor, thermonuclear fusion: the basic process, thermonuclear fusion in sun and other stars, controlled thermonuclear fusion.
(Ch. 42 and 43 of Ref. 1)

Unit IV
Particle physics, leptons, hadrons, conservation law, quark model, messenger partiles, expanding univers, background radiation, dark matter, big bang

(Ch. 44 of Ref. 1)

References:
1. Halliday, Resnick and Walker "Principles of Physics" International Students Version 9th Ed.

Semester IV (Subject Centric Core Course S 2.2) 4T4 Experimental Techniques in Physics

Unit 1: Radiation Sources, Detectors and Sensors

Different types of radiations (X-rays, UV-VIS, IR, microwaves and nuclear) and their sources
Detectors: gamma-rays, X-rays, UV-VIS, IR, microwaves and nuclear detectors
Sensors: Sensor's characteristics, Classification of sensors, Operation principles of sensors such as electric, dielectric, acoustic, thermal, optical, mechanical, pressure, IR, UV, gas and humidity with examples

Unit 2:Structural Characterization and Thermal Analysis

X-ray Diffraction – Production of X-rays, Types (continuous and characteristics), Bragg's diffraction condition, principle, instrumenation (with filters) and working, Techniques used for XRD – Laue's method, Rotating crystal method, Powder (Debye-Scherrer) method, Derivation of Scherrer formula for size determination Neutron Diffraction: Principle, Instrumentation and Working
Thermal analysis: Principle, Instrumentation and Working: Thermo-gravimetric (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC); Graphical analysis affecting various factors. Numericals

Unit 3: Morphological and Magnetic Characterization

Optical Microscopy: Principle, Instrumentation and Working of optical microscope.
Electron Microscopy: Principle, Instrumentation and Working of Scanning Electron Microscope (SEM), Field Emission Scanning Electron Microscope (FESEM) – Advantages over SEM, Transmission Electron Microscope (TEM), Selected Area Electron Diffraction (SAED)
Probe Microscopy: Principle, Instrumentation and Working of Scanning Tunneling Microscope (STM) and Atomic Force Microscope (AFM)
Magnetic Characterization: Principle, Instrumentation and Working of Vibrating Sample Magnetometer (VSM), Analysis of Hysteresis loop, SQUID Technique:
Principle, Instrumentation and Working. Numericals

Unit 4 : Spectroscopic Analysis

Spectroscopic characterization (principle, instrumentation and working): Infra-Red (IR), Fourier Transform Infra-Red (FTIR), Ultraviolet-Visible (UV-VIS), Diffused Reflectance Spectroscopy (DRS), X-ray Absorption (XPS), Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR). Numericals.

Reference Books:

1. Nuclear Radiation Detectors, S.S. Kapoor, V. S. Ramamurthy, (Wiley-Eastern Limited, Bombay)
2. Instrumentation: Devices and Systems, C.S. Rangan, G.R. Sarma and V.S.V. Mani, Tata Mc Graw Hill Publishing Co. Ltd.
3. Instrumental Methods of Chemical Analysis, G. Chatwal and S. Anand, Himalaya Publishing House
4. Instrumental Methods of Analysis by H.H. Willard , L.L. Merritt, J.A. Dean, CBS Publishers
5. Characterization of Materials, John B. Wachtman & Zwi. H. Kalman, Pub. Butterworth Heinemann (1992)
6. Elements of X-ray diffraction, Bernard Dennis Cullity, Stuart R. Stock, (Printice Hall, 2001 - Science – 664

Semester IV (Subject Centric Core Course S 2.3) 4T4 Communication electronics

UNIT I

Modulation AM and FM (Transmission and reception): Modulation, AM generation, Power consideration, Balanced modulator, SSB transmission, AM detection, AGC, Radio receiver characteristics, signal to noise ratio, FM analysis, noise considerations, generation, direct method and reactance tube method, FM transmitter, AFC, FM Propagation, phase discriminator.

UNIT II

(Propagation of radio waves) Ground wave, sky wave and space wave propagation. Ionosphere (Eccles- Larmer theory, magneto ionic theory).

UNIT III

(Antenna and TV) Antenna, HF antenna, Yagi antenna, loop antenna, Satellite communication, parabolic reflector, dish antenna, Fundamentals of image transmission, vestigial transmission, TV camera tubes, image orthicon, vidicon, TV transmitter, TV receiver and picture tubes.

UNIT IV

(Transmission Lines) Voltage and current relations on transmission line, propagation constant, characteristic impedance, impedance matching, quarter wave T/L as impedance transformer, attenuation along coaxial cable, cables of low attenuation, propagation of radio waves between two parallel lines, wave guide modes, TE10 mode and cut off wavelength, cavity resonator, light propagation in cylindrical wave guide, step index and graded index fibers, attenuation and dispersion in fibers.

Books Recommended:

1. George Kennedy & Davis: Electronics Communication Systems

2. Millar & Beasley: Modern Electronics Communication

3. R.R Gulani: Monochrome and colour television (Wiley Eastern Limited)

4. Taub and Schilling: Principle of Communication Systems (TMH)

5. Simon Gaykuti: Communication Systems (John Wiley & Sons Inc. 1994)

(This course cannot be offered to students opting for elective Applied Electronics E1.5 and E2.5)

Semester IV (Subject Centric Core Course S 2.4) 4T4 ElectroAcoustics

Unit – I:

Fundamentals of ultrasonic, Acoustics interaction with liquids, Velocity in fluids, Absorption due to heat conduction and viscosity, single relaxation, internal degrees of freedom, Relaxation in binary mixtures, Normal and associated liquid essential difference in low and high amplitude ultrasonic wave propagation of low amplitude waves, ultrasonic generators piezoelectric effect. Propagation in Solids Attenuation due to electron phonon interaction; Phonon-Phonon interaction, Measurement Techniques, optical method, interference method, Pulse method, Sign-around method. Applications of ultra-sound in industrial and medical fields.

Unit - II

Architectural Acoustics, Classical ray theory. Decay of sound in live and in dead rooms, Measurement of reverberation time. Effect of absorption on reverberation, Sound absorption coefficient, absorbing materials and their uses. Fundamentals of musical scales. Physics of musical instruments. Public address system and music sound system for auditoria. Instruments used for acoustical tests. Underwater acoustics, Velocity of Sound in Sea-water, sound transmission loss in sea-water. Refraction Phenomena, Masking by noise and by reverberation, Passive detection hydrophone systems.

Unit – III

Loud Speakers, idealized direct radiator, Typical cone Speaker, Effect of voice coil parameters, Horn Loudspeakers, pressure response, Woofer, midrange and tweeter, Crossover net works, Fletcher Munsion Curves, Baffles; Infinite type, vented type and acoustic suspension type, Microphones, Moving coil type, Carbon microphones, condenser microphones, Cardiod type, Polar response, Rating of microphone responses. Reciprocity theorem and calibration. RIAA equalization Preamplifiers, Tone control circuits, Equalization amplifiers, Noise filters, Dolby Noise Reduction, High Fidelity Stereo amplifiers, Recording and reproduction of sound.

Unit – IV

Noise Decibels and levels, dB Scales in acoustics, Reference Quantity for acoustic Power, intensity and pressure, Determination of overall levels from band levels, Basic sound measuring system using sound level meter. Octave band analyzer. Acoustic Calibrator, Definition of Speech interference levels (SIL), Noise criteria for various spaces. Nomogram relating SPL in octave bands to loudness in Tones, Computation of LL and SIL. .

Text and Reference books:

1. Fundamentals of Acoustics: Kinsler and Fry, (Wiley Eastern).
2. Acoustics: Leo L. Beranek (John Wiley and Sons.).
3. Noise Reduction: L. L. Beranek.
4. Fundamentals of Ultrasonic: J. Blitz.
5. Ultrasonic Absorption: A. B. Bhatia.
6. Acoustical Test and Measurements: Don Davis.

BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
B. Sc. Part I – Semester I
BIOTECHNOLOGY
(With effect from academic session 2013-14)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
6) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part I – Semester I - PAPER I
MICROBIOLOGY

UNIT I
History, Development and Microscopy

History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner.
Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance, principles and applications of dark field, phase contrast, fluorescent microscopy.
Electron microscopy: Principle, ray diagram and applications, TEM and SEM, comparison between optical and electron microscope, limitations of electron microscopy.
Stains and staining procedures: Acidic, basic and neutral stains, Gram staining, Acid fast staining, Flagella staining, Endospore staining.

UNIT II
Bacteria:

Bacterial morphology and subcellular structures, general morphology of bacteria, shapes and sizes, generalized diagram of typical bacterial cell.
Slime layer and capsule, difference between the structure, function and the position of the two structures.
Cell wall of gram +ve and Gram -ve cells.
General account of flagella and fimbriae.

Chromatin material, plasmids; definition and kind of plasmids (conjugative and non-conjugative) F, R, and Col plasmids.
Endospores: Detailed study of endospore structure and its formation, germination, basis of resistance.

UNIT III

A. A brief idea Bergey's manual. Morphology of archaea, archaeal cell membrane (differences between bacterial and archaeal cell membrane), other cell structures, concept of the three distinct archaea groups.
B. **Viruses**: General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids, phage and animal cell viruses, example of each and their importance. Brief idea of lytic cycle and lysogeny.

UNIT IV

Nutrition: Basic nutritional requirements: Basic idea of such nutrients as water, carbon, nitrogen, sulfur and vitamins etc., natural and synthetic media, nutritional classification of bacteria. Selective and Differential media, Enriched media, Enrichment media.

B. Sc. Part I – Semester I - PAPER II
(MACROMOLEULES)

UNIT I

Nucleic Acids

Chemical structure and base composition of nucleic acids, Chargaff's rules, Watson Crick Model (B-DNA), deviations from Watson-Crick model, other forms of DNA (A- and Z-DNA), forces stabilizing nucleic acid structures, (hydrogen bonds and hydrophobic associations, base stacking). Maxam and Gilbert DNA sequencing, structure of t-RNA.

UNIT II

Chromosomes, Concept of Genes and Nucleosomes

Concept of prokaryotic genes and eukaryotic genes: Definition of a gene, concept of split genes, introns, exons, spacers, C-value and C-value paradox, basic idea of Cot curves.
Chromatin structure: Nucleosome structure (10 nm fibre, experiments leading to discovery of nucleosomal structure, types of histones, arrangement of histones in the octamer, H1 histone and its role, role and length of linker DNA), 30 nm fibers (arrangement of nucleosome in a helical structure), domain and loop structure (further compacting of 30 nm fibre, role of scaffolding proteins). Role of telomere and centromere, telomeric and centromeric repeat sequences.

UNIT III

Amino acids: Structure of amino acids occurring in proteins, classification of amino acids (pH based, polarity based and nutrition based), Physico-chemical properties of amino acids (solubility, boiling and melting points, reactions like Edman's, Sanger's, Dansyl chloride, ninhydrin). Titration curves of neutral, basic and acidic amino acids.
Primary structure of proteins: Determination of primary structure (end group analysis, cleavage of disulfide bonds, amino acid composition, use of endopeptidase specificity, sequence determination, assignment of disulfide position).

UNIT IV

Secondary structure of proteins: The α-helix, β-structures (parallel, antiparallel, mixed, β-turn).
Tertiary structure of proteins: Forces that stabilize the structure (electrostatic forces, hydrogen and disulfide bonds, hydrophobic associations), myoglobin as an example of tertiary structure, concept of domains, protein denaturation.
Quaternary structure of proteins: Forces stabilizing quaternary structure, advantages of oligomeric proteins.

B.Sc. I
SEMESTER I PRACTICALS
Biotechnology
Microbiology & Macromolecules

1. Formol titration of glycine.
2. Quantitative Estimation of proteins by Biuret method
3. Determination of albumin & A/G retion in serum.
4. Estimation of DNA by Diphenylamine method
5. Estimation of RNA by Orcinol method
6. Quantitative estimation of amino acids using Ninhydrin reaction.
7. Demonstration, use and care of microbiological equipments.
8. Preparation of media, sterilization and isolation of bacteria.
9. Isolation of Bacteriophage from sewage / other sources.
10. Demonstration of motility of Bacteria.
11. Simple staining of bacteria
12. Gram staining of Bacteria
13. Acid fast staining of Bacteria
14. Endospore staining.
15. Demonstration of starch hydrolysis by bacterial cultures
16. Growth of fecal coliforms on selective media.

Note: - Mandatory to perform atleast 6 practical

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BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
B. Sc. Part I – Semester II
BIOTECHNOLOGY
(With effect from academic session 2013-14)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
	---

2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
	---

3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
6) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.

7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part I – Semester II - PAPER I
MICROBIOLOGY & CELL BIOLOGY

UNIT I
Microbial Growth
Growth: Growth rate and generation time, details of growth curve and its various phases.
Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat). Measurement of growth.
Physical conditions required for growth: Temperature (classification of microorganisms on the basis of temperature requirements), Ph etc. Pure cultures and cultural characteristics. Maintenance of pure culture.

UNIT II:
B. Microbial Control
Microbial Control: Terminologies - Sterilization, disinfection, antiseptic, sanitization, germicide, microbistasis, preservative and antimicrobial agents.
Mechanism of cell injury: Damage to cell wall, cell membrane, denaturation of proteins, inhibition of protein synthesis, transcription, replication, other metabolic reactions and change in supercoiling of DNA.
Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), dessication, surface tension, osmotic pressure, radiation, UV light, electricity, ultrasonic sound waves, filtration.
Chemical control: Antiseptics and disinfectants (halogens, alcohol, gaseous sterilization.
Concept of biological control.

UNIT III
Cell Biology
Eukaryotic Cell - Structure and function of the following: nucleus, nuclear membrane, nucleoplasm, nucleolus, golgi complex, endoplasmic reticulum, lysosomes, peroxisomes, glyoxisomes and vacuoles.

UNIT IV
Plant cell wall.
Cytoskeleton (actin, microtubules) and cell locomotion.
Mitosis and meiosis. Brief idea of cell cycle.
Muscle and nerve cell structure, synaptic transmission and neuromuscular junctions.

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B. Sc. Part I – Semester II - PAPER II
(CELL CONSTITUENTS & ENZYMOLOGY)

UNIT I
Carbohydrates
Definition, classification, nomenclature of carbohydrates, structures of monosaccharides, disaccharides and polysaccharides (structures of starch and glycogen as examples of homopolysaccharides). Concept and examples of heteropolysaccharides.

UNIT II
Lipids
Types of lipids, structures of saturated and unsaturated fatty acids, triglycerides, phospholipids, plasmalogens, gangliosides and sphingolipids. Terpenoids and isoprenoids - definition and representative structures, steroids. Concept of acid value, saponification value and iodine value.

UNIT III
Enzymes
Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc.

Classification and nomenclature.
Concept of isoenzymes (example Lactate Dehydrogenase) and multienzymes (example pyruvate dehydrogenase)
Substrate Specificity (bond specificity, group specificity, absolute specificity, stereo-specificity, proof-reading mechanism), lock and key and induced fit models.
Concept of allosteric enzymes (brief idea of ATCase as an example)
Mechanisms of catalysis: Acid-base, covalent and metal ion catalysis.

UNIT IV
Assay of Enzymes: Concept of activity, specific activity, turnover number, units of enzyme activity (katal, international unit), spectrophotometric methods of assay of enzymes (simple and coupled assay), very brief idea of other methods.
Enzyme kinetics: Michaelis-Menten equation, effect of substrate concentration, effect of enzyme concentration, effect of Ph and temperature, temperature quotient, single reciprocal(Eadie-Hoffstee equation) and double reciprocal plots(Lineweaver-Burke plots), enzyme inhibition kinetics (reversible inhibition types – competitive, uncompetitive and non-competitive), brief idea of irreversible inhibition.

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B.Sc. I
SEMESTER II PRACTICALS
Biotechnology
Microbiology, Cell constituents & Enzymology

1. Qualitative Analysis of sugars and proteins.
2. Quantitative estimation of sugars (Dinitrosalicylic acid method).
3. Estimation of glucose by Benedict's quantitative method
4. Quantitative estimation of proteins by Lowry's method.
5. Extraction and quantification of total lipids.
6. Determination of saponification value of Fats
7. Determination of Acid Value of Fats
8. Isolation of urease and demonstration of its activity
9. Assay of protease activity.
10. Preparation of starch from Potato and its hydrolysis by salivary amylase.
11. Assay of alkaline phosphatase
12. Immobilization of enzymes / cells by entrapment in alginate gel
13. Effect of temperature / pH on enzyme activity
14. Isolation of pure culture by pour plate method
15. Isolation of pure culture by streak plate method.
16. Anaerobic cultivation of microorganisms.
17. Cultivation of yeast and moulds.
18. Antibiotic sensitivity assay.
19. Oligodynamic action of metals.
20. To study germicidal effect of UV light on bacterial growth.
21. Stages of mitosis.
22. Stages of meiosis.

Note: - Mandatory to perform atleast 6 practical.

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B. Sc. Semester Pattern Syllabus
B. Sc. Part II – Semester III
BIOTECHNOLOGY
(With effect from academic session 2014-15)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
	---

3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
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7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part II – Semester III - PAPER - I
(METABOLISM)

UNIT I

Bioenergetics: Concept of free energy, Entropy, Enthalpy & Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate, Creatine phosphate etc.
Glycolysis (pathway, entry of other monosachharides and disaccharides, regulation, inhibitors)
Gluconeogenesis: Bypass reactions.

UNIT II

Structure of mitochondria.
TCA cycle: Detailed account, regulation, amphibolic nature and anaplerosis.
Electron Transport Chain: Components of the chain, sites of ATP synthesis, chemiosmotic theory of oxidative phosphorylation.

UNIT III

Lipid Metabolism

β-oxidation of fatty acids, role of carnitine, oxidation of unsaturated fatty acids & odd carbon fatty acids. Regulation.
Ketogenesis, Ketosis & ketoacidosis in physiology & pathology.

Biosynthesis of fatty acids, fatty acid synthase complex, regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids.

UNIT IV

Metabolism of Nitrogenous Compounds

Transamination (mechanism). Oxidative & Non-oxidative deamination.

Urea cycle: Detailed account, linkage of urea & TCA cycle, compartmentation of urea cycle, regulation, metabolic disorders of urea cycle.

Transmethylation & Decarboxylation, physiologically important products of decarboxylation.

Biosynthesis of purines and pyrimidines: Salvage pathways.

B. Sc. Part II – Semester III - PAPER – II
(BIOPHYSICAL TECHNIQUES I)

UNIT – I:

Spectrophotometry: Concept of electromagnetic radiation, spectrum of light, absorption of electromagnetic radiations, Concept of chromophores and auxochromes, involvement of orbitals in absorption of electromagnetic radiations, Absorption spectrum and its uses, Beer's law - derivation and deviations, extinction coefficient. Difference between spectrophotometer and colorimeter. Instrumentation of UV and visible spectrophotometry

Double beam spectrometer; dual-wavelength spectrometer

UNIT II:

a) Applications of UV and visible spectrophotometry.
b) Spectrofluorometry: principle, instrumentation and applications. Absorption & emission flame photometry: principle, instrumentation and application.
c) Principles of IR and Mass spectrometry

UNIT III:

Chromatography: Partition principle, partition coefficient, nature of partition forces, brief account of paper chromatography.

Thin layer chromatography and column chromatography.

Gel filtration: Concept of distribution coefficient, types of gels and glass beads, applications.

UNIT IV

Ion-exchange chromatography: Principle, types of resins, choice of buffers, applications including amino acid analyzer.

Affinity chromatography: Principle, selection of ligand, brief idea of ligand attachment, specific and non-specific elution, applications.

Elements of high pressure liquid chromatography.

B.Sc. II
SEMESTER III PRACTICALS
Biotechnology
Metabolism & Biophysical Techniques

1. Spectrophotometric analysis of DNA denaturation.
2. Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.
3. Protein estimation by E280/E260 method.
4. Paper chromatography of amino acids/sugars.
5. TLC of sugars/amino acids.
6. Cellular fractionation and separation of cell organelles using centrifuge.
7. Isolation of mitochondria and assay of marker enzyme.
8. Estimation of Urea by diacetyle monoxime method
9. Estimation of Sugars by Folin Wu method
10. Validity of Beer’s law for colorimetric estimation of creatinine.
11. Absorption spectrum of NAD & NADH
12. Preparation of standard buffers and determination of pH of a solution
13. Titration of a mixture of strong & weak acid

Note: - Mandatory to perform atleast 6 practical

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B. Sc. Semester Pattern Syllabus
B. Sc. Part II – Semester IV
BIOTECHNOLOGY
(With effect from academic session 2014-15)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
	---

2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
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7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part II – Semester IV - PAPER - I
(IMMUNOLOGY)

UNIT I

Immune system, Organs and cells of immune system
Immunity, innate immune mechanism
Acquired immune mechanism, Antigen, Antigenecity (factors affecting antigenecity)
Humoral immunity, main pathways of complement system.

UNIT II

Antibody structure and classes.
Cell mediated immunity: TC mediated immunity, NK cell mediated immunity, ADCC, delayed type hypersensitivity, cytokines and brief idea of MHC.

UNIT III

Hypersensitivity and vaccination : General features of hypersensitivity, various types of hypersensitivity, Vaccination: Discovery, principles, significance. Concept of autoimmunity.

UNIT IV

Immunological Techniques:Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA.
Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.

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B. Sc. Part II – Semester IV - PAPER – II
(BIOSTASTICS & BIOPHYSICAL TECHNIQUES II)

UNIT – I:

a) Migration of ions in electric field, Factors affecting electrophoretic mobility.
b) Paper electrophoresis: - Electrophoretic run, Detection techniques, Cellulose acetate electrophoresis, High voltage electrophoresis.
c) Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels, Detection, Recovery & Estimation of macromolecules.

UNIT II

a) SDS-PAGE Electrophoresis: - applications (determination of molecular weight of proteins, determination of subunit stoichiometry, molecular biology applications).
b) Isoelectric focussing, Principle, Establishing pH amd density gradients, Procedures & applications.
c) Pulsed-field gel electrophoresis.

UNIT – III:

Isotopic tracer technique: -

a) Radioactive & stable isotopes, rate of radioactive decay. Units of radioactivity.
b) Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique), Cerenkov radiation.
c) Measurement of Stable isotopes: Falling drop method for deuterium measurement, Mass spectrometry.
d) Principles of tracer technique, advantages and limitations, applications of isotopes in biotechnology (distribution studies, metabolic studies, isotope dilution technique, metabolic studies, clinical applications, autoradiography).

UNIT IV

Centrifugation:

a) Basic principles, concept of RCF, types of centrifuges (clinical, high speed and ultracentrifuges).
b) Preparative centrifugation: Differential and density gradient centrifugation, applications (Isolation of cell components).
c) Analytical centrifugation: Sedimentation coefficient, determination of molecular weight by sedimentation velocity and sedimentation equilibrium methods.

Biostatistics

Basic concepts of mean, median, mode, Standard deviation and Standard error

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B.Sc. II
SEMESTER IV PRACTICALS
Biotechnology
Immunology & Biophysical techniques

1. Antigen – antibody reaction – determination of Blood group
2. Pregnancy test
3. Widal test
4. Ouchterloney immunodiffusion
5. Radial immunodiffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Paper electrophoresis of proteins
9. Gel electrophoresis of proteins.
10. SDS-PAGE of an oligomeric protein.
11. Calculation of mean, median, and mode (manual/computer aided).
12. Calculation of standard deviation and standard error (manual/computer aided).
13. Biostatistical problem based on standard deviation.

Note: - Mandatory to perform atleast 6 practical

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B. Sc. Semester Pattern Syllabus
B. Sc. Part III – Semester V
BIOTECHNOLOGY
(With effect from academic session 2015-16)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
6) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part III –Semester V - PAPER – I
(MOLECULAR BIOLOGY)

UNIT I
DNA Replication

Enzymology of replication (detailed treatment of DNA polymerase I, brief treatment of pol II and III, helicases, topoisomerases, single strand binding proteins, DNA melting proteins, primase and RNA primers, distributive and processive properties of DNA polymerase I and III, importance of the β-subunit in polymerase III), proof for semiconservative replication, discontinuous replication and Okazaki fragments, Replication origins, initiation, primosome formation, elongation, and termination. Use of DNA replication mutants in the study of replication.

UNIT II
Mutations & DNA Repair

Gene mutations: Missense, nonsense and frameshift mutations.
Mutagens: Physical and chemical mutagens.
Repair: Mismatch repair, NER, BER, light induced repair, SOS repair.

UNIT III

Transcription

Enzymatic synthesis of RNA: Basic features of transcription, structure of prokaryotic RNA polymerase (core enzyme and holoenzyme, significance of σ factor), concept of promoter (Pribnow box, -10 and -35 sequences and their significance), auxiliary proteins of transcription, role of NusA.

Four steps of transcription (promoter binding and activation, RNA chain initiation and promoter escape, chain elongation, termination and release).

UNIT IV

Details of initiation, elongation, and termination (intrinsic and rho factor mediated termination).

Brief idea of reverse transcription.

Regulation of Transcription in Prokaryotes: Basic idea of lac- and trp-operons.

B. Sc. Part III – Semester V - PAPER – II
(MOLECULAR BIOLOGY & rDNA TECHNOLOGY)

UNIT I

Genetic Code

Genetic code: Argument for triplet code, experimental elucidation of codons, identification of start and stop codons, universality, degeneracy and commaless nature of codons.

The decoding system: aminoacyl synthetases, brief structure of tRNA, the adaptor hypothesis, attachment of amino acids to tRNA.

Codon-anticodon interaction - the wobble hypothesis.

Selection of initiation codon - Shine and Dalgarno sequence and the 16S rRNA.

UNIT II

Protein synthesis:

Initiation, elongation, and termination.

Regulation of translation: Autogenous control of r-proteins, phage T4 protein p32 translational regulation. Antibiotics affecting translation.

UNIT III

rDNA Technology

DNA cloning: Basics of genetic engineering, restriction endonucleases, other enzymes of DNA manipulation.

Vectors: Plasmid vectors (pBR322 and pUC 18/19)

Phage vector: Lambda replacement and insertion vectors

Cosmids, phagemids, and YAC.

Cutting and joining DNA (cohesive end ligation, methods of blunt end ligation). Transfection and transformation. Selection of transformed cells. Screening methods.

UNIT IV

Genomic DNA library and cDNA library – concept and methods of creating these libraries. Advantages and disadvantages of cDNA library over genomic DNA library.

General consideration of Polymerase chain reaction, designing of primers for PCR.

Expression of cloned genes: General features of an expression vector. Expression of a eukaryotic gene in prokaryotes – advantages and problems. Applications of recombinant DNA technology:

B.Sc. III
SEMESTER V PRACTICALS
Biotechnology
Molecular Biology & rDNA technology

1. To measure concentration of DNA & RNA by UV spectrophotometry
2. Estimation of proteins by Bradford method
3. Isolation of genomic DNA.
4. Isolation of Plasmid DNA.
5. Isolation of chloroplast DNA.
6. Restriction digestion of DNA.
7. Demonstration of Replica plating technique

8. Identification of Lac+ bacteria by blue white screening using IPTG
9. Ligation of DNA
10. Demonstration of Southern blotting
11. Demonstration of western blotting
12. Chemical mutagenesis and production of microbial mutants.

Note: - Mandatory to perform atleast 6 practical

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B. Sc. Semester Pattern Syllabus
B. Sc. Part III – Semester VI
BIOTECHNOLOGY
(With effect from academic session 2015-16)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
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7) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
8) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part III –Semester VI - PAPER – I
(APPLICATIONS OF BIOTECHNOLOGY)

UNIT I
Environmental Biotechnology
Water and waste water treatment process: Current community drinking water treatment process, disinfection of water (chlorination and ozonation), primary, secondary and advanced treatment of sewage (domestic waste water),
Definition and concept of: biodegradation, biodeterioration and biotransformation.

UNIT II

Xenobiotic and recalcitrant compounds. Bioaccumulation and biomagnification.

Assessment of water and wastewater quality: Concept of COD,DO and BOD. Indicators of faecal pollution and MPN and MF technique for coloforms. Significance and principal of IMViC.

UNIT III

Industrial Biotechnology

Basic Principles of Industrial Biotechnology: Important commercial products produced by microorganisms and GMOs and their applications, design of typical submerged fermentor, significance of various parts and provisions of fermentor, isolation of industrially important microorganisms – primary and secondary screening.

UNIT IV

Food Biotechnology

Food Biotechnology: Production and types of cheese, microorganisms as food – production of mushroom and spirulina, assessment of microbiological quality of various foods.

Industrial awareness: Quality control and quality assurance in food and pharamaceutical industry, concept of current good manufacturing practices in pharmaceutical industry

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B. Sc. Part III – Semester VI - PAPER – II
(PLANT & ANIMAL BIOTECHNOLOGY)

UNIT I:

a) Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids, Laboratory facilities
b) Tissue culture media (composition and preparation)
c) Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.

UNIT II:

a) Tissue and micropropagation, suspension culture, callus formation, regeneration, production of haploids, protoplast culture and somatic hybridization
b) Cloning in plants - Ti plasmid.
c) Concept of transgenic plants
d) Bt cotton and other plant applications.

UNIT III:

a) Various techniques of animal cell and tissue culture, Culture media, growth factors, laboratory facilities.
b) Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors.
c) Primary culture, immortal cells, cell lines.
d) Maintenance of cell lines in the laboratory.

UNIT IV:

a) Brief idea about recombinant DNA products in medicine (insulin, somatostatin, vaccines), Concept of Gene therapy,
b) Production of recombinant vaccines – hepatitis.
c) Concept of transgenic animals
d) In vitro fertilization and embryo transfer in humans and farm animals.

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B.Sc. III
SEMESTER VI PRACTICALS
Biotechnology
Animal, Plant, Industrial & Environmental Biotechnology

1. Establishing a plant cell culture (both in solid and liquid media) – seed germination, callus culture, suspension cell culture, regeneration from callus cells.
2. Anther culture, embryo culture, suspension culture.

3. Cell count by hemocytometer.
4. Cytology of callus.
5. Establishing primary cell culture of chicken embryo fibroblasts.
6. Animal tissue culture – maintenance of established cell lines.
7. Animal tissue culture – virus cultivation.
8. Measurement of cell size.
9. Microphotography.
10. IMViC test.
11. Determination of COD
12. Testing of chlorine demand of water
13. Microbiological quality assurance of any of the commercially available foods.
14. Bioassay of penicillin/vitamin B12
15. Determination of fecal coliforms by MPN technique/MF technique
16. Isolation of azotobacter and rhizobium.
17. Sterility testing of injectibles.
18. Assay of amylase
19. Determination of seed viability.

Note: - Mandatory to perform atleast 6 practical

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RTM, NAGPUR UNIVERSITY, NAGPUR.

SEMESTER PATTERNSYLLABUS

FOR B Sc. BOTANY

B.Sc. SEMESTER- I

PAPER-I Viruses, Prokaryotes& Algae

PAPER-II Fungi, Lichen, Plant-Pathology&Bryophyta

B.Sc. SEMESTER-II

PAPER-I Pteridophyta& Gymnosperms

PAPER-II Palaeobotany& Morphology of Angiosperms

B.Sc. SEMESTER-III

PAPER-I Angiosperm Taxonomy

PAPER-II Cell Biology, Plant Breeding& Evolution

B.Sc. SEMESTER-IV

PAPER-I Angiosperm Anatomy& Embryology

PAPER-II Genetics & Molecular Biology

B.Sc. SEMESTER-V

PAPER-I Biochemistry & Plant Physiology-I

PAPER-II Plant Ecology I

B.Sc. SEMESTER-VI

PAPER-I Plant Physiology- II& Biotechnology

PAPER-II Plant Ecology- II, Techniques & Utilization of Plants.

SEMESTER – I

PAPER – I

VIRUSES, PROKARYOTES AND ALGAE

Unit I

Introduction to Botany.

Virus: General characteristics and nature of Viruses,.

Ultra structure of TMV, Structure and Multiplication of T_4 - Bacteriophage. Economic importance.

Mycoplasma : - structure, Properties, Reproduction.

Comparison between Archaebacteria and Eubacteria.

Unit II

Bacteria:-Cell structure, Flagella. Reproduction: (Binary fission, Conjugation). Economic importance.

Cyanobacteria: -General account, Economic Importance, Ultra cell structure, Reproduction. eg.*Nostoc.*

Unit III

Algae – General characteristics, Classification (Fritsch 1954),

Life history of: - *Oedogonium, Chara.*

Unit IV

Algae **- Life history** of *Vaucheria, Ectocarpus, and* Economic importance of Algae.

Note:- Developmental stages not expected

List of Practicals :

Study of Bacterial forms from permanent micropreparation

Gram staining of Bacteria, ultrasturcture of Bacteriophage from TEM photographs

Study of Cyanobacteria: *Nostoc*.

Study of Algal genera: *Oedogonium, Chara, Vaucheria, Ectocarpus.*

SEMESTER – I

PAPER – II

FUNGI, LICHEN, PLANT PATHOLOGY, BRYOPHYTA

Unit I

Fungi:- General charachteristics, Classification(Alexopoulos 1996), Economic importance

Life history of: - *Albugo, Mucor.*

Unit II

Fungi- Life history of :- *Puccinia, Cercospora*

Lichens :- Types, Reproduction and Economic importance

Unit III

Plant pathology:– Host, pathogen, symptoms, Causes and Control of following diseases:-Leaf curl of Papaya, Citrus canker and Red rot of Sugarcane

Bryophyta:–Classification (Proskauer 1957), General characters (Hepaticopsida, Anthocerotopsida and Bryopsida), Economic importance, and alteration of generation

Unit IV

Life history of:- *Riccia, Anthoceros, Funaria*

Note: developmental stages not expected

List of Practicals :

Study of Fungal genera:- *Albugo, Mucor, Puccinia, Cercospora*

Study of Lichen: - Thallus structure, Types

Plant pathology: – Leaf curl of Papaya, Red rot of Sugarcane, Citrus canker

Study of Bryophytes :- *Riccia, Anthoceros, Funaria*

Botanical Excursions (One short/Long excursion is compulsory).

Semester - I Botany Practical examination
Question Paper

Time: 5 hrs **Marks: 30**

Q. 1) Gram Stain the given Bacterial strain / Stain the **Cyanobacterial** material [A], & Identify **04**

Q. 2) Identify & give characters of the given **Algal** material [B]and make a temporary Mount **04**

Q. 3) Identify & give characters of the given **Fungal** material[C] and make a temporary Mount **04**

Q. 4) Identify & give characters of the given **Bryophytic** material [D] and make a temporary Mount **04**

Q. 5) **Spotting** : **06**

E-Virus/Bacteria/Cyanobacteria	F- Algae	G- Fungi
H-Bryophyte	I- Plant pathology	J- Lichen

Q. 9) Viva-voce **03**

Q. 10) Practical Record & Excursion Report **05**

SEMESTER – II

PAPER – I

(PTERIDOPHYTA & GYMNOSPERMS)

Unit I

Pteridophyta :- Classification system (Smith 1952), General characters (Psilopsida, Lycopsida, Sphenopsida and Pteropsida), Economic importance, alternation of generation

Life history of:- *Rhynia, Selaginella*

Unit II

Life history of:- *Equisetum,*

Apogamy, Apospory, Stelar system in pteridophytes, Concept of heterospory and seed habit.

UNIT III

Gymnosperms:- Classification (Stewart 1982), General characters, Economic importance, alternation of generation.

Life cycle of the following:- *Cycas.*

UNIT IV

Life cycle of the:- *Pinus*.

Cycadeoidea (morphology, anatomy of Stem and flower)

NOTE: Developmental stages not expected.

List of Practicals

Study of Pteridophytes : *Rhynia, Selaginella, Equisetum.*

Study of Gymnosperm: *Cycas*, *Pinus*, *Cycadeoidea.*

SEMESTER – II

PAPER – II

PALAEOBOTANY & MORPHOLOGY OF ANGIOSPERMS

Unit I

Palaeobotany: Geological time scale

Fossilization: Replacement theory, Infilteration theory

Types of fossils: Impression, Compression, Petrifaction

Fossil plants: Gymnosperms: *Glossopteris* (Leaf, Scutum),

Unit II-

Root Morphology - Tap root & adventitious roots, Modifications for storage, Respiration & reproduction.

Stem Morphology:- shape, surface, texture, nature, Branching (Monopodial, Sympodial), modifications (Runner, Rhizome, Tuber, Bulb, cladode).

Leaf Morphology:--Typical Leaf, Types (Simple, Compound), Phyllotaxy, Venation, and modifications of leaf (Tendril, Phyllode)

Unit III-

Inflorescence: Simple (Racemose and Cymose type).

Flower: Details of typical flower, Epigyny, Perigyny & Hypogyny, Androphore, Gynophore & Gynandrophore.

Calyx & Corolla: - Cohesion, Forms of corolla and Aestivation.

Unit IV

Flower: **Androecium: -** Parts, Cohesion & Adhesion, Fixation, dehiscence. **Gynoecium:** - Parts, Cohesion, Adhesion, Placentation.

Fruit: Classification of fruits, simple and aggregate fruits, Composite fruit.

List of Practicals

i. **Fossils** : Types, *Glossopteris*, *Cycadeoidea*

ii. Study of **Root**: Types, Modifications.

iii. Study of **Stem**: shape, surface, texture, nature Branching, Modifications (Ex. *Hibiscus, Ocimum,* any grass).

iv. Study of **Leaf**: Stipules, base, kind, shape, surface, margin, Apex, texture, Phyllotaxy, Venation & Modifications.

v. **Inflorescence:** Types.

vi. **Flower**: Parts, Thalamus, Calyx, Corolla, Androecium, Gynoecium.

vii. **Fruits:** Types.

Botanical Excursion: (Two short or one long out of the state is compulsory).

Semester II practical examination

Question Paper

Time : 5 hrs **Marks : 30**

Q. 1) Identify & give characters of the given **Pteridophytic** material **[A]**and make temporary Mount. **04**

Q. 2) Identify & give characters of the given **Gymnospermic [B]** material and make temporary mount **04**

Q. 3) Describe the given **leaf** material **[C]** **04**

Q.4) Describe (Calyx, Corolla, Androecium & Gynoecium) of given **Flower [D]**. **04**

Q. 5) **Spotting** : **06**

E. Pteridophyte	F. Fossil
G. Gymnosperm	H. Vegetative morphology
I. Inflorescence/flower	K. Fruit.

Q. 9) Viva-voce **03**

Q. 10) Practical Record & Excursion Report **05**

SEMESTER – III

PAPER – I

ANGIOSPERM TAXONOMY

Unit I

Origin of Angiosperms (Benettitalean theory). Phylogeny of Angiosperm: Homology, monophyly, polyphyly, Clads.

Fossil Angiosperms: Flower (Sahanianthus).

Angiosperm Taxonomy: Floras, Herbarium, keys (Indented and Bracketed), Holotype, Lectotype, Neotype.

Botanical Nomenclature: Principles (rank and ending of taxa, principle of priority),

Unit II

Classification of angiosperms: Natural, Artificial, Phylogenetic system of classification.

Systems of classification: Bentham & Hooker and Engler &Prantl (along with merits and demerits),

Modern trends in Taxonomy : Cytotaxonomy (Karyotype), Phytochemistry (Proteins, flavonoids, Betalains) , Taximetrics to taxonomy.

Unit III

Study of Families (Dicot): Malvaceae, Brassicaceae, Fabaceae (Papilionoideae, Caesalpinioideae, Mimosoideae)

Unit IV

Study of Families (Dicot): Asteraceae, Asclepiadaceae, Euphorbiaceae

Study of Families (Monocot): Poaceae

List of Practicals

Study of Families covered in the theory portion.

Study of fossil Angiosperms micropreparation and specimens: *Sahanianthus*, *Enigmocarpon*

Botanical Excursions (Two short or One long out of the state is compulsory).

SEMESTER – III

PAPER – II

CELL BIOLOGY, PLANT BREEDING & GENETICS

Unit I

Structure of typical plant cell, Ultrasturcture and functions of: Cell wall, Cell Membrane (Fluid mosaic model), Nucleus, Endoplasmic reticulum (RER and SER)

Unit II

Ultrastructure & Functions of: Golgi Complex, Vacuoles, Ribosomes (70S and 80S), Mitochondria, Chloroplasts,

Unit III

Chromosome organization: Morphology (chromatid, chromomere, centromere, telomere, secondary constriction, satellite, karyotype), Molecular organization (Nucleosome model)

Sex Chromosome : Structure of sex chromosome in plants (XY type in *Melandrium*)

Cell division in plants: Mitosis, Meiosis and their significance.

Unit IV

Plant Breeding- Definition and objective, Pure line selection, Hybridization (emasculation, bagging, crossing, labelling), Colonal selection, Heterosis (Definition and scope)

Biostatistics- Mean, Mode, Median, Standard deviation, Standard error, Student's t- test

Evolution- Origin of life (Millers theory),

List of Practicals

Study of Cell organelles with the help of photographs/ Slides

Study of mitosis in plant material

Study of meiosis in plant material

To calculate Mean, Mode, Median, standard error from the given data (At least 10 problems to be solved)

To calculate the student's t-value from the given data (At least 10 problems to be solved)

Semester III practical examination

Question Paper

Time : 5 hrs **Marks : 30**

Q. 1) Describe in technical language the given Angiospermic material [A]**.** Classify &Identify the Family giving reasons **06**

Q. 2) Write floral formula and Draw Floral Diagram of the given flower [B] **03**

Q. 3) Prepare semi-permanent squash / smear of given material [C] & Identify the stage of cell division **05**

Q. 4) To solve the given problem of biostatistics **04**

Q. 5) Spotting : **04**

D. Fossil angiosperm H. Cell organell (photocopy)

E. Cytology I. Taxonomy

Q. 6) Viva-voce **03**

Q. 7) Practical Record & Excursion Report **05**

SEMESTER – IV

PAPER – I

ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit I

Basic body plan & Modular type of Growth.

Meristems :Classification of meristems based on origin and position.

Permanent tissue and their functions:Simple tissue (parenchyma, collenchyma, sclerenchyma), Complex tissue(xylem and phloem).

Unit II

Apical meristem of Root and Shoot: Apical cell theory, tunica-corpus theory, Types of root apex according to Newman.

Primary structure of root in dicot (Sunflower) and monocot (Maize)

Primary structure of stem in dicot (Sunflower) and monocot (Maize)

Types of vascular bundles- dicots and monocots

Cambium (structure, types, function)

Unit III

Periderm, growth ring, sap wood, heart wood

Secondary growth (Sunflower stem) and anomalous secondary growth in *Bignonia* and *Dracena* stem.

Anatomy of leaf: Dicot (Nerium), monocot (Maize).

Senescence and abscission of leaves.

Unit IV

Pollination: Types and adaptation, significance

Structure of anther, Microsporogenesis, male gametophyte

Types of ovules, structure of anatropous ovule

Megasporogenesis and female gametophyte (polygonum type)

Double fertilization and triple fusion, endosperms and its types, Structure of dicot (Onagad) and monocot embryo.

List of practicals

Study of simple tissue, complex tissue and secreatory tissue from permanent slides

Study of types of vascular bundles

Study of internal structure of dicot and monocot root using hand section and prepare temporary mounts -Sunflower, Maize

Study of internal structure of dicot and monocot stem using hand section and prepare temporary mounts -Sunflower, Maize

Study the growth ring in woods-Teak wood

Study of internal structure of secondary growth and anomalous secondary growth using hand section and prepare permanent micropreparations - *Bignonia* stem and *Dracena* stem.

Study of internal structure of leaves- *Nerium*, Maize

Study of types of ovules, anther structure, pollen grains, adaptations for pollination

To calculate the percent pollen germination in the given specimen

Botanical Excursions (One short tour is compulsory).

SEMESTER- IV

Paper-II

Genetics & Molecular Biology

Unit- I

Mendelism: - Laws of inheritance (Law of segregation and independent assortment)

Interaction of genes: Allelic- Incomplete dominance (1:2:1 ratio in *Mirabilis jalapa*); Non-allelic- Complementry (9:7 ratio) and Dominant epistasis (12:3:1 ratio)

Linkage: Definition, Theory of linkage (Coupling and Repulsion theory), types (complete and incomplete), significance

Unit- II

Crossing over: Definition, theories (Breakage and reunion), significance

Variation in chromosome number: Polyploidy (auto- and allo-), aneuploidy (nullisomics, monosomics, trisomics and tetrasomics), significance

Structural changes in chromosome: deficiency, duplication, significance of inversion and translocation.

Unit- III

Structure of DNA (Watson and Crick model)

Semi conservative method of DNA replication in eukaryotes

Concept of gene; Benzor's concept, cistron, mutons and recons, jumping gene.

Mutation: Spontaneous and induced, physical and chemical mutagens, application of induced mutations in crop improvement

DNA damage and repair: Photoreactivation, excision repair

Unit- IV

Satellite and repetitive DNA

Genetic code: Definition and characteristics

t-RNA (Clover leaf model)

Gene expression in prokaryotes: Transcription and translation

Regulation of gene expression (Lac operon model).

List of practicals

To prove the Mendel's law of segregation with the help of coloured beads.

To prove the Mendel's law of independent assortment with the help of coloured beads.

From the given data workout the type of gene interaction in the given cross (Atleast 10 problems of each type mentioned in theory syllabus).

Semester IV Practical examination

Question Paper

Time : 5 hrs **Marks : 30**

Q. 1) Prepare temporary mount of the given material [A](Root/Leaf)& Identify giving diagnostic character **03**

Q. 2) Prepare double stained permanent mounts of the given material [Stem] [B] & Identify giving diagnostic character **06**

Q. 3) Calculate percent germination in the given pollen grains [C] **02**

Q. 4) To prove Mendel's Law of Inheritance through coloured beads [D] **04**

Q. 5) To work out the type of gene interaction in the given cross from the given data. **03**

Q. 6) Spotting: **04**

E- Tissue F- Root anatomy

G-Stem anatomy H-Embryology

Q. 7) Viva-voce **03**

Q. 8) Practical record and excursion report **05**

SEMESTER – V

PAPER – I

BIOCHEMISTRY & PLANT PHYSIOLOGY-I

Unit I

Carbohydrates: Definition, properties and role; Classification: Aldoses and ketoses; monosaccharides, disaccharides and polysaccharides; Structure of Glucose and starch

Lipids: Definition, properties and role; fatty acids, oils and waxes, beta oxidation.

Aminoacids- Chemistry of amino acids present in proteins (Classification), peptide bond

Basics of Enzymology: Nomencleture, Characteristics and properties of Enzymes, factors affecting enzyme activity, Holoenzyme, Apoenzyme, Co-enzymes& Co-factors, Regulation of Enzyme Activity (Enzyme-Substrate Complex Theory), Mechanism of Action (Lock & Key Model, Induced Fit Model)

Unit II

Plant-water relations: Properties of water, diffusion, diffusion pressure deficit and its significance; Osmosis: Concept, types, osmotic potential and its significance; Imbibition: concept and significance

Water conduction through xylem: Root pressure theory, cohesion-adhesion theory; transpiration; stomatal opening mechanism with reference to K^+-malate hypothesis

Phloem transport: Munch hypothesis

Unit III

Mineral nutrition: Role and deficiency symptoms of macro- and micro- nutrients (N, P, Fe, Mn, B , Ca); Solute transport: passive (Donnan's equilibrium), active (carrier concept)

Lipid metabolism:

Respiration: Types (aerobic and anaerobic respiration), respiratory substrates and Respiration quotient, glycolysis, Kreb's cycle, oxidative phosphorylation (ETS); fermentation (alcohol and lactic acid), photorespiration. Glyoxylate cycle .

Unit IV

Photosynthesis: concept, definition, significance, photosynthetic pigments and their role, action spectra, Emerson's enhancement effect, red drop mechanism; photolysis of water (Hill's reaction), cyclic and non-cyclic photophosphorylation, Light independent reactions: C3, C4 and CAM pathways and their significance; factors affecting photosynthesis

Nitrogen metabolism: Mechanism of biological nitrogen fixation, importance of nitrate reductase

List of practicals

To study the effect of various chemicals on permeability of membranes.

To study the ascent of sap in suitable plant material.

To separate chlorophyll pigment by paper chromatography.

To determine the RQ of given plant material.

To perform microchemical tests for determination of reducing and non-reducing sugars, starch, cellulose, oils and proteins.

To study the effect of light intensity and quality, CO_2 concentration and temperature on rate of photosynthesis by suitable method.

To determine osmotic potential of the cell sap by plasmolytic method.

To study the activity of enzyme amylase, catalase and peroxidase.

Miner Physiology experiments

SEMESTER – V

PAPER – II

PLANT ECOLOGY - I

Unit I

Ecology: definition, branches and significance of ecology

Climatic Factors: Atmospheric (Gaseous composition), Light & Temperature (effect on vegetation).

Edaphic Factor :Pedogenesis, Soil profile, Soil properties (physical and chemical)

Unit II

Physiographic factor- Biotic Factor: Interactions between plants and animals and human, Interaction between plants growing in a community, Interactions between plants and soil microorganisms. Biogeochemical Cycles: Nitrogen, phosphorous

Unit III

Ecosystem: Biotic and Abiotic components, Food chain, Food web, Ecological pyramids

Autecology (definition, importance), ecad, ecotype- characteristics and importance

Synecology (or community ecology)- Study of community: analytical (quantitative- frequency, density, abundance; qualitative- Life forms, Raunkier's Biological spectrum) and synthetic characters (presence, fidelity, dominance)

Unit IV

Principles of Phytogeography, Distribution (wides, endemics, discontinuous species), Theories (Landbridge and continental drift), Climatic regions of India, Phytogeographic regions of India (Chatterjee 1962; Name, distribution area, typical vegetation)

List of practicals:

To determine frequenct, density, abundance of the community by quadrate method.

To determine the homogeneity of vegetation by Raunkiers frequency diagram.

To determine the water holding capacity of the given soil samples.

To determine the water rising capacity of the given soil samples.

To determine the soil moisture of the given samples.

Botanical Excursions (One short tour is compulsory).

Semester V Practical examination

Question Paper

Time : 5 hrs **Marks : 30**

Q. 1) To perform given Physiology Experiment [A] & report the findings **06**

Q. 2) To perform the given Biochemical Experiment [B] & report the findings **04**

Q. 3) To perform the given Ecological Experiment [C] & report the findings **05**

Q. 4) To perform the given microchemical test [D] & report the findings **03**

Q. 5) Spotting : **04**

- E - Plant Physiology
- F -Plant Physiology
- G - Ecology (Component of aquatic ecosystems)
- H - Ecology(Component of terrestrial ecosystems)

Q. 6) Viva Voice **03**

Q. 7) Practical Record & Excursion Report **05**

SEMESTER – VI

PAPER – I

PLANT PHYSIOLOGY-II & BIOTECHNOLOGY

Unit I

Growth: Concept, growth curve, phases of growth

Phytochromes: Pr and Pfr forms, their role

Circadian rhythms and biological clock

Plant growth regulators: Role of auxin, cytokinins, gibberilins, ABA and ethylene

Plant movements: Tropic and nastic movements

Unit II

Photoperiodism: physiology of flowering, photoperiodism and vernalization, role of florigen

Senescence and abscission

Seed dormancy: Causes and role, methods to break seed dormancy

Plant defence: Definition: Hypersensitive response and Systemic acquired resistance; Role of secondary metabolites (Terpenes and phenolic compounds)

Unit III

Plant tissue culture: definitions of- totipotency, explant, asceptic culture, in vitro, micropropagation; methods of sterilization (autoclaving, dry heat, chemicals), culture media (MS media) hormone requirement & applications of tissue culture.

Callus and organ culture (shoot tip, anther) and its application, cybrid production and its application.

Unit IV

Genetic engineering: Tools- Enzymes (Restriction enzymes, ligases, DNA polymerases), Plasmid as cloning vectors.

DNA library: cDNA and genomic library.

Agarobacteriumtumefaciens mediated gene transfer, structure of Ti -plasmids

Advantages and disadvantages of transgenic plants, example Bt cotton and golden rice.

List of Practicals

To determine seed viability by a convenient method

Principle and working of: oven, autoclave, laminar air flow hood

To study the structure of following vectors on the basis of photographs and diagrams: plasmid vector, Binary vector

To study the effect of various plant growth regulators on the growth and development of plants.

To study steps of genetic engineering from photograph example Bt cotton and golden rice.

SEMESTER – VI

PAPER – II

PLANT ECOLOGY, TECHNIQUES & UTILIZATION OF PLANTS

Unit I

Plant succession: Definition, Causes of succession, Hydrosere, Xerosere

Plant adaptations: Morphological, Anatomical & Physiological responses of Hydrophytes, Xerophytes, Halophytes (with one example)

Unit II

Environmental Pollution: Agricultural, noise and thermal pollution, Control of environmental pollution, Environmental management

Natural resources- types (renewable and non-renewable), factors for depletion; conservation of forest and water resources

Unit III

Principle, types and application of: microscopy (Light, fluorescent,SEM, TEM), centrifugation, electrophoresis (SDS-PAGE and Agarose), spectroscopy (UV-Vis), chromatography (Paper chromatography, Thin layer chromatography)

Unit IV

Utilization of **Plants**: Morphology, Utilization and Important chemical constituents of :-

Food: Wheat; Oil: Ground nut; Fibre: Cotton; Spices: Clove; Beverages: Coffee; Medicinal: Neem; and Rubber.

Ethnobotany: Introduction, definition, branches &importance of ethnobotany

List ofPracticals

To study the morphological and anatomical characteristics of anyone hydrophyte and xerophyte.

To study the morphological characteristics of cladode, phylloclade, phyllode and pneumatophores.

Principle and working of: spectrophotometer, microscope etc.

To determine the DO of water samples

different sources.

To study the dust holding capacity of leaves.

To estimate transparency, pH and temperature of different water bodies

To estimate salinity (chlorides) of different water samples.

To determine the percent leaf-area injury of different leaf samples collected around polluted sites.

Utilization of **Plants**: Morphology, Utilization and Important chemical constituents of plants mentioned in theory. To study the plants of ethnobotanical importance.

Microchemical Tests: Lipid, Proteins, starch, Lignin, Carbohydrates, Cellulose.

Electrophoretic /chromate graphic separation of amino acids carbohydres

Botanical Excursions (One short tour is compulsory).

Semester VI Practical examination

Question Paper

Time : 5 hrs **Marks : 30**

Q. 1) To determine seed viability [A] & report the findings **05**

Q. 2) To study the given Ecological material [B] & report the findings. **05**

Q. 3) Electrophoretic/chromatographic separation of amino acid and carbohydrates [D]. **04**

Q. 4) Morphology, anatomy and utilization of the given plant material [E]. **04**

Q. 5) **Spotting:** **04**

E -Ecology (morphology)

F - Biotechnology Instruments

G - Utilization of plant

H -Utilization of plant

Q. 7) Viva Voice **03**

Q. 8) Practical Record & Excursion Report **05**

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B. Sc. Semester V Suggested Laboratory Exercises

MAJOR PLANT PHYSIOLOGY EXPERIMENTS (ANY NINE):

1. To study the permeability of plasma membrane using different concerntrations of organic solvents.
2. To study the effect of temperature on permeability of membranes.
3. To determine the osmotic potential of vacuolar sap by plasmolytic method.
4. To determine the water potential of any tuber.
5. To compare the rate of transpiration from two sufaces of leaf- a) bell jar method b) Cobalt chloride method.
6. To determine the path of water (Ascent of sap).
7. To separater chloroplast pigments a) by solvent method and preparation of their absorption spectra b) paper chromatography.
8. To separate amino acids from plant materials an paper chromatography and their identification by comparison with standards.
9. To measure rate of photosynthesis by Wilmott's bubbler under variable conditions of light, temperature and CO_2.
10. To compare rates of respiration f various plant parts.
11. To demonstrate bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant materials.

MINOR MAJOR PLANT PHYSIOLOGY EXPERIMENTS (ANY SEVEN):

1. To demonstrate the phenomenon of dispersion.
2. To demonstrate the phenomenon of adsorption.
3. To demonstrate the phenomenon of imbibitions.
4. To demonstrate the root pressure.
5. To demonstrate that the amount of water absorbed and the amount of water transpired is approximately equal.
6. To demonstrate that the light is necessary for photosynthesiss (Ganong's light screen).
7. To demonstrate that the light, chlorophyll and CO_2 are necessary for photosynthesis (using Moll's half-leaf experiment).
8. To demonstrate fermentation by Kuhne's tube.
9. To demonstrate aerobic respiration.
10. To demonstrate the evolution of CO_2 in respiration.
11. To demonstrate that the part of energy is released in the form of heat during respiration.
12. To demonstrate the measurement of growth of germination pea seeds.
13. To demonstrate the phomenon of gravitropism (geotropism), phototropism and hydrotropism.
14. To demonstrate seed vaiability test by T.T.C. (Triphenyl-tetrazolium chloride).

15. To demonstrate the phenomenon of nastic movement in *Mimosa pudica / Biophytum sensituvum* plants.

Suggested Laboratory Exercises

ECOLOGY EXPERIMENTS (Any nine):

1. To determine the minimum number of quadrates required for reliable estimate of biomass in grasslands.
2. To study the frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkiaer's Standard Frequency Diagram.
3. To estimate importance value index for grassland species on the basis of relative frequency relative density and relative biomass in protected and razed grassland.
4. To measure the vegetation cover of grassland through point-frame method.
5. To measure the above-ground plant biomass in a grassland.
6. To determine the Kemp's constant for dicot and monocot leaves and to estimate leaf-area-index of a grassland community.
7. To determine diversity indices (Richness, Simpson, Shannon-Wiener) un grazed and protected grasslands.
8. To estimate bulk density and porosity of grassland and woodland soil.
9. To determine moisture content and water holding capacity of grassland and woodland soil.
10. To study the vegetation structure through profile diagram.
11. To estimate transparency, pH and temperature of different water bodies.
12. To measure dissolved oxygen content in polluted and unpolluted water samples.
13. To estimate salimity of different water samples.
14. To determine the percent leaf-area-injury to different leaf samples collected around polluted sites.
15. To estimate dust-holding capacity of the leaves of different plant species.
16. To study the ecological characters (morphological and anatomical) of the following plants-
    a. **Hydrophytes**: *Hydrilla, Vallisneria, Nymphaea, Potamogeton, Eichhornia* and *Trapa*. (Any Four).
    b. **Xerophyte**: i. For morphological features: *Acacia auriculiformis, Parkinsonia, Muehlenbeckia, Ruscus, Asparagus, Kalanchoe, Euphorbia nerifolia, Opuntia*; ii. For morphological and anatomical features: *Nerium, Casuarina*.
    c. **Halophytes**: for morphological features: *Rizophora*.
    d. **Epiphytes**: for morphological and anatomical features: Orchid (*Vanda*).
    e. **Parasite**: For morphological and anatomical features: *Cuscuta*.

    Note: - 1. Experiment no. 16 is compulsory, 2. Frequent tours to the different ecological sites to study vegetation are compulsory. 3. One long excursion is

essential, 4. Excursion and study tour reports dully signed by the H.O.D. to be submitted at the time of examination.

Suggested Laboratory Exercises

BIOCHEMISTRY EXPERIMENTS (Any nine):

1. To study the ENZYME activity of **Catalase** and **Peroxidase** in suitable plant material as influenced by pH and temperature.
2. To study the ENZYME activity of **Amylase** from germination Barley/ Wheat grains.
3. Colorimeteric/Spectrophotometric estimation of sugar and starchy (Carbohydrates in suitable plant materials.
4. To prepare the standard curve of protein and determine the protein content in plant samples.
5. Estimation of Anthocyanin pigments from different plant material (At least two) and preparation of absorption spectra.

Semester VI Practical

Biotechnology:

1. To get acquainted with the laboratory equipments, apparatus and instruments in biotechnology laboratory.
2. To demonstrate the technique of micropropagation by using different explants e.g. axillary buds and shoot meristem.
3. To demonstrate the technique of anther culture.
4. To demonstrate the root and shoot formation from the apical and basal portion of the stem segments in liquid medium containing different hormones.
5. To isolate protoplast from different tissues using commercially available enzymes.
6. Immobilization of embryos from suitable plant seeds using sodium alginate.

Utilization of plants:

1. **Food plants:** Study of morphology, structure and simple micro-chemical tests of the food storing tissues in rice, wheat, maize, potato and pulses (soybean, pea) and sugarcane.
2. **Fibres:** Study of cotton flower, section of cotton ovules developing seeds to trace the origin and development of cellulosic ‘fibers’ (seed epidermal hair, microscopic study of cotton and test for cellulose). Section and staining of jute stem to show the location and development of fibres, microscopic structure and test for lingo-celllose.
3. **Vegetable oils:** Study of hand sections of groundnut, mustard and coconut and staining of oil droplets by Sudan-III and Sudan black.
4. **Field visits:** Study sources of firewood (ten plants), timber-yielding trees (ten plants), and bamboos, preparation of list mentioning special features.

5. **Spices:** samples of black paper, cloves, cinnamon (had sections and opend fruit of cardamom and describe them briefly) survey of spices found and use locally for practical assignment.
6. **Medicinal plants:** preparation of an illustrated inventory of ten medicinal plants used in indigenous system of medicine and allopathy- write their botanical and vernacular names, part/s used and diseases disorders for which they are prescribed.
7. **Beverages:** study section of boiled coffee beans and tea leaves to study the characteristic structural features.
8. **Rubber:** Collect illustrative materials of *Havea Brasilensis*, study morphology of the plant and tapping practices, history of rubber, list the many uses of rubbers.

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RTM NAGPUR UNIVERSITY NAGPUR
SEMISTER PATTERN SYLLABUS
(To be implemented from session 2013-14)

SUBJECT CHEMISTRY
B.Sc. –I , Semester - I
CH – 101: Paper- I (Inorganic Chemistry)

Unit-I **(7.5 Hrs)**

(A) Atomic structure-Idea of de-Broglie matter Waves, Heisenberg's uncertainty principle. Schrodinger wave equation, significance of Ψ and Ψ^2,Quantum numbers, shapes of s, p, and d orbitals, Aufbau principle ,Pauli's exclusion principles and Hund's rule of maximum multiplicity . Electronic Configuration of elements and ions (Z = 1 to 30)

(B) Periodic Properties: Atomic and ionic radii, ionization energy, electron affinity and electronegativity- Definition, trends in periodic table. Factors affecting ionization potential. Pauling's and Muliken's scale of electronegativity. Effective nuclear charge and Slater's rule with some exercises

Unit-II **(7.5 Hrs)**

(A) Covalent Bond:Valency Bond Theory ,Formation of Hydrogen molecule, Limitations, directional characteristics of covalent bond, overlap criterion and bond strength. Bond energy, bond length, Bond order, Bond angle. Various types of hybridization and shape of inorganic molecules.Valence shell electron pair repulsion (VSEPR) theory toNH_3, SF_4,ClF_3, and H_2O

(B)Ionic solids: Ionic structures, Lattice energy and Born- Harber cycle. Solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajans rule.

Unit – III **(7.5 Hrs)**

(A) s- block elements-Comparative study: Electronic configuration, atomic and ionic radii, Ionisation potential, Reducing properties. Diagonal Relationships (Li-Mg) . Hydrogen bonding .Classification and effect of Hydrogen bonding on viscosity, solubility , M.pt. and B.pt

(B)Chemistry of Noble Gases: Chemical properties of the noble gases, Chemistry of Xenon, Structure and bonding in xenon fluorides and oxyfluorides ($XeOF_2$ and $XeOF_4$)

Unit- IV **(7.5 Hrs)**

(A) p-block elements -Comparative study of groups 13 to 17: Atomic and ionic radii, Ionisation potential, electronaffinity, electronegativity, redox properties, oxidation state. Diagonal relationship (B-Si).

(B) Hydrides : Comparative study with respect to structure of NH_3, PH_3, AsH_3 and SbH_3.

Oxides: Structure of P_2O_3 ,P_2O_5 and Oxyacids of Phosphorous (H_3PO_3 and H_3PO_4)

Peroxyacids of sulphur: Preparation and structure of Caro's and Marshall's acids.

Hydrides of boron: Structure and bonding of diborane , structure of borazine .

CH – 102 : Paper- II (Physical Chemistry)

Unit-I **(7.5 Hrs)**

Gaseous State

A) Postulates of kinetic theory of gases, derivation of kinetic gas equation, deduction of various gas laws from kinetic gas equation. Qualitative discussion of the Maxwell- Boltzmann distribution of molecular velocities. Effect of temperature on molecular velocities. Different types of molecular velocities (most probable, R.M.S. and average and expressions for them, their inter relationships. Definitions of Mean free path collision diameter and collision number.

(B) Ideal gas and real gases, behavior of real gases, deviations from ideal behavior, explanation of the terms – Compressibility factors and Boyle temperature. Causes of deviation from ideal behaviors. Vander Wall's equation of state, explanation of behaviour of real gases. Critical phenomenon (P-V isotherms of real gases). The isotherms of Van der Wall's equation, Relationship between critical constants and Van der Walll's equation, Relationship between critical constants and Vander Waal's constants.

Unit-II

Solid State

(7.5Hrs)

Laws of crystallography

i) Law of constancy of interfacial angles
ii) Law of rationality of indices
iii) Law of symmetry, symmetry elements in crystals.
Unit cell, space lattice, orientation of lattice place (Miller indices).Bravais lattices, crystal systems, X-ray diffraction by crystal, derivation of Braggs' equation. Determination of crystal structure of NaCl, KCI and CsCl Laue's method and powder method.

Unit- III **(7.5 Hrs)**

Liquid State

A) Intermolecular forces, structure of liquids (a qualitative description), structural differences between solids, liquids and gases, liquid crystals,Classification, structure of Nematic and Cholesteric phases, Thermographic and seven segment cell.

B) Properties of liquid :

i) Surface tension : Explanation, methods of determination, Capillary rise method and drop number method, Parachor value and its application .

ii) Viscosity : Explanation, coefficient of viscosity, Effect of temperature on Viscosity, relative viscosity, specific viscosity and intrinsic viscosity and reduced viscosity. Method of determination by Ostwald viscometer.

iii) Refractive index : specific refraction, molar refractions and chemical constitution. Method of determination by Abbe's Retractometer.

Unit- IV

Surface Chemistry and Catalysis- **(7.5 Hrs)**

A) Adsorption- General introduction, Factors affecting adsorption of Gases by Solids, Types of adsorption, Adsorption Isotherms :Freundlich Adsorption Isotherm, Langmuir Adsorption Isotherm, B.E.T. Equation(no derivation), Application of B.E.T. Equation in Determination of Surface Area of Adsorbent, , Effect of Dissolve substance on Surface Tension of the solvent (Adsorption at the Surfaces of Solutions), Application of Adsorption.

B) Catalysis:- Introduction, Homogeneous & Heterogeneous Catalysis Examples , Action of Catalytic Promoters & Inhibitors, enzyme catalysis, auto catalysis ,Kinetics of Enzyme Catalysed Reactions- Machaelis-Menten Equation

CH-103: Laboratory Course

Practical- I(Inorganic Chemistry): Semi micro Qualitative Analysis

Qualitative analysis of inorganic salt mixture containing two acidic radicals of different group and two basic radicals of same groups. (At least six mixtures to be analysed)

Practical- II (Physical Chemistry)

1) Determination of relative viscosity of unknown liquid by Ostwald viscometer.
2) To determine the percentage composition of given binary mixture (Ethanol-water) by viscosity method.
3) 'Determination of surface tension of a given liquid by drop number method (Stalagmometer method)
4) Comparison of cleaning action of surfactants.
5) Determination of refractive index of given liquid by Abbe's refractometer.
6) Construction of various crystal modelsof NaCl unit cell.
7) To verify the Freundlich & Langmuir's adsorption isotherm of acetic acid on charcoal.

B.Sc. –I , Semester - II

CH – 201: Paper- I (Organic Chemistry)

Unit - I **(7.5 Hrs)**

A) Structure and Bonding : Hybridization in case of Methane, Ethane, Ethylene and Acetylene, Bond lengths, bond angles and bond energies. Elementary ideas of Inductive effect, Electromeric effect. Resonance effect,Hyperconjugation (definition and examples). Hydrogen bonding in organic compounds (with reference to alcohol) and its consequences. .

B) Mechanism of Organic Reactions : Homolytic & heterolytic bond fission with examples . Electrophiles & nucleophiles definition and example both neutral and charged.Types of organic reactions addition, substitution, elimination, rearrangement. Reactive intermediates carbocations, carbaions, free radicals, carbenes, formation, geometry, stability.

Unit - II **(7.5 Hrs)**

Stereochemistry of Organic Compounds : Concept of isomerism. Types of isomerism with suitable examples. Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic centre(lactic acid as example). Optical activity, chiral and achiral molecules with two stereogenic centres (Tartaric acid) diastereo-isomers, mesocompound. Resolution of enantiomers biological and chemical methods. Inversion retention and recemisation. Asymmetric synthesis. Relative and absolute configuration, sequence rules, D & L and R & S system of nomenclature.

Geometrical isomerism : E & Z system of nomenclature, geometric isomerism in maleic acid and fumaric acid and 2-butene.

Conformational isomerism : Conformational analysis of ethane and n-butane.
Newman's projection and sawhorse formulae. Difference between configuration and conformation.

Unit - III **7.5 Hrs**

A) Alkanes: IUPAC nomenclature of branched and unbranched alkanes. Alkyl group, methods of formation (Ethane) - Wurtz reaction, Kolbe's reaction, decarboxylation of carboxylic acid. Physical properties and chemical reactions of alkanes: halogenation, nitration, sulphonation, isomerization, cyclization, aromatization, pyrolysis and cracking oxidation, L. P. G., Octane number. Mechanism of free radical chlorination of methane.

Cycloalkanes : Nomenclature,Baeyer's strain theory and its limitations. Ring strain in small rings cyclopropane and cyclobutane. Theory of stainless rings. Conformational analysis of cyclohexane, axial and equatorial bonds.

B) Alkenes : Nomenclature of alkenes, methods of formation (ethylene & propylene) - dehydrogenation, dehydrohalogenation of alkyl halides, dehydration of alcohol dehalogenation of dihalides.Chemical reactions of alkenes (ethylene and propylene) - hydroboration, oxidation $KMnO_4$, HIO_4, Epoxidation, Ozonolysis, Hydroxylation, Polymerization Substitution in allylic position of alkenes. Markownikoff's Rule and peroxide effect. Ionic Mechanism of addition of Br_2 to ethene and HBr to propene Free radical mechanism of addition of HBr to propene.

Unit - IV **7.5 Hrs**

A) Dienes: Nomenclature and classification of dienes Methods of formation of 1, 3 - butadiene. Chemical reactions of butadiene - 1, 2 and 1, 4 additions Diels-Alder reaction.

Alkynes: Nomenclature, structure and bonding in Alkynes. Methods of formation of acetylene from - calcium carbide, dehydrohalogenation of dihalides Chemical reaction - hydroboration, oxidation metal ammonia reduction & polymerization. Oxyacetylene flame. Acidity of alkynes.

B) Aromatic compounds and Aromaticity: Nomenclature of Benzene derivatives, structure of benzene, Molecular formula and Kekule structure. Resonance structure, MO picture, Huckel rule, aromatic ions (cyclopentadienyl anion and cycloheptatrienyl cation). Aromatic electrophillic substitution mechanism with energy profile diagram (eg. nitration and sulphonation).

CH – 202: Paper- II (Physical Chemistry)

UNIT-I : Thermodynamics **7.5 Hrs**

(A) Recapitulation of thermodynamic terms : system, surrounding, types of system (closed, open & isolated), Thermodynamic, variables, intensive & extensive properties, thermodynamic processes isothermal, adiabatic, isobaric, isochoric, cyclic, reversible & irreversible. State function & path functions, concept of heat & work.

(B) Statements of first law of thermodynamics, definition of internal energy & enthalpy, heat capacity, heat capacity at constant volume and at constant pressure, their relationship. Joule-Thomson experiment, Joule-Thomson coefficient & inversion temperature, calculations of w, q ΔE & ΔH for expansion of gases for isothermal & adiabatic conditions for reversible process,.

Thermo chemistry : Heat of reaction ,relation between heat of reaction at constant volume and constant pressure. Hess's law of constant heat of summation & its applications. Average bond energy ,bond dissociation energy and its calculations from thermochemical data,

UNIT-II : Phase Equilibra **7.5 Hrs**

(A) Phase rule : Statement of phase rule, definition of phase, component and degree of freedom, Applications of phase rule to one component system i) water system, ii) Sulphur system. Need of reduced phase rule equation. Two component system (Pb-Ag system) ,Pattinson,s process.

(B) Liquid-Liquid mixtures : Ideal liquid mixtures, Raoults law of ideal solutions, Henry's law, non-ideal systems, azeotropes : HCl-H_2O & ethanol- water system. Partial miscible liquids : phenol-water system, trimethylamine-water, nicotine-water system, lower & upper consolute temperature, effect of impurity on consolute temperature , Nernst distribution law, limitations and applications(association and dissociation).

UNIT-III : Electrochemistry **7.5 Hrs**

A) Electrical transport : Conductance in metals (electronic) & in electrolyte solutions (ionic conductance), conductivity of electrodes, specific, equivalent and molar conductance, measurement of equivalent conductance, variation of equivalent & specific conductance with dilution, mobility of ions & Kohlrausch's law, Arrhenius theory of electrolyte dissociation & its limitation, Debye-Huckel theory (elementary treatment).Relaxation effect, Electrophoretic effect and Onsagar equation.

B) Migration of ions, velocity of ions & change in concentration around electrode, transport number : definition & determination by Hittorfs method & moving boundary method, factors affecting transport number of ions, relation between transport number & ionic conductance. Application of Kohlrausch's law & conductance for the determination of degree of dissociation, dissociation constant of acids, solubility of sparingly soluble salt, conductometric titrations (Acid-base & precipitation titrations) .

UNIT-IV: Chemical Kinetics **7.5 Hrs**

(A) Concept of reaction rate, factors affecting the rate of a reaction – concentration., temperature, pressure, solvent, light, catalyst. Order and molecularity, Zero order. Mathematical expression for rate constant of first and second order reactions, their characteristics. Pseudo order reactions. Half life and mean life of reactions with examples. Methods of determination of order of reaction –integration method, differential method, graphical method, method of half life period and isolation method. Effect of temperature on rate of reaction. Arrhenius equation, concepts of activation energy.

(B) Collision theory of bimolecular reactions (hard sphere model). Transition state theory, expression for rate constant based on equilibrium constant and thermodynamic aspects. Lindmann's theory of unimolecular reactions

CH-203: Laboratory Course

Practical I (Organic Chemistry):

A) Qualitative Analysis: Element detection(N, Cl , Br, F & S),Identification of functional groups (-COOH, Phenolic –OH,_-CHO, Aromatic $-NH_2$, $-CONH_2$) ,determination of M.P & B.P.

B) Preparation: i) Hydrolysis : Preparation of Benzoic acid from Benzamide
ii) Oxidation: Preparation of Benzoic acid from Benzaldehyde
iii) Bromination of Phenol

Practical II(Physical Chemistry):

1 To determine the heat of solution of potassium nitrate calorimetrically.
2 To determine the heat of ionization of acetic acid calorimetrically
3 To determine the solubility of benzoic acid at different temperatures and to determine heat of solution of benzoic acid.
4 To construct the phase diagram of three component system(Acetic acid-chloroform-water)
5. To determine the critical solution temperature of two partially miscible liquids(phenol-water systems).
6 To study the distribution of Iodine between Water and Carbon tetrachloride/Kerosene
7. To determine the strength of the given acid (HCL or CH_3COOH) conductometrically using standard alkali solution.
8. To determine the specific reaction rate of the hydrolysis of methyl acetate catalyzed by H^+ ions at room temperature.
9 . To dertermine the specific reaction rate of hydrolysis of ethyl acetate catalysed by base (saponification)

B.Sc. –II , Semester - III

CH – 301:Paper- I (Inorganic Chemistry)

Unit – I **7.5 Hrs**

(A) MO theory :LCAO approximation, wave equation for molecular orbitals. Difference between bonding and anti bonding MO in terms of energy and electron density distribution curves, order of energy levels in MO. Molecular Orbital diagrams for homonuclear diatomic molecules of elements(with Z= 1 to 9) Concepts of nonbonding MO in HF molecule. Coulson's MO diagram of CO and NO diatomic molecule.

(B).Preparation ,properties and structure of tetrasulphur tetranitride (S_4N_4) and Interhalogen compounds. Poly halides(Structure of I_3^-, I_5^-, and ICl_4^-).

Unit- II: **7.5 Hrs**

A) Chemistry of elements of first transition series:

Characteristic properties of the elements of first transition series with reference to their:
Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties , Colour, Complex formation tendency and catalytic activity.

B) Non-aqueous solvents:

Classification of solvents and characteristic reactions(acid base, redox & precipitation reactions) in Non-aqueous solvents with reference to i)Liquid Ammonia and ii) Liquid Sulphur dioxide.

Unit – III: **7.5 Hrs**

A) Chemistry of elements of second and third transition series:

Electronic configuration of 4d and 5d transition series .Comparative treatment with their 3d- analogous (Group Cr-Mo-W, Co-Rh-Ir,) in respect of oxidation states and magnetic behavior.

B) Errors in Chemical Analysis:

i) Random and Systematic errors, Explanation of terms: Accuracy and Precision, Uncertainty, Absolute and Relative errors, Mean , Median, Average and Standard deviations, Significant figures, numerical problems.

ii) Statistical Test of Data: Q-test, 2.5d and 4d Rules for rejection of data. Numerical problems

Unit – IV: **7.5 Hrs**

A) Chemistry of Lanthanides:

Position in periodic table , electronic configuration, Oxidation states, Atomic and ionic radii, Lanthanide contraction and its consequences, Complex forming tendency. Occurrence and separation of lanthanides (ion exchange and solvent extraction).

B) Chemistry of Actinides:

Position in periodic table, electronic configuration, Oxidation states, Atomic and ionic radii.

CH-302 : Paper- II (Organic Chemistry)

Unit –I **7.5 Hrs**

Orientation : Activating (–OH, $–NH_2$) & deactivating (–Cl, $–NO_2$, –COOH) substituent's, their orientation and directive influence on further electrophilic substitution, o/p ratio. Methods of formation and chemical reactions of alkyl benzene (Toluene) and biphenyl.

Alkyl halides : Nomenclature, classification, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides S_N1 and S_N2 with energy profile diagrams.

Polyhalogen compounds : Chloroform and carbon tetrachloride – formation and chemical reactions.
Nuclear and side chain halogen derivatives of benzene (Aryl halides) : Chlorobenzene and benzyl chloride preparation and reactions. Relative reactivity of alkyl halides vs aryl halides. Synthesis and uses of DDT and BHC.

Unit – II **7.5 Hrs**

A) Alcohols : Classification and nomenclature,

Dihydric alcohols : Nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage ($pb(Oac)_4$ and HIO_4) and Pinacol – pinacolone rearrangement.

Trihydric alcohols : Nomenclature and methods of formation, chemical reactions of glycerol.

(C) **Phenols :** Nomenclature, structure and bonding, Preparation of phenols From cumene, chlorobenzene (Dows and Raschig process) and diazonium salts. Physical properties and acidic character, Resonance stabilization of phenoxide ion, Reactions of phenols, Electrophilic aromatic substitution, acetylation and carboxylation, Claisen rearrangement, Gatterman synthesis reaction Mechanism of i) Fries Rearrangement,ii) Reimer-Tiemann reaction.

Unit – III **7.5 Hrs**

Aldehydes and ketones : Nomenclature and structure of the carbonyl group, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides and ketones from nitriles. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation, Wittig reaction, Mannich reaction, oxidation of aldehydes(by $KMnO_4$,Tollens reagent and Fehlings solution), Baeyer-Villiger oxidation of Ketones, Cannizaro reaction, (with mechanism) MPV, Clemmensen, Wolf-Kishner, $LiAlH_4$ and $NaBH_4$ reductions,

Unit IV **7.5 Hrs**

A) Carboxylic Acids : Nomenclature, structure & bonding, Physical properties, acidity of carboxylic acids, effect of substituent's on acid strengths preparation of carboxylic acids(from G.R. and cyanides), Reactions of carboxylic acids, Hell-Volhard-Zelinsky reactions. Reduction of carboxylic acids, Mechanism of decarboxylation. Methods of formation and chemical reactions of unsaturated monocarboxylic acids (crotonic acid and cinnamic acid).

Dicarboxylic acids : Methods of formation and effect of heat and dehydrating agents. (Succinic acid, Phthalic acid).

(B) Carboxylic acid derivatives : Structure & nomenclature of acid chlorides, esters, amides and acid anhydrides. Interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, Chemical reactions, Mechanism of esterification and hydrolysis (acidic and basic).

CH- 303: Laboratory Course

Practical-I (Inorganic Chemistry):

Volumetric Analysis (All 5 Expts. to be performed)

Preparation of standard solution by weighing is compulsory

1) Estimation of Fe(II) by dichromate using internal indicator.
2) Determination of acetic acid in commercial vinegar using NaOH
3) Determination of alkali content in antacid tablet using HCl
4) Determination of Zn by complexometric titration with EDTA
5) Determination of total Hardness of water (permanent and Temporary) by EDTA

Practical- II(Organic Chemistry):

Complete analysis of simple organic compound involving following steps :-

(i) Preliminary examination ii)Detection of elements iii)Detection of functional group iv)Determination of M.P. / B.P. v) Preparation of derivative and its M.P./B.P. vi)Performance of specific test if any

B.Sc. –II , Semester – IV

CH – 401:Paper- I (Inorganic Chemistry)

Unit-I: **7.5 Hrs**

Coordination compounds:

Distinction among simple salts , double salts and coordination compounds. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples, Nomenclature of Coordination compounds. Chelates: Classification and their application, Valence Bond Theory of transition metal complexes.

Unit- II: **7.5 Hrs**

A) Isomerism in coordination compounds:

Structural isomerism and Stereoisomerism in coordination compounds.

B) Oxidation and reduction:

Use of redox potential data: Analysis of Redox cycle, redox stability in water, Latimer diagram of Chlorine and Oxygen, Frost diagram of Nitrogen and Oxygen, and Porbaix diagrams of Iron.

Unit- III: **7.5 Hrs**

A) Organometallic Chemistry

Definition, Nomenclature and Classification of Organometallic compounds .Preparation properties and application of Alkyl and Aryls of Li and Al. A brief account of metal ethylenic complexes (Structure only).Homogeneous Hydrogenation (Wilkinson's Catalyst reaction).

B) Metal carbonyls-Definition, preparation, properties, structure and bonding in mononuclear carbonyls- $Ni(CO)_4$, $Fe(CO)_5$ and $Cr(CO)_6$

Unit –IV : **7.5 Hrs**

A) Bioinorganic Chemistry: Essential and Trace elements in biological processes, Metalloporphyrins with special reference to structure and role of Hemoglobin and Myoglobin in transport of Oxygen. Biological role of Na^+ and K^+ and Ca^{2+} metal ions.

B) Hard and Soft Acids and Bases: Classification of Acids and Bases as Hard and Soft. Pearson's HSAB Concept and its applications.Symbiosis.

CH – 402:Paper- II (Physical Chemistry)

UNIT- I ; Thermodynamics **7.5 Hrs**

(A) Second law of thermodynamics : Need for second law of thermodynamics, statements of second law of thermodynamics, Carnot's cycle and its efficiency, thermodynamic scale of temperature,concept of entropy, entropy as a state function of V & T, P & T, entropy change in phase change for ideal gas, entropy as criteria of spontaneity & equilibrium.

(B)Free energy functions: Helmholtz free energy (A) & Gibb's free energy (G) and their properties, standard free energies, effect of temperature on free energy (Gibb's – Helmholtz equation) & its applications, A & G as criteria for thermodynamic equilibrium.

(C) Systems of variable composition: Partial molar quantities, chemical potential, Van't-Hoffs reaction isotherm, relation between standard free energy change & equilibrium constant (thermodynamic derivation of law of mass action), effect of temperature on equilibrium constant (reaction isochore).

UNIT –II : Electrochemistry **7.5 Hrs**

(A) Galvanic cells, irreversible & reversible cells, emf of cells & its measurement, calculation of thermodynamic quantities of a cell reactions (ΔG, ΔH & ΔS & equilibrium constant)

(B) Types of reversible electrodes : gas electrode, metal-metal ion electrode, amalgam electrode, metal insoluble salt-anion, redox electrodes, Half cell reactions, Nerns't equation, calculation of cell emf from single electrode potential, reference electrodes, standard electrode potential, concentration cells with & without transference, liquid-junction potential, salt bridge & its functions, Applications of emf measurements in : (i) pH^- determination using hydrogen electrode, quinhydrone electrode & glass electrode (ii) potentiometric titration(Acid –Base and Redox titrations).

Unit-III **7.5 Hrs**

A)_Nuclear chemistry : Composition of Nucleus, Mass defects, nuclear binding energy, Average binding energy per nucleon, explanation of nuclear stability on the basis of graph between average binding energy per nucleon and atomic mass number. Nuclear reactions : Fission and fusion. Nuclear models : Liquid drop model, Shell model and comparison between them. Explanation of fission by liquid drop model. Applications of radioisotopes in medicine, agriculture, carbon dating and structure determination

B) Dipole moment

Electrical dipole moment, polarizatrion of molecules (Clasius Mosotti equation), orientation of dipoles in an electric field. Determination of dipole moment. Bond moments. Group moments for benzene derivatives.Application of dipole moment to (i) % ionic character (ii) Shape of molecules, (iii) study of geometrical isomers and (iv) substituted benzene molecules.

Unit IV : Spectroscopy **7.5 Hrs**

A) Rotational Spectroscopy :

Introduction to spectroscopy, Dipole moment and Rotational Spectra. Rotational spectra of diatomic molecules, Energy levels of rigid rotor. Selection rule for transition between energy levels. Expression for wave number (cm^{-1}) of spectral lines in terms of rotational constant (B) and rotational quantum number (J). Intensity of spectral lines. Application of rotational spectra for determination of bond length of diatomic molecules. Introduction to non-rigid rotor.

B) Vibrational Spectra :

Energy levels of simple harmonic oscillator, Energy level diagram, relative populations of energy levels. Selection rule for pure vibrational spectra (harmonic oscillations), Force constant. Anharmonic oscillator,

Morse equation, selection rules, idea of overtones. Degrees of freedom and normal modes of vibration for polyatomic molecules. Idea of vibrational frequencies of different functional groups.

CH-403: Laboratory Course

Practical-I (Inorganic Chemistry):

A) Gravimetric Analysis

i) Estimation of Ba^{2+} as $BaSO_4$,

ii) Estimation Ni^{2+} as Ni-DMG

B) **Chromatographic separation** of binary mixtures(at least Two) containing Cu(II), Co(II) and Ni(II) ions by paper chromatography and determination of Rf values.

Practical-II (Physical Chemistry):

1. To determine the strength of strong acid and a week acid in a given mixture conductometrically by titrating it with standard alkali solution.
2. To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
3. To determine the ionization constant of weak acid conductometrically.
4. To titrate potentiometrically ferrous ammonium sulphate solution using potassium dichromate solution as titrate and calculate the redox potential of Fe^{2+}/Fe^{3+} system on hydrogen scale.
5. To determine the dissociation constant of weak acid potentiometrically by titrating it against alkali.
6. To determine heat of solution of solid calcium chloride and calculate lattice energy of calcium chloride from its enthalpy change data using Born-Harber cycle.
7. To determine the strength of given acid (HCL or CH_3COOH) potentiometrically using standard alkali solution
8. To determine the molecular state of Benzoic Acid by distribution method .

B.Sc. –III, Semester – V

CH- 501:Paper- I (Organic Chemistry)

UNIT- I **7.5 Hrs**

Organic compounds of Nitrogen : Preparation of nitroalkanes and nitrobenzene, chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitrobenzene and their reduction in acidic, neutral and alkaline media. Picric acid- preparation and uses,

Amines : Structure and nomenclature of amines, Physical properties, stereochemistry of amines, separationof mixture of 1°, 2° and 3° amines, structural features affecting basicity of amines, preparation of alkyl &aryl amines (reduction of nitro compounds and nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel phthalimide reaction, Hofmann bromamide reaction, Reactions of amines, Preparation and synthetic transformations of aryl diazonium salts.

UNIT – II **7.5 Hrs**

HETEROCYCLIC COMPOUNDS :

Molecular orbital picture and aromaticity of furan, thiophene, pyrrole and pyridine. Methods of synthesis of pyridine. Mechanism of electrophilic and nucleophilic substitution reaction of pyridine. Chemical reaction of pyridine. Structure of pyridine. Comparison of basicity of pyrrole and pyridine. Introduction to condensed five and six membered heterocycles. Preparation and reactions of Indole, Quinoline and Isoquinoline with special reference to Fischer Indole synthesis, Skraup synthesis and Bischler Napieralski synthesis.

UNIT-III **7.5 Hrs**

A) Quantitative Analysis : Estimation of carbon, hydrogen, nitrogen, sulphur and halogens (only principles and calculations). Calculation of Empirical and molecular formula with Numericals

B) Organometallic compounds :

Organomagnesium compound : Grignard reagent formation, chemical reactions and structure.

Organozinc compounds : Formation and chemical reactions. Organolithium compounds: Formation and chemical reactions.

UNIT-IV

SPECTROSCOPY :

A) **Electromagnetic spectrum :** Absorption spectra, Ultraviolet absorption spectroscopy, Absorption laws(Beer Lambert law), molar absorptivity, Presentation and analysis of UV spectra, Types of electronic transitions, Effect of conjugation, concept of chromophores and auxochromes, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated dienes and enones.

B) Infrared (IR) absorption spectroscopy : Molecular vibrations, Hook's law, Selection rules, Intensity and position of IR bands, measurement of IR spectrum. Fingerprint region, characteristic absorptions of various functional groups and application of IR spectra.

CH- 502:Paper- II (Physical Chemistry)

Unit I : Quantum Chemistry I **7.5 Hrs**

A) Failure of classical mechanics : Explanation on the basis of Black body radiation, Photoelectric effect, heat capacity of solids and Bohr's model of Hydrogen atom (No derivation) . Plank's quantum theory. De Broglie's hypothesis (Derivation and experimental proof). Heisenberg's uncertainty principle (Explanation and experimental proof).

B) Introduction to wave functions (Ψ), well behaved wave functions. Interpretation of wave function (Ψ) and its square (Ψ^2). Schrodinger wave equation. Normalized and orthogonal wave functions (only qualitative idea no problems). Introduction to operators. Postulates of quantum mechanics, Derivation of Schrodinger wave equation from postulates of quantum mechanics. Partical in a one dimensional box : derivation of energy and normalized wave function. Graphical representation of Ψ and its square Ψ^2. Applications of particle in a one dimensional box. Numerical problems.

Unit II : **7.5 Hrs**

A) **Quantum Chemistry** Schrodinger wave equation for hydrogen atom, separation in to three equations (without derivation, in terms of r, θ and Φ), Total wave function for hydrogen atom in terms of radial and angular wave functions, energy of hydrogen atom (no derivation). Hydrogen like wave functions, radial wave functions and angular wave functions. Interpretation of quantum, numbers. Concept of orbital and radial probability distribution curves for 1s, 2s, 2p, 3p and 3d orbitals.

B) Molecular orbital theory : Criteria for forming M. O. from A. O., LCAO-MO method for H_2^+ molecule, expression for energy levels for bonding and antibonding wave functions. Normalized wave functions for bonding and antibonding (no derivation).Physical pictures of bonding and antibonding wave functions. Introduction to M. O. theory for H_2 molecule (Qualitative treatment, without derivation). Introduction to Valance bond theory for H_2 molecule.

Unit III **7.5 Hrs**

A) Solutions and Colligative properties

Methods of expressing concentration of solutions, Raoults law of relative lowering of vapour pressure, molecular mass determination from relative lowering of vapour pressure. Osmosis, osmotic pressure and its measurement by Barkeley and Hartley method.Determination of molecular mass from osmotic pressure. Elevation of boiling point, determination of molecular mass from elevation of boiling point. Depression of freezing point. Determination of molecular mass from depression of freezing point. Van't Hoff factor, degree of dissociation and association of solute.

B) Magnetic properties :

Electron spin angular momentum, spin quantum number, electron as magnetic dipole, magnetic moment of electron, Bohr magneton, relation between magnetic moment and number of unpaired electrons. Magnetic properties of substances. Diamagnetism, paramagnetism, ferromagnetism, determination of magnetic susceptibility using Gouy method. Determination of magnetic moment of paramagnetic substances. Applications of magnetic susceptibility measurements.

Unit IV **7.5 Hrs**

A) Photochemistry :

Interaction of radiation with matter, difference between thermal and photochemical process, Beer – Lamberts, laws of photochemistry : Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes (nonradiative and radiative) fluorescence, phosphorescence, chemiluminesence, quantum yield, determination of quantum yield of reactions, causes for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCI from H_2 and Cl_2 Photosensitized reactions. Energy transfer processes.

B) Raman Spectroscopy :

Raman effect, Concept of polarizability, Pure rotational Raman spectra of diatomic molecules. Applications of rotational spectra.

CH-503: Laboratory Course

Practical I (Organic Chemistry):

Estimations i) Estimation of Glucose
ii) Estimation of Amide
iii) Estimation of Nitro group
iv) Estimation of Carboxylic group
v) Saponification of oil

Practical II (Physical Chemistry):

1.To verify law of refraction for mixture (glycerol-water) using Abbe's refracto meter.
2.To determine the specific rotation of a given optically active compound.
3. To verify Beer-Lambert law for $KMnO_4$ and determine the concentration of the given solution of $KMnO_4$.
4. To determine molecular mass of a non-volatile solute by Rast method.
5. To determine the molecular weight of polymer by Viscometric method.
6. To determine the surface tension of methyl alcohol, ethyl alcohol & n-hexane at room temperature & also calculate atomic parachors of carbon, hydrogen & oxygen.
7. To determine the energy of activation of reaction between persulphate iodide .
8. To study the rate of acid catalysed iodination of acetone.

B.Sc. –III, Semester – VI

CH – 601: Paper- I (Inorganic Chemistry)

Unit- I

A) Metal ligand bonding in Transition Metal Complexes: **7.5 Hrs**

Limitations of Valency bond theory, Crystal field theory: Splitting of d-orbital in octahedral,tetrahedral and square planar complexes. Factors affecting the Magnitude of 10Dq,Crystal field Stabilisatation Energy of Octahedral and Tetrahedral complexes (Numericals)

B) Electronic spectra of Transition Metal Complexes:

Jahn Teller Effect, Selection Rules (Laporte and Spin selection Rules).Hole Formalism Principle. Electronic spectrum of $[Ti(H_2O)_6]_{3+}$ and $[Cu(H_2O)_6]_{2+}$ complex ions

Unit-II

A) Magnetic Properties of Transition Metal Complexes: **7.5 Hrs**

Method of determining of Magnetic Susceptibility by Gouy's Method. Spin only formula and orbital contribution to magnetic moment.Magnetic properties of Octahedral and Tetrahedral complexes with respect to CFT. Numericals on magnetic moments

B) Thermodynamic and Kinetic aspect of metal complexes:

Thermodynamic and Kinetic stability of metal complexes, their relation. Stepwise stability and overall stability constant and their relationship, Factors affecting the Stability of complexes. Determination of composition of Fe(III)-SSA complex by Mole Ratio and Job's Method.

Unit –III

A) Colorimetery and Spectrophotometery: **7.5 Hrs**

Principles of photometery:Beer-Lamberts Law,derivation and deviation(Numericals). Types of colorimeter and spectrophotometer with simple schematic diagrams. Application of colorimeter and spectrophotometer in quantitative analysis with reference to estimation of Cu(II) as Cu- ammonia complex.

B) Separation Techniques:

a) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography.

b) Ion- Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures.

c) Solvent Extraction: Principle and Classification , Factors influencing extraction and application in chemistry

Unit- IV Inorganic Polymers: **7.5 Hrs**

Silicones: Introduction, Nomenclature, preparation, properties and uses, General introduction to Silicon oils, Silicone Elastomers and Silicon Resins

Phosphonitrilic halide polymers : Introduction, Preparation, properties and uses. Structure and bonding in $(NPCl_2)_3$ and $(NPCl_2)_4$,

CH- 602: Paper- II (Organic Chemistry)

UNIT- I : NMR **7.5 Hrs**

Nuclear Magnetic Resonance (NMR) spectroscopy. Proton Magnetic Resonance spectroscopy. Nuclearshielding and deshielding, Chemical shift, Spin-spin splitting and Coupling constant. Areas of signals.Interpretation of NMR spectra of organic molecules such as ethyl bromide, ethanol,

acetaldehyde, 1,2 dibromoethane, ethyl acetate, toluene, acetophenone, acetyl acetone. Problem pertaining to the structure elucidation of simple organic molecules by NMR technique.

UNIT- II **7.5 Hrs**

A) ORGANIC SYNTHESIS VIA ENOLATES :

Acidity of α- hydrogens, Reactivity of methylene group. Malonic ester preparation and reaction- Acetoacetic ester - synthesis by Claisen condensation reactions, Keto - enol tautomerism of acetoacetic ester, Preparation of acetic acid, succinic acid, crotonic acid and heterocyclic compounds

C) **CARBOHYDRATES :** Definition, classification and reaction of glucose. Mechanism of osazone formation. Determination of structure of glucose. Determination of ring size of monosaccharides. Epimerisation, mutarotation, conversion of glucose into fructose and vice-versa. Chain lengthening and shortening of aldoses(Wohl's degradation).Introduction to structures of maltose, sucrose, lactose, starch , cellulose, ribose and deoxyribose without involving structure determination.

UNIT-III **7.5 Hrs**

A) AMINO ACIDS, PEPTIDES, PROTEINS & NUCLEIC ACIDS :
Classification, structure and stereochemistry of amino acids. Acids base behavior, isoelectric point and electrophoresis. Structure and nomenclature of peptides and protein. Classification of proteins. Protein denaturation. Structure determination of proteins (primary and secondary).
NUCLEIC ACIDS : Introduction, constituents of nucleic acids. Ribonucleosides and Ribonucleotides. Double helical structure of DNA.

B) FATS, OILS AND DETERGENTS : Natural fats, edible and industrial oils of vegetable origin, Glycerides, hydrogenation of unsaturated oils, Definition of Saponification value. Iodine value. Acid value, Soaps,
Synthetic detergents, Alkyl and aryl sulfonates.

UNIT- IV **7.5 Hrs**

A) SYNTHETIC DYES : Colour and constitution (Witt theory, electronic concept) Classification of Dyes based on chemical constitution.Synthesis and uses of Congored, Crystal violet, Phenolphthalein and Alizarin dye.

B) SYNTHETIC DRUGS: Definition,Classification,Preparation ,properties and uses of :Aspirin, Paracetamol,Dettol,Chloroquine,Phenobarbitone,Chloramphenicol, ,Chloramine T.

C) SYNTHETIC POLYMERS : Addition or chain growth polymerisation, free radical. Vinyl polymerisation, Ionic vinyl polymerisation, Ziegler - Natta polymerisation .Condensation or step growth polymerisation. Polyesters, polyamides,

CH-603: Laboratory Course

Practical-I (Inorganic Chemistry):

A) Preparation of following complexes and Comments on its VBT structure, magnetic properties and colors
a) $[Cu(NH_3)_4(H_2O)_2]SO_4$ b) $[Ni(NH_3)_6]SO_4$ c) Trans $[Co(NH_3)_4Cl_2]Cl$ d) $K_3[Fe(C_2O_4)_3].H_2O$

B) Colorimetery

i) Colorimetric or spectrophotometric estimation of copper (II) in commercial copper sulphate sample as ammonia complex.
ii) Jobs method of determination of composition of Fe- SSA complex
iii) Mole Ratio Method of determination of composition of Fe- SSA complex

Practical-II (Organic Chemistry):

Separation of an organic mixture containing two solid components using NaOH /$NaHCO_3$ for separation , identification of the components and preparation of suitable derivatives (minimum five mixtures)

BIOCHEMISTRY
B. Sc. Semester Pattern Syllabus
B. Sc. Part I – Semester I
BIOCHEMISTRY
(With effect from academic session 2013-14)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks).

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part I – Semester I - PAPER I
BIOMOLECULES & HUMAN PHYSIOLOGY

UNIT I:

Carbohydrates: Structure of monosaccharides, sterioisomerism and optical isomerism of sugars, reactions of aldehydes and ketone groups, ring structure and anomeric forms, mutarotation. Chemical reactions of sugars, important derivatives of monosaccharides, di- and tri-saccarides Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides, e.g. glycogen, Starch, cellulose, blood group polysaccharides, inulin, chitin, glycosaminoglycans.

UNIT II

Lipids: Definition and classification. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats - hydrolysis, saponification value, acid value, rancidity of fats, Reichert-Meissel number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins. phosphatidyl serine, phosphatidyl inositol, plasmalogens), sphingomyelins, glycolipids -cerebrosides, gangliosides.

UNIT III:

A) Muscles: Structure of striated muscle fiber. Molecular organization of contractile system, Sliding mechanism of muscle contraction, Neuromuscular Junction

B) Digestion. Digestion and absorption of carbohydrates, fats, proteins.

UNIT IV:

Membrane structure & transport: Membrane composition, Fluid mosaic model of Singer & Nicolson. Active & passive transport, Na-K pump, Calcium Pump

B. Sc. Part I – Semester I - PAPER II
(MICROBIOLOGY & VIROLOGY)

UNIT – I:

A) History & Development of microbiology: Controversy over spontaneous generation, Fermentation & Germ theory of diseases, Concept of immunization.

B) Microscopy: Compound Microscopy: Parts of Compound microscope, Numerical aperture & its importance, Resolving power, Importance of Oil immersion objective, Ray diagram of compound light microscope, Principles and applications of Dark field, Phase contrast, UV & Fluorescent microscopy. Electron microscopy: Principle and Ray diagram.

UNIT II:

A) Staining: Principle and technique of simple & differential staining (Gram, Acid-fast & Endospore staining).

B) Viruses: General characteristics of viruses. Virus Structure. Basis of Virus classification. Detailed study of Lytic cycle & Lysogeny.

UNIT – III:

A) Classification of Microorganisms: Prokaryotes and Eukaryotes, Haeckal system, Whittaker system, Bergey's Manual.

B) Bacteria: i) Bacterial morphology & subcellular structures (General morphology of bacteria, shapes & sizes). ii) Slime layer & capsule. iii) Cell wall structure of Gm +ve & Gm-ve cells iv) General account of Ribosome, Flagella & Fimbriae. v) Chromatin materials, plasmids and episomes. vi) Endospore: Detailed study of endospore structure & its formation, Basis of resistance.

UNIT IV:

Growth: i) Growth rate and generation time, ii) Details of growth curve & its various phases. Synchronous cultures: Selection by size, age & induction. Iii) Continuous cultures: Chemostat, Turbidostat & Dialysis techniques. iv) Measurement of growth: - Total cell count and viable cell count method. v) Physical conditions required for growth: - a) Temperature: - Classification of microorganisms on the basis of temp. requirements. b) Classification on the basis of gaseous requirements. c) Classification on the basis of hydrogen ion concentration

B. Sc. Part I Semester I
PRACTICALS

[A] Biomolecules

1) Qualitative analysis of Carbohydrates, Proteins, Urea, Creatinine, Cholesterol.
2) Colorimetric estimation of proteins by biuret method.
3) Extraction of total lipids by Folch Method.
4) Determination saponification value of fats.
5) Determination of Acid value of fats.
6) Preparation of starch from potato and its hydrolysis by salivary amylase.

[B] Microbiology

1) Demonstration, uses, & care of microbiological equipments.
2) Isolation of Bacteria on nutrient agar plate from water, air, skin, teeth samples etc.
3) Simple staining of Bacterial pure culture
4) Gram staining of bacterial pure culture.
5) Identification of spore producing capacity of bacterial pure culture & its comparison with any endospore-producing bacteria.
6) Bacterial capsule staining

7) Anaerobic culture of bacteria
8) Demonstration of starch hydrolysis by bacterial cultures.
9) Effect of osmotic pressure on bacterial growth.
10) Isolation of bacteriophage from sewage / other sources.

Note: - Mandatory to perform atleast 3 practical from each section

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Semester I

BOOKS FOR REFERENCE

1) Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2) Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3) TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4) Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
5) Biochemistry – Lehninger – CBS Publishers.
6) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
7) Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.
8) General Microbiology, Vol. I & II – Powar, Daginawala – Himalaya Publishing House.
9) General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
10) Fundamental Principals of Bacteriology – Salle – TMH Pub. Co. Ltd. – New Delhi.
11) Microbiology – Davis, Dulbacco, Eisen, Ginsberg – Harper International Edition.
12) Microbiology – Pelczar, Chan, Kreig –McGraw Hill Int. Edition.
13) Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.
14) Fundamental Virology (1995) – B. N. Fields, D. M. Knipe, P. M. Howley, R. M. Chanock, J. L. Meenick, T. P. Monath, Strans, Lippin Cott Raven.

BIOCHEMISTRY

B. Sc. Semester Pattern Syllabus

B. Sc. Part I – Semester II

BIOCHEMISTRY

(With effect from academic session 2013-14)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks)..

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.

7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part I – Semester II - PAPER I
HUMAN PHYSIOLOGY

UNIT I:

Excretion: - Structure of Nephron in brief. Mechanism of urine formation. (Glomerular filtration, Tubular reabsorption & Active secretion). Regulation of acid–base balance by the kidney. Brief idea of Juxtaglomerular apparatus.

Reproduction: Brief account of histological structure of Ovary & Testis. Structure & Functions of male & female sex hormones. Menstrual Cycle

UNIT II

Hematology: - Composition of blood, proteins in plasma & their functions, Coagulation of blood. Structure of hemoglobin and its functions, Mechanism of transport of O2 & CO2 by blood, Bohr's effect and chloride shift. Functions of RBCs, Fate of RBCs, Platelets & WBCs like Neutrophil, Eosinophil, Basophil, Lymphocytes (T & B) & Monocytes.

UNIT III:

Neurobiology: Structure of Neurons, Physiological properties of Nerve fibers, Detailed account of impulse generation (Membrane potential, its development, depolarization, depolarization) & conductivity (Transmission of impulse in myelinated and nonmyelinated nerve fiber). ii) Synapse and mechanism of synaptic transmission (Cholenergic and adrenergic transmission).

UNIT IV

Endocrines: -An overview of important endocrine glands & their hormones. Chemistry and classification of hormones. Role of Hypothalamus & Pituitary in hormone secretion. Storage, secretion and function of hormones (Thyroxine, parathormone, adrenaline, noradrenaline, insulin, glucagon, cortisol, Sex hormones). Concept of second messengers like cAMP, cGMP, Ca^{+2}, diacylglycerol and inositol-tri-phosphate. Basic mechanism of action of Peptide and Steroid hormones.

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B. Sc. Part I – Semester II - PAPER II
(MICROBIOLOGY & IMMUNOLOGY)

UNIT – I:

Nutrition: i) Basic nutritional requirements: ii) Nutritional classification of bacteria: Phototrophs & chemotrophs. iii) Pure cultures and methods of obtaining pure cultures.

UNIT II

Microbial control: i) Terminology: ii) Factors influencing antimicrobial activity. iii) Mechanism of cell injury iv) Physical control methods, v) Chemical control methods vi) Chemotherapeutic agents: - Sulphonamides and Antibiotics vii) Standardization of disinfectant: Phenol coefficient.

UNIT – III:

Immunology:

A) **The immune system**: - Active & Passive Immunity, Organ & cells of the immune system & their functions.
B) **Immunoglobulins:** - Nature & general properties of antibodies, Antibody reactions & antibody binding sites, Antibody specificity, Haptens, Basic structure of IgG, Brief account of other types of antibodies.

UNIT IV

Immunology:

A) Clonal selection theory. Brief idea of Hybridomas and monoclonal antibodies, Preparation and its application.

B) Brief idea of Complement system.
C) Brief account of cell mediated (Cellular) immunity & Humoral (Noncellular) immunity.

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B. Sc. Part I Semester II
PRACTICALS

[A] Physiology

1. RBC count
2. Measurement of blood pressure by sphygmomanometer.
3. Differential leucocyte count of blood.
4. WBC count.
5. Estimation of urine / serum creatinine
6. Estimation of urine / serum urea by diacetyl monoxime method
7. Assay of hemoglobin by hemoglobinometer.
8. Colorimetric estimation of blood/serum cholesterol.
9. ESR of blood.
10. Determination of clotting time of blood by capillary tube method.
11. Estimation of glucose by Benedict quantitative method.
12. Determination of bilirubin in serum

[B] Microbiology

13. Motility of given bacterial pure culture & its comparison with Lactobacillus / P. vulgaris.
14. Antibiotic sensitivity of bacterial pure culture.
15. Oligodynamic activity test of copper / metal.
16. Detection of coliforms in water.
17. Isolation of pure culture (any one or two bacteria from above sample) by pour plate method.
18. Isolation of pure culture by Streak plate method
19. Isolation of pure culture by spread plate method
20. To study the germicidal effect of UV light on bacterial growth.
21. Demonstration of effectiveness of alcohol as a disinfectant.
22. Detection of bacteria / fungi in spoiled food

[C] Immunology

23. Pregnancy test.
24. Ouchterlony immunodiffusion.
25. Demonstration of immunoelectrophoresis
26. Determination of blood groups (ABO & Rh system).

Note: - Mandatory to perform atleast 6 practicals, 3 from section A, 2 from section B and 1 from section C

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Semester II
BOOKS FOR REFERENCE

1) Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
2) Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
3) TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
4) Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
5) Biochemistry – Lehninger – CBS Publishers.
6) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
7) Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.
8) Immunology – Riott, Brastoff, Male – Mosby
9) Introduction to Immunology – Nandini Shetty.
10) Immunology – Janis Kuby. – W. H. Freeman and Co.
11) General Microbiology, Vol. I & II – Powar, Daginawala – Himalaya Publishing House.
12) General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
13) Fundamental Principals of Bacteriology – Salle – TMH Pub. Co. Ltd. – New Delhi.
14) Microbiology – Davis, Dulbacco, Eisen, Ginsberg – Harper International Edition.
15) Microbiology – Pelczar, Chan, Kreig –McGraw Hill Int. Edition.
16) Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.
17) Outlines of Biochemistry – Conn & Stumpf.
18) The Experimental Foundations of Immunology – W. R. Clark.

B. Sc. Semester Pattern Syllabus
B. Sc. Part II – Semester III
BIOCHEMISTRY
(With effect from academic session 2014-15)

10) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks).

1) .

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part II – Semester III - PAPER - I
(MACROMOLECULES)

UNIT I:
Proteins: -

a) Quick review of amino acids, physico-chemical properties of amino acids (Solubility, Boiling & melting points, Reactions like Edman's, Sanger's, Dansyl chloride, Ninhydrin & Formaldehyde). Unusual amino acids.
b) Determination of primary structure of proteins
c) Peptide, peptide mapping, Merrifield-Gutt synthesis.

UNIT II:
Proteins: -

a) Secondary structure of proteins: - The α helix, β–pleated sheet structures.
b) Tertiary structure of proteins: Forces that stabilize the structure, Concept of domains, Protein denaturation.
c) Quaternary structure of proteins: Subunit interaction
d) Structure and biological functions of Collagen

UNIT-III:
Nucleic acids: -
a) Chemical structure & base composition of nucleic acids, Chargaff's rules.
b) Double helical structures, Watson - Crick Model (B-DNA), Deviations from Watson - Crick Model, Other DNA helices (A- & Z- DNA).
c) Forces stabilizing nucleic acid structures, Denaturation & renaturation, Sugar phosphate chain conformation, Base pairing, Base stacking, Hydrophobic and ionic interactions,

UNIT-IV:
Nucleic acids: -
a) Tm & buoyant density and their relationship with G-C content in DNA, Satellite DNA.
b) DNA sequencing: Maxam-Gilbert & Sanger's dideoxynucleotide sequencing.
c) Structure of m-RNA, r-RNA & t-RNA.

B. Sc. Part II – Semester III - PAPER – II
(BIOPHYSICAL TECHNIQUES I)

UNIT – I:
Spectrophotometry:-
a) Concepts of electromagnetic radiation's, Spectrum, Absorption of electromagnetic radiation's, Orbital theory, Concept of orbitals & their involvement in absorption of electromagnetic radiation's, Concept of chromophores, Beer's law – derivation & deviations, Extinction coefficient.
b) Instrumentation & applications of UV & Visible spectrophotometry.

UNIT II:
Spectrophotometry:-
a) Spectrofluorometry, Absorption & emission flame photometry.
b) **Buffers and pH:** Buffer capacity, Mechanism of buffer action, Henderson-Hasselbalch equation, Isoelectric pH, Biochemically & Physiologically important buffers. Titration curve of weak acids, Titration curve of amino acids. Electrometric determination of pH (Hydrogen, Calomel and combined glass electrode).

UNIT III:
Chromatography:-
a) Partition principle, partition coefficient, Nature of partition forces, Detailed account of Paper, Thin layer & Column chromatography (Column efficiency and concept of plates).
b) Gel filtration: - Concept of distribution coefficient, Types of gels & glass beads, Applications.

UNIT IV:
Chromatography:-
a) Ion-Exchange chromatography: - Principle, Types of resins, Choice of buffers, Applications.
b) Affinity chromatography: - Principle, Selection of ligand, Ligand attachment, Specific & non-specific elution, Applications.
c) Elements of High Pressure Liquid Chromatography & Gas Chromatography.

B. Sc. Part II Semester III
PRACTICALS

1) Quantitative estimation of amino acids using Ninhydrin reaction.
2) Estimation of DNA by diphenylamine reaction.
3) Estimation of RNA by orcinol reaction.
4) Determination of albumin and A / G ratio in serum.
5) The validity of Beer's law for colorimetric estimation of creatinine.
6) Estimation of blood glucose by Nelson-Somogyi method.
7) Estimation of blood sugar by Orthotoluidine method.
8) Determination of absorption maxima of hemoglobin.
9) Absorption spectrum of NAD and NADH
10) Separation of amino acids by two-dimensional TLC.
11) Separation of amino acids by descending\ascending paper chromatography.
12) Estimation of glycine by Sorenson's formol titration.

13) Preparation of standard buffers and determination of a pH of a solution.
14) Determination of pKa of weak acid by pH meter.
15) Determination of isoelectric pH of casein, egg albumin & BSA.
16) Titration of mixture of strong acid and weak acid.
17) Titration curves of amino acid/weak acids and determination of pK value.
18) Colorimetric estimation of calcium in serum.

Mandatory to perform atleast 6 practical

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Semester III
BOOKS FOR REFERENCE

1) Harper's Biochemistry – Murray, Granner, Mayes, Rodwell- Prentice Hall International Inc.
2) Biochemistry – Lehninger – CBS publishers.
3) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
4) Textbook of Biochemistry – West, Todd, Bruggen, Mason – Amerind publishing Co. Pvt. Ltd.
5) Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay & Nath – Himalaya Publ. House.
6) A Biologists Guide to Principle & Techniques of Practical Biochemistry – Williams & Wilson – Edward Ernold Publ.
7) The Tools of Biochemistry – T. G. Cooper.
8) Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
9) Principles of Biochemistry – White, Handler, Smith – McGrew Hill Publ.
10) Biologist's Physical Chemistry – T. G. Morris.
11) Chromatography – G. Abbott.
12) Methods in Experimental Biology – R. Ralph.
13) Physical biochemistry – vanHolde – Prentice Hall Inc.
14) Physical Biochemistry – D. Friefelder – W. H. Freeman & Co.
15) Chromatography: A Lab Handbook of chromatographic and electrophorectic methods – Erich Heftman – Van Nostrand Reinhold, NY.
16) Immunology – Riott, Brastoff, Male – Mosby
17) Introduction to Immunology – Nandini Shetty.
18) Immunology – Janis Kuby. – W. H. Freeman and Co

B. Sc. Semester Pattern Syllabus
B. Sc. Part II – Semester IV
BIOCHEMISTRY
(With effect from academic session 2014-15)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10marks).

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
	---

2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.

5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part II – Semester IV - PAPER - I
(ENZYMOLOGY)

UNIT - I:
a) History & Terminology
b) Classification & nomenclature of enzymes, Specificity of enzyme action (Lock & key model & Induced fit model).
c) Enzyme catalysis: Proximity & Orientation effect, covalent catalysis, acid-base catalysis, metal ion catalysis.
d) Regulatory enzymes: - Allosteric (ATCase) & covalently modulated (Glycogen phosphorylase) enzymes.

UNIT II:
a) Mechanism of action of Chymotrypsin and Ribonuclease.
b) Role of vitamins as coenzyme precursors (Riboflavin, Niacin, Pyridoxine, Biotin and Thiamine)
c) Effect of enzyme concentration, upward & downward curvatures with examples.
d) Effect of temperature on enzyme activity & temperature quotient.

UNIT-III:
Enzyme kinetics: Importance of measuring initial velocities, Derivation of Michaelis-Menten equation, Single & double reciprocal plots, Graphical representation of various inhibitors (Competitive, Noncompetitive & Uncompetitive) on Lineweaver-Burke plots. Importance of K_{cat} / K_{m}. Bisubstrate reactions – brief introduction to sequential and ping-pong mechanisms with examples.

UNIT IV
a) Effect of pH, General pH profile diagram with exceptions.
b) Concept of enzyme assay & its importance, Enzyme activity units (Katal & Specific activity)
c) Enzyme isolation and purification:- Enzyme solubilization, Brief idea of various fractionation procedures, Criteria for enzyme purity and homogeneity,

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B. Sc. Part II – Semester IV - PAPER – II
(BIOPHYSICAL & BIOCHEMICAL TECHNIQUES)

UNIT – I:
Electrophoresis:-
a) Migration of ions in electric field, Factors affecting electrophoretic mobility.
b) Paper electrophoresis: - Electrophoretic run, Detection techniques, Cellulose acetate electrophoresis, High voltage electrophoresis, Applications.
c) Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels, Detection, Recovery & Estimation of macromolecules, Applications.

UNIT II
Electrophoresis:-
Disc-Gel electrophoresis: - Procedure & Applications.
a) SDS-PAGE Electrophoresis: - Isoelectric focussing, Principle, Establishing pH gradients, Stabilization against convection, Procedures & applications.

b) **Immunological techniques:** Immunodiffussion, Immunoelectrophoresis, Radioimmunoassay, ELISA and immunofluorescence.

UNIT – III:

Isotopic tracer technique: -

a) Radioactive & stable isotopes, Pattern and rate of radioactive decay. Units of radioactivity.
b) Measurement of radioactivity: - Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique), Autoradiography. Cerenkov radiation. Brief idea of radiation dosimetry.
c) Measurement of stable isotopes by Mass Spectrometry
d) Isotopes commonly used in biochemical studies – ^{32}P, ^{35}S, ^{14}C, ^{3}H. Applications of isotopes in biochemistry, Principles of tracer techniques, Its advantages and limitations, Distribution studies, Isotope dilution technique, Metabolic studies, Clinical application.

UNIT IV

Centrifugation: -

a) Basic principles, Mathematics & theory (RCF, Sedimentation coefficient, Svedberg constant)
b) Types of centrifuge :- Desk top, High speed & Ultracentrifuges.
c) Preparative centrifugation: - Differential & density gradient centrifugation, Applications (Isolation of cell components).
d) Analytical centrifugation: - Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

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B. Sc. Part II Semester IV

PRACTICALS

1) Estimation of ascorbic acid by 2,6-dichlorophenol indophenol method
2) Isolation of casein by isoelectric precipitation method.
3) Estimation of proteins by Folin-Lowry's method.
4) Fractionation of proteins by ammonium sulphate and determination of its purity by PAGE electrophoresis.
5) To show using PAGE that commercially available BSA is not a homogeneous preparation.
6) SDS-PAGE of BSA & comparison of results with previous (PAGE) experiment.
7) Immobilization of enzymes / cells by entrapment in alginate gel.
8) Isolation of cell organelles by differential centrifugation
9) Assay of salivary amylase
10) Isolation of Urease and demonstration of its activity
11) Paper electrophoresis of serum proteins
12) Gel electrophoresis of serum proteins
13) Effect of pH on activity of enzyme
14) Effect of temperature on activity of enzyme
15) Demonstration of dialysis
16) Radial immunodiffusion.
17) Widal test
18) Demonstration of Salting-Out of proteins by ammonium sulphate precipitation.

Mandatory to perform atleast 6 practical

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Semester IV

BOOKS FOR REFERENCE

1) Biochemistry – Lehninger – CBS publishers.
2) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
3) The nature of enzymology – Foster – Croom Helm, London.
4) Fundamentals of enzymology – Price & Stevens – Oxford Science Publ.
5) Principals of enzymology for food science – J. R. Whitkar – M. Dekker Publs.
6) Enzymes – Dixon & Webb – Academic press.
7) Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay & Nath – Himalaya Publ. House.
8) A Biologists Guide to Principle & Techniques of Practical Biochemistry – Williams & Wilson – Edward Ernold Publ.

9) The Tools of Biochemistry – T. G. Cooper.
10) Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
11) Outlines of Biochemistry – Conn & Stumpf.
12) Physical Biochemistry – H. B. Bull – John Wiley & Sons.
13) Enzyme Kinetics – Irwin H. Segal – Wiley Intersci. Publ.
14) Principles of Biochemistry – White, Handler, Smith – McGrew Hill Publ.
15) Biologist's Physical Chemistry – T. G. Morris.
16) Enzyme Kinetics – Paul Engel.
17) Enzyme Technology – Chaplin, Buche – Cambridge Univ. Press.
18) Chromatography – G. Abbott.
19) Methods in Experimental Biology – R. Ralph.
20) Physical biochemistry – vanHolde – Prentice Hall Inc.
21) Physical Biochemistry – D. Friefelder – W. H. Freeman & Co.

B. Sc. Semester Pattern Syllabus
B. Sc. Part III – Semester V
BIOCHEMISTRY
(With effect from academic session 2015-16)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carries 20 marks (each paper 10 marks).

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks
	Total - 150 marks

2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks
	Total - 30 marks

3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay at least one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part III –Semester V - PAPER – I
(METABOLISM I)

UNIT – I:

Bioenergetics:

a) Concept of free energy, Entropy, Enthalpy & Redox Potential. Determination of $\Delta G^{0'}$ for a reaction.
b) High energy phosphate compounds (Ex. ATP, Phosphoenol pyruvate, Creatine phosphate etc.) – phosphate potential, Free energy of hydrolysis of ATP along with reasons for high $\Delta G^{0,}$. Other high energy compounds.
c) ATP-ADP Cycle, Energy charge (Phosphate potential) & its relation to metabolic regulation.

UNIT II

Techniques involved in metabolic studies: -

a) Studies with intact organisms, Excised organs, Organ slices, Isolated cells, Cell organelles & purified enzymes. Drawbacks & Advantages of each.
b) Studies with microorganisms & tissue culture, Advantages & disadvantages of each.
c) Clinical techniques employed in metabolic studies: Fistula, Catheterization & Organectomy.
d) Tracer studies, Inhibitors & mutation studies.

UNIT – III:

Carbohydrate metabolism: -

a) Detailed account of glycolysis with energy considerations & regulation, Entry of fructose, mannose & galactose in glycolysis, Cori cycle, Futile or substrate cycles in carbohydrate metabolism.
b) Glycogenolysis & Glycogenesis – Detailed account & hormonal control. Glycogen storage diseases.
c) Formation of acetyl CoA & detailed account of TCA Cycle, Isotopic tests of TCA cycle (Concept of Prochirality), Regulation, Amphibolic and anaplerotic nature of TCA cycle.

UNIT IV

Carbohydrate metabolism:-

a) Glyoxylate cycle and its role in conversion of fats into carbohydrates.
b) Gluconeogenesis– Detailed account of bypass reactions, Regulation, Malate & glycerophosphate shuttle system.
c) **Electron Transport chain-**Structure of mitochondria, oxidative and substrate level phosphorylation, Electron carriers of ETC, Incomplete reduction of oxygen (Cell injury – superoxide radicle), ATP Synthase (F1 F0 ATPase), Chemiosmotic hypothesis, Sites of ATP synthesis, Specific inhibitors and uncouplers of oxidative phosphorylation.

B. Sc. Part III – Semester V - PAPER – II
(MOLECULAR BIOLOGY)

UNIT –I:

DNA Replication in Prokaryotes: -

a) Basic Features of replication: Semiconservative nature of replication with experimental proof, Origin of replication, priming, 5'→3' direction of replication, Leading and lagging strand, bidirectional / unidirectional replication.
b) Different models of replication: Theta (θ) model, Rolling circle or sigma (σ) replication
c) Concept of Okazaki Fragment with experimental proof.
d) DNA replication in E. coli: Initiation, Elongation and Termination

UNIT –II:

DNA Replication in Prokaryotes: -

a) DNA Polymerases: Structure of polymerase I, Structure and properties of Klenow fragment, 5'->3' exonuclease activity, Nick translation, DNA polymerase III: Concept of holoenzyme, processivity, fidelity of replication. Other types of polymerases.
b) Regulation of E. coli Replication: concepts of C and D value.
c) DNA damage & repair: Ames test, types of DNA damage, Mismatch Repair (mut HLS system), Base Excision Repair, Nucleotide Excision Repair, Direct Repair, SOS or Error Prone repair.

UNIT – III:

Transcription: -

a. Basic features of RNA synthesis, Terminology, Prokaryotic RNA polymerases

b. Prokaryotic transcription: Initiation, elongation and termination with reference to Role of promoter, determination of length of promoter by DNA foot printing method. Conserved features of promoter. Weak and strong promoters, role of σ subunit, Different kinds of sigma subunits, Promoter binding and activation, RNA chain initiation and promoter escape, abortive initiation, rho dependent and independent termination of transcription.

UNIT – IV:

Transcription: -

a) Inhibitors of prokaryotic transcription: e.g. rifamycins.
b) Regulation of gene expression in prokaryotes: Lac Operon & Trp Operon
c) Reverse transcription.

B. Sc. Part III Semester V

PRACTICALS

1) To measure concentration of DNA & RNA by UV spectrophotometry.
2) Estimation of protein by Bradford method.
3) UV spectrophotometric estimation of a given protein by E 280\260 method.
4) Colorimetric estimation of inorganic phosphate in serum by Fiske-Subbarow method.
5) Isolation of glycogen from liver source and its estimation by anthrone method.
6) Determination of true glucose by Glucometer/Glucose oxidase method.
7) Determination of glucose by Folin-Wu method.
8) Effect of NaF on glycolysis in RBC by estimating glucose.
9) Determination of creatine & creatinine in urine.
10) Determination of serum acetylcholine esterase.
11) Screening test for glucose-6-phosphate dehydrogenase in RBCs.
12) Determination of serum pyruvate kinase.
13) Isolation of RNA from yeast

Mandatory to perform atleast 6 practical

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Semester V

BOOKS FOR REFERENCE

1) Harper's Biochemistry – Murray, Granner, Mayes, Rodwell – Prentice Hall International Inc.
2) Biochemistry – Lehninger – CBS Publishers.
3) Biochemistry – Stryer – W. H. Freeman & Co. New York.
4) Biochemistry – Geoffrey L. Zubay – McGraw Hill.
5) Biochemistry – J. David Rawn – Neil Patterson publs. NC.
6) Textbook of Biochemistry– West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt. Ltd.
7) Mol Bio (Fundamentals of molecular biology) – Upadhyay & Upadhyay, Himalaya Publishing House.
8) Molecular Biology – David Friefelder – Narosa Publishing House, New Delhi.
9) Cell Biology, Genetics, Molecular Biology, Evolution & Ecology – Verma, Agarwal – S. Chand & Co.
10) Molecular & Cell Biology – Bhamrah – Anmol Publ. Pvt. Ltd., New Delhi.
11) Molecular Biology of the Cell – Alberts, Bray, Lewis, Raff, Roberts, Watson – Garland Publishers, New York.
12) Molecular Biology of the gene – J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner- Freeman.
13) Molecular Biology of the Gene – Watson, Hopkins, Roberts, Steitz, Weiner – Benjamin Cummings Publishing Co.
14) Molecular Cell Biology – Baltimore, Zipursky, Matsudaria, Darnel – W. H. Freeman & Co., New York.
15) Principles of Biochemistry – White, Handler, Smith – McGraw Hill Publ.

B. Sc. Semester Pattern Syllabus
B. Sc. Part III – Semester VI
BIOCHEMISTRY
(With effect from academic session 2015-16)

1) The examination shall comprise two theory papers, an Internal assessment and a practical. Each theory paper shall be of three hours duration and carry 50 marks. The practical shall be of 6 hours duration and carry 30 marks. Internal assessment carry 20 marks.

Theory Paper I	50 marks
Theory Paper II	50 marks
Practical	30 marks
Internal Assessment	20 marks

	Total - 150 marks
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2) The distribution of marks in practical shall be as follows.

[A] Experiments,	20 marks
[B] Practical record	05 marks
[C] Viva	05 marks

	Total - 30 marks
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3) The syllabus is based on six theory periods and six practical periods per week. Candidates are required to pass separately in theory, internal assessment and practical examination.
4) Students are expected to perform all the practicals mentioned in the syllabus.
5) The B. Sc. Students of Biochemistry shall pay atleast one visit to any Biochemical / Research Institute as study tour during three-year degree course.
6) Internal assessment: There shall be one internal assessment based on two theory papers for 10 Marks each. Total 20 Marks. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
7) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method teacher / department / college propose to adopt a scheme of marking for internal assessment.
8) The internal assessment marks assigned to each theory paper shall be awarded on the basis of attendance / home assignment / class test / Project assignment / seminar / any other innovative practice / activity.
9) The concerned teacher / department / college shall have to keep the record of all the above activities till six months after the declaration of result of that semester.

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B. Sc. Part III –Semester VI - PAPER – I
(METABOLISM II)

UNIT – I:
Lipid metabolism: -

a) Hydrolysis of triacylglycerols, transport of fatty acids into mitochondria (Carnitine), Detailed account of β-oxidation of fatty acids (β-oxidation in mitochondria and peroxisomes), Oxidation of unsaturated fatty acids & odd carbon fatty acids. α & ω–Oxidation- Brief idea. ATP yield from fatty acid oxidation. Regulation.
b) Detailed account of HMP Shunt & its significance in general, its connection to lipid metabolism.

UNIT – II:
Lipid metabolism: -

a) Ketogenesis, Ketosis & ketoacidosis in physiology & pathology.
b) Biosynthesis of fatty acids, Fatty acid synthase complex, Regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids.
c) Biosynthesis of triglycerides & phospholipids (Phosphatidyl-ethanolamine, choline, inositol), sphingolipids.

UNIT – III:
Protein metabolism: -
a) Transamination.
b) Oxidative & Non-oxidative deamination.
c) Transport of ammonia (Carrier of ammonia – Glutamine, Alanine).
d) Urea cycle – Detailed account, Linkage of urea & TCA cycle, Compartmentation of urea cycle, Regulation, Metabolic disorders of Urea cycle, Treatment of disorder of urea cycle.
e) Transmethylation & Decarboxylation.
f) Metabolism of phenylalanine. Glycogenic and ketogenic amino acids.

UNIT IV
Nucleic acid metabolism: -
a) Biosynthesis of purine nucleotides & its regulation (De novo synthesis), Recycling of purine bases by salvage pathway using PRPP.
b) Catabolism of purine nucleotides, Gout.
c) Biosynthesis of pyrimidine nucleotides – De novo synthesis, its regulation & Salvage synthesis.
d) Catabolism of pyridimine nucleotides.
e) Ribonucleotides as precursors of deoxiribonucleotides (Ribonucleotide reductase & its regulation)
f) Concept of cyclic nucleotides in metabolism, cAMP.

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B. Sc. Part III – Semester VI - PAPER – II
(MOLECULAR BIOLOGY & rDNA TECHNOLOGY)

UNIT –I:
Genetic Code & Decoding System: -
a. **The Genetic Code**: Features of genetic code, Deciphering the genetic code, Wobble hypothesis,
b. **The decoding system: -** i) Aminoacyl synthatases, ii) Brief structure of t-RNA, iii) Attachment of amino acid to t-RNA, iv) Error correction in amino acylation.
c. Selection of initiation codon – (Shine-Dalgarno sequence).

UNIT II
Translation:
Protein synthesis- Initiation, Elongation & Termination (Ribosome structure, A and P sites, charged tRNA, f met tRNA, initiator codon, formation of 70S initiation complex, role of EF-Tu, EF-Ts, EF-G, and GTP. Release factors RF1 and RF2.

UNIT –III:
Basic Introduction to rDNA Technology
a. **Terminology**:
b. **Restriction endonucleases**: Rstriction-modification system, types of restriction enzymes, sticky and blunt ends.
c. **Joining DNA molecules**: joining blunt ended molecules, homopolymer tail joining, joining cohesive ends, use of T4 DNA ligase, use of linkers and adaptors.
d. **Vectors**: Plasmids – Characteristics of an Ideal Vector, Types of plasmids: pBR322 and pUC18. Lambda insertion and replacement vectors, cosmids, phagemids, Ti-plasmid. Concept of expression vectors. Features of expression vectors necessary for expression of heterologous genes. Shuttle vectors.

UNIT –III:
Basic Introduction to rDNA Technology
a) **Methods of transformation/transfection**: Calcium-phosphate precipitation, Electroporation,
b) **Selection**: selection by the use of antibiotic resistance, blue-white screening.
c) **Screening methods**: functional cloning or complementation, southern and northern blotting, colony lift screening, western blotting, immunological methods, screening through protein activity
d) **Genomic and cDNA libraries**: Method of generating genomic and cDNA library, comparison between the two types of libraries, Advantages and disadvantages of cDNA library.
e) **Polymerase chain reaction**: Detailed procedure of PCR, important considerations for primer designing, Salient applications of PCR.
f) **Applications of recombinant DNA technology**: Brief idea about recombinant DNA products in medicine (insulin, hGH), Recombinant vaccines, Gene therapy, DNA fingerprinting, Bt cotton, herbicide resistance.

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B. Sc. Part III Semester VI
PRACTICALS

1) Estimation of serum urea by diacetyl monoxime method.
2) Assay of activity of SGOT & SGPT.
3) Assay of activity of serum acid & alkaline phosphatase.
4) Inhibition of alkaline phosphatase activity by EDTA.
5) Assay of activity of papain.
6) Determination of serum phospholipids.
7) Determination of serum lipase.
8) Determination of serum isocitrate dehydrogenase.
9) Estimation of lipase by titrimetric method.
10) Demonstration of isolation of plasmid by alkaline lysis method.
11) Demonstration of isolation of genomic DNA.
12) Demonstration of Southern / western blotting.
13) Demonstration of replica plating technique.
14) Demonstration of restriction digestion
15) Identification of Lac+ bacteria by blue white screeing using IPTG
16) Determination of uric acid in urine
17) Determination of ketone bodies in urine
18) Determination of urinary ammonia

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Semester VI
BOOKS FOR REFERENCE

1) Harper's Biochemistry – Murray, Granner, Mayes, Rodwell – Prentice Hall International Inc.
2) Biochemistry – Lehninger – CBS Publishers.
3) Biochemistry – Stryer – W. H. Freeman & Co. New York.
4) Biochemistry – Geoffrey L. Zubay – McGraw Hill.
5) Biochemistry – J. David Rawn – Neil Patterson publs. NC.
6) Textbook of Biochemistry– West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt. Ltd.
7) Mol Bio (Fundamentals of molecular biology) – Upadhyay & Upadhyay, Himalaya Publishing House.
8) Molecular Biology – David Friefelder – Narosa Publishing House, New Delhi.
9) Cell Biology, Genetics, Molecular Biology, Evolution & Ecology – Verma, Agarwal – S. Chand & Co.
10) Molecular & Cell Biology – Bhamrah – Anmol Publ. Pvt. Ltd., New Delhi.
11) Molecular Biology of the Cell – Alberts, Bray, Lewis, Raff, Roberts, Watson – Garland Publishers, New York.
12) Molecular Biology of the gene – J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner- Freeman.
13) Concepts in Biotechnology – Editors- Balasubramanian, Bryee, Dharmalingam, Green, Jayraman – Sangam Books.
14) Molecular Biology of the Gene – Watson, Hopkins, Roberts, Steitz, Weiner – Benjamin Cummings Publishing Co.
15) Molecular Cell Biology – Baltimore, Zipursky, Matsudaria, Darnel – W. H. Freeman & Co., New York.
16) Outlines of Biochemistry – Conn & Stumpf.
17) Principles of Biochemistry – White, Handler, Smith – McGraw Hill Publ.
18) Cell & Molecular Biology – Phillip Sheller – Wiley Publ.
19) Introduction to Modern Biochemistry – Karlson – Academic Press.

Semester-wise Syllabus for B.Sc. Computer Science Subject

Structure

B.Sc. Part I Semester I
Paper-I :- Programming in C
Paper-II :- Fundamentals of Information Technology

B.Sc. Part I Semester II
Paper-I :- Object Oriented Programming using 'C ++'
Paper-II :- System Analysis and Design

B.Sc. Part II Semester III
Paper I :- Data Structures
Paper II :- Operating Systems

B.Sc. Part II Semester IV
Paper I :- Java Programming
Paper II :- Linux Operating System

B.Sc. Final Semester V
Paper I :- Visual Basic Programming
Paper II :- Database Management System
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B.Sc. Final Semester VI
Paper I :- Compiler Construction
Paper II :- SQL AND PL/SQL

Practicals

Note :- 1) A student has to perform ALL exercises.
II) Not more than two students should be allowed on one machine.

B.Sc. Part I Semester I **:** Programming in C
B.Sc. Part I Semester II **:** Object Oriented Programming using 'C ++'
B.Sc. Part II Semester III **:** Data Structure (using C++)
B.Sc. Part II Semester IV **:** Java Programming
B.Sc. Final Semester V **:** Visual Basic Programming
B.Sc. Final Semester VI **:** SQL AND PL/SQL (Oracle)

Valuation Pattern :-

In University practical examination a student has to perform any one exercise from the list prescribed in the syllabus and it is to be executed on machine.

The valuation scheme of practical examination will be as under.

Record	- 6
Viva	- 6
Writing	- 09
Execution	- 09
TOTAL	**- 30**

B.Sc. Part I Semester I (From 2013-2014)

Paper I

PROGRAMMING IN 'C'

UNIT- I :

Programming Structure : Sequence, Selection, Iteration and Modular. **Problem Solving techniques**: Development Tools**:** Algorithm, Flowcharts and Pseudo code (Definition and its characteristics) **Developing Algorithm and Drawing flowcharts**

UNIT- II :

C Character set, Tokens, Identifier, Keywords, Variables**,** Data types, Qualifiers. Operators and Expressions: Arithmetic, Relational, Logical, Bit-Wise, Increment, Decrement, Conditional and Special operators. typedef, Type Conversion, Constants, Declaring Symbolic Constants, Character Strings, Enumerated Data Types, Operator Precedence and Associativity. Library functions. : Maths, string handling Functions. Control Structure: Compound Statement, Selection Statement: if, if-else, Nested if, switch. Iteration statement: for, while, do..while, Nested loops, Jump statement: break, continue, goto. (Special emphasis on problem solving)

UNIT- III :

Arrays: Need, Types: Single and Two Dimensional Array.

Strings: Strings Manipulation, Arrays of Strings, Evaluation order

Function: Function Components, Return Data type, Parameter Passing, Return by Reference, Default Arguments, Recursive Functions, Arrays with Functions, Storage Classes. (Special emphasis on problem Solving)

UNIT- IV :

Structure: Declaration, Definition, Accessing structure members, Initialization, Nesting of Structures.

Union: Unions, Differences between Structure and Union

Pointer: Introduction, Address Operator (&), Pointer variables, void pointers, Pointer Arithmetic, Pointers to Pointers.

File handling : Hierarchy of File Stream Classes, Opening & closing a file, Testing for errors, File Modes, File pointers and their manipulations, Sequential Access, Random Access , Command Line arguments.

Text Books

1. **The Art of programming through flowcharts & algorithm by Anil B. Chaudhari Firewall Media, Laxmi publication, New Publication.**
2. **Programming in C by E. Balagurusamy** TMH Publications**.**

Reference Books

1. C Programming - Kernighen Ritche
2. Programming with C – Y. Kanetkar.
3. C Programming – Holzner, PHI Publication.
4. Programming in C – Ravichandran.

B.Sc. Part I Semester I

Paper II

FUNDAMENTALS OF INFORMATION TECHNOLOGY

UNIT - I :

Basic Components of Digital Computers: Block Diagram**. CPU:** Functions of Each Unit: Primary Memory, ALU and CU, Instruction format. **Bus**: Data, Control and Address Bus **Number Systems:** Binary, Octal, Decimal, HexaDecimal, Their Conversions, Binary Arithmetic. ASCII, BCD, EBCDIC**.**

Language Evolution : Generation of Languages : Machine, Assembly, High Level Languages. Characteristics of Good Language **Translators :** Compiler, Interpreter and Assembler. Source and Object Program.

UNIT - II :

Memory: Static & dynamic, RAM, ROM, PROM, EPROM, EEPROM, flash and Cache.
Storage Devices: Hard Disk, Zip Disk and Optical Disk. Pen Drive, Blue Ray

UNIT - III :

Input Devices: Keyboard, Mouse, Light Pen, Touch Screen, Voice Input , MICR, OCR, OMR, Barcode Reader and Flatbed Scanner.
Output Devices: VDU, Printers: Dot Matrix, Laser and Inkjet.
Plotters: Drum, Flat-Bed and Inkjet.

UNIT - IV :

Network: Network terminology, Topologies : Linear, Circular, Tree and Mesh. Types of Networks: LAN, WAN, MAN. Repeaters, Bridge, Routers, Brouters and Gateway. Modem for Communication between pc's, wi-fi network, Introduction of Bluetooth and Infrared devices. Network protocols. Architecture **:** Peer-to-Peer, Client/Server.

Text Books:

1. Information technology concepts by Dr. Madhulika Jain, Shashank & Satish Jain, [BPB Publication, New Delhi.]
2. Fundamentals of Information Technology By Alexis And Mathews Leon
[Leon Press, Chennai & Vikas Publishing House Pvt Ltd, New Delhi]

B.Sc. Part I Semester I
Practical List
Programming in 'C'

1) Program to Compute Fibonacci series
2) Program to find if a given number is prime or not.
3) Program to accept number and display it in words
4) Program to find sum of digits of any entered no.
5) Program to reverse the digit.
6) Program to find frequency of occurrence of a given number from array of N elements.
7) Program to reverse the array.
8) Program to Insert an element in One dimensional Array at a given position.
9) Program to Delete an element form One dimensional Array.
10) Program to Arrange string data (name of students) in alphabetical order using bubble sort.
11) Program to search the element in an array of N elements using
    a) Linear search method
    b) Binary search
12) Program to a) Multiply two Two dimensional Array's (3 X 3 matrix)
    b) Find largest element in Two dimensional Array (3 X 3 matrix).
13) Program a) To Check if given String is Palindrome or not
    b) To calculate number of blanks, vowels and words from entered phrase.
14) Program to a) compute Cosine series : cos x = 1- x^2/2! + x^4/4!-x^6/6!+---------.
    b) Compute Sine series : sin x = x- x^3/3!+ x^5/5! –x^7/7! + ---------
15) Program to find Factorial of a number using recursive function.
16) Program using function to find sum of two numbers
    a) With no argument & no return values
    (b) With argument & no return values
    (c) With argument & return values
17) Program to demonstrate passing structure to functions. Fields are empno, name, Basic
    a) Call by Value
    b) Call by reference
18) Program to
    a) swap values of two variables by passing pointers.
    b) Read two integers and determine bigger of the two with the help of function big() returning an integer pointer.
19) Create a sequential file and perform following operation fields are Roll, Name, M1, M2, M3
    a)Add records
    b)Process & Display output.

B.Sc. Part I Semester II

Paper I

OBJECT ORIENTED PROGRAMMING USING 'C++'

UNIT - I :

Object Oriented Methodology:

Elements of Object Oriented programming, Objects, Classes, OOPs features.

Classes & Objects: Specifying a Class, Creating Objects, Accessing Class members, Defining member function, Outside Member Functions as inline, Accessing Member Functions within the class, Static data member, Access Specifiers: Private, Protected and Public Members.

UNIT - II :

CONSTRUCTORS & DESTRUCTORS: Introduction, Parameterized Constructors, Constructor Overloading, Constructors with Default Arguments, Copy Constructor, Destructor, Order of Construction and Destruction, Static data members with Constructor and Destructors.

OPERATOR OVERLOADING: Definition, Overloadable Operators, Unary Operator Overloading, Unary & Binary overloading, Rules for Operators Overloading.

UNIT - III :

DYNAMIC OBJECTS: Pointers to Objects, Creating and Deleting Dynamic Objects: New and Delete operators, Array of Objects, Array of Pointers to Objects, Pointers to Object Members, this Pointer**.**

INHERITANCE: Defining, Abstract classes, Single, Multilevel, Multiple, Hierarchical, Hybrid Inheritance, Constructor and Destructor in Derived Classes.

UNIT - IV :

VIRTUAL FUNCTIONS: Need for Virtual Functions, definition, Pure Virtual Functions, Abstract Classes, Rules for Virtual Functions.

EXCEPTION HANDLING: Exception Handling Model, List of Exceptions, Handling Uncaught Exceptions, Fault Tolerant Design Techniques, Memory Allocation Failure Exception, Rules for Handling Exception Successfully.

Text Books

1. **Mastering C++ by K R Venugopal Tata McGraw-Hill , New Delhi.**

Reference Books**:**

1. The C++ Programming Language –Bjarne Stroustrup
2. Programming with C++ - Ravichandran
3. Programming with C++ - Robert Lafore
4. Object Oriented Programming with C++ by E. Balagurusamy, McGraw Hill

B.Sc. Part I Semester II
Paper II

SYSTEM ANALYSIS AND DESIGN

UNIT - I :

Introduction : System, Subsystems, Components of Computerized Information System, Systems Analysts, SDLC, Prototyping.

Feasibility Study and Analysis: Identifying Problems, Organizing Feasibility Analysis: Economic, Financial, Organizational and Technological. Feasibility Decision, Choice of a solution.

Data Collection: Interviews, Brain Storming, Questionnaires, Document Search, Observation.

UNIT - II :

Structured tools and techniques of Data analysis : Structured English, Process Charts, SOP, Decision Tables and Decision Trees, Data Flow Diagram, Data Dictionary.
(Special emphasis on problem solving)

System Design : Input design: Input Validation, Human factor Consideration, Messages, System Tolerance. Output design: Categories of output, Design Principles, Control of Output. Forms: Principles of Form Design, Ways to ensure Quality Forms.

Codes: Types, Physical Representation of Codes, Principle of Code Design.

UNIT - III :

Implementation: Training, Operational Training and Related Activities, Planning to Implement Change, Change Strategies.

Testing: Preparation for Testing, Test Execution: Levels of Testing, Component, Function, Subsystem, System, Test Evaluation, Acceptance.

Conversion: Cold Turkey, Parallel, Pilot, Modular and Sequential Methods. Conversion Period Length. **System Evaluation.**

UNIT - IV :

Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, **Scheduling:** Work Breakdown Structure, Activity Networks and CPM, Gantt Charts, PERT Charts, Project Monitoring and Control. Risk Management, Software Configuration Management: Necessity, Configuring Management Activities

Software Reliability and Quality Management: Software Reliability, Software Quality, ISO 9000. Software Maintenance: Characteristics of Software Maintenance, Maintenance Process Models, Estimation of Maintenance Cost.

Software Reuse: What can be reused, Why no reuse so far, Basic Issues.

Text Books:

1) Information Systems Analysis, Design and Implementation By K. M. Hussain Donna Hussain [Tata McGraw-Hill Publishing Company Ltd, New Delhi]
2) Fundamentals of Software Engineering by Rajib Mall [PHI Publication]
3) Workbook on Systems Analysis & Design by V. Garg [PHI Publication]

Reference Books**:**

1. System Analysis and Design- Don Yeates, shiebls, Helmy (M).
2. System Analysis & Design - Edward –TMH
3. System Analysis and Design – Satzinger, Robert Jackson and Stephen Burd, Thomson Learning
4. Introduction to Systems Analysis Design, Igor Hawryszkiewycz, PHI

B.Sc. Part I Semester II
Practical List
OBJECT ORIENTED PROGRAMMING USING 'C++'

1) Demonstrate the usage of Constructor and Destructor.
i) Define a class **data** with data member **acct_no, balance** containing constructor **data** to initialize data member and a member function **display** for output.

2) Program to demonstrate usage of a constructor and Destructor function. Declare a class with public data member count. The class containing one constructor and destructor to maintain updated information about active objects i.e. i) No of objects created. ii) No of objects Destroyed.

3) Program to accept the distance between city **1st & 2nd**, city **2nd & 3rd**. calculate the distance between city **1st & 3rd**. Define a class **road** with private data member **km, m, d1, d2, d3** containing member function getdata to accept values of **d1, d2** and **calculate** for calculating distance.

4) Demonstrate the use of operators overloading (string manipulation: + for concatenation and relational operators for alphabetical comparison).

5) In a bank N depositor deposit the amount, write a program to find total amount deposited in the bank. Declare a class deposit with private data member **Rupee** and **Paisa** containing member function **getdata, putdata.**
- **i) Use array of objects**
- **ii) Use Operator '+' overloading.**

6) Declare class event and accept time of first event and second event and find the difference between 1st and 2nd event. Containing public member function **getdata** and **display** with private data member **hour**, **minute, second and total.**
- **i) Use Operator '-' overloading.**

7) Program to demonstrate **Single Inheritance**. Declare a class **B** and derive publically class **D** from **B**.
i) The class **B** contains private data member **a**, public data member **b** with member function **get_ab, get_a, show_a.**
ii) The derived class **D** contains data member **c** with member function **mul** and **display.**

8) Program to demonstrate **Multiple Inheritances. Declare class M** and **N** and derive publically class **P** from **M** and **N.**
i) Declare a class **M** with protected data member **m** and public member function **get_m.**
ii) Declare a class **N** with protected data member **n** containing member function **get_n.**
iii) Declare class **P** containing member function **display.**

9) Program to demonstrate Multilevel Inheritance. Declare a class **student** and derive publically a class **test** and derive publically class **result** from class **test.**
i) The class student contains protected data member **roll_number** with public member functions **get_number** and **put_number.**
ii) The class **test** containing protected data member **sub1, sub2** with public member function **get_marks** and **put_marks.**
iii) The class **result** contains data member **total** and public member function **display.**

10) Program to demonstrate Hierarchical Inheritance. Declare a class **Side** and derive publically class **Square** from base class **side** and also derive publically class **cube** from base class **side.**
i) Class **Side** contains protected data member **L** with a member function **set_values.**
ii) Class **Square** contains member function **sq.**
iii) Class **Cube** contains member function **cub.**

11) Program to demonstrate usage of normal virtual function and pure virtual Function with abstract class.

12) Program to determine whether the input is +ve or –ve through exception.

13) Program to raise exception if an attempt is made to perform divide-by-zero.

B.Sc. Part II Semester III (From 2014-2015)

Paper I

DATA STRUCTURES

UNIT - I :

LINKED LIST : Linked List, Representation of Single, Double, Header, Circular Single and Double Linked list, All possible operations on Single and Double linked List using Dynamic representation, Polynomial Representation and its Manipulation.

UNIT - II :

STACKS : Stacks terminology, Representation of Stacks in Memory, Operation on Stacks, Polish Notations, Translation of infix to postfix & prefix expression, Infix to Postfix Conversion, Evaluation of Postfix Expression, Recursion, Problems on Recursion, Quick Sort and Tower of Hanoi Problem.

UNIT - III :

QUEUE : Representation of Queues in Memory, Circular Queue. Dequeue and Priority Queue. Operations of above Structure using Array and Linked Representation.

SORTING AND SEARCHING: Selection Sort, Insertion Sort, Merge Sort, Efficiency of Sorting Methods, Big-O Notations.

Hash Tables, Hashing Technique, Collision Resolution Technique.

UNIT - IV :

TREES : Basic Terminologies, Representation of Binary Trees in Memory, Traversing of Binary tree, Binary Search Tree, Operation on Binary Search Tree, Heap Tree, Operation on Heap Tree, Heap Sort Method

GRAPHS : Basic Terminologies, Definition and Representation of Graphs in Memory: Linked List and Matrix Representation. Traversing graphs : BSF, DFS Method.

Text Books:

1.Classical Data Structures : D. Samanta. PHI, New Delhi.
2. DATA STRUCTURE : LIPSCTUZ SCHUM OUTLINE SERIES

Reference Books:

1. Data structure Using C++ : Y. Kanetkar
2. Data Structures Using C++: Tennenbaum
3. Data structures by Tremblay Sorenson
4. Data structures by Bhagat singh Naps

B.Sc. Part II Semester III

Paper II

OPERATING SYSTEMS

UNIT - I :

Structure of Operating System, Operating System functions, Characteristics of Modern OS. **Process Management**: Process states, Creation, Termination, Operations on Process, Concurrent process, Processes Threads, Multithreading, Micro Kernels

CPU Scheduling: Schedulers, Scheduling Methodology, CPU Scheduling Algorithm: FCFS, SJF, RR, Priority Scheduling.

UNIT – II :

Performance comparison : Deterministic Modeling , Queuing analysis, Simulators.

Deadlock and Starvation: Resource Allocation Graph, Conditions for Dead Lock, Dead Lock Prevention, Dead Lock Detection, Recovery from Deadlock.

UNIT - III :

Memory Management: Logical Vs. Physical Address Space, Swapping, Memory Management Requirement, Dynamic Loading and Dynamic Linking, Memory Allocation Method: Single Partition allocation, Multiple Partitions, Compaction, paging, segmentation, Segmentation with paging. Protection.

UNIT - IV :

I/O Management: I/O hardware, I/O Buffering, Disk I/O, Raid, Disk Cache. **File Management:** File Management system, File Accessing Methods, File Directories, File Allocation Methods, File Space Management, Disk Space Management, Record blocking. **Protection Mechanisms**: Cryptography, Digital Signature, User Authentication.

Text Books:

1: **Operating Systems by P. Balakrishna Prasad [Scitech Publication]**

Reference Books:

1. Operating System Concept : Silbershaz (Addision Education)
2. Operating Systems - H.M. Deitel - Addision Wesley.
3. Operating Systems- John J. Donoven.
4. Operating System : A.S.Godbole (TMH)
5. Modern Operating Systems : Tenenenbaum (Pearson Education)
6. Operating System : Peterson.

B.Sc. Part II Semester III
Practical List

Data Structure (Programming using C++)

1) Program to insert a node at the beginning, at the end and in the middle of the given linked list.
2) Program to delete a node at the beginning, at the end and in the middle of the given linked list.
3) Program to create a linked list of customer names and their telephone numbers. (Using Menu Driven and include features of adding a new Customer and deleting an existing Customer.)
4) Program to reverse a linked list.
5) Program to search a value in the given linked list.
6) Program to insert a node at the beginning, at the end or in the middle of a given doubly linked list.
7) Program to delete a node from the beginning, at the end or in the middle of a given doubly linked list.
8) Program to create, insert and delete a node in Circular linked list.
9) Program to push and pop an element into / from a stack implemented using linked list.
10) Program to push and pop an element into / from a stack implemented using Array.
11) Program to evaluate postfix expression.
12) Program to sort an array using quick sort.
13) Program to solve Towers of Hanoi problems using recursion.
14) Program to perform insertion and deletion operation in linear queues.
15) Program to perform insertion and deletion operation on circular queues.
16) Program to sort an array using Insertion sort.
17**)** Program to sort an array using Selection sort.
18) Program to insert an element in a binary search tree.
19) Program to traverse inorder of a binary tree.
20) Program to traverse preorder of a binary tree.
21) Program to traverse postorder of a binary tree.

B.Sc. Part II Semester IV

Paper I

JAVA PROGRMMING

UNIT - I :

Introduction to Java: -History of Java, features of Java, getting started with Java. **Java programs**:-Introduction of Application & Applets. **Variables**: -Variable naming, variable initialization, assign values, Rules of variables, Scope of variable. **Operators**: -Arithmetic, Assignment, Unary, Comparison, Shift, Bit- Wise, Logical, Conditional, New, Special, Relational. Data types:-Integers, Char, String, Float etc. Typecasting: **Tokens**: -Java tokens Order of precedence of operators Streams: - Input and output.

UNIT - II :

Creating a class & subclass: -Declaring a class, Naming class, Rules to assign Class & Subclass, Creating a new object, Class of an object. **Data members**: -Declaring data member, Naming variables, using class members. **Methods**: -Using data members, Invoke a method, passing arguments to a method, calling method. **Access Specifier & Modifiers**: -Public, Private, Protected, Static & Final. **Overloading**: -Method overloading, Constructor overloading. **Java class library**: - Different types of classes. **Decision making & loops**:-If-then-else, Switch,? : operator, While-loop, do-while loop, for. **Array**: -Creating an array, one-dimensional array, two-dimensional array. **String**: -String array, string methods. **Inheritance**: -Single & multiple inheritances **Interfaces**: -Defining interfaces, extending interfaces, implementing interfaces.

UNIT - III :

Packages: -Java API packages, creating packages, accessing packages, adding a class to packages. **Import statement**: - Introduction & implementation of import statement. **Applets**:-Introduction to Applets & Application, how applets application are different creating An applet. Applets life cycle, designing a web page, creating an executable applet, running the applet, applet tags, passing a parameter to applet, HTML tag, Converting applet to application. **Threads**:-Overview of threads, single & multiple threads, lift cycle of threads, stopping & blocking threads, working with threads, priority to thread, synchronization. **Exceptions & Errors**:-Introduction, types of error, exception, syntax of exception, handling techniques, exception for Debugging.

UNIT - IV :

Event: -Event driven programming**,** handling an (AWT) events**. Graphic class:-** Introduction, the graphic classes, drawing & filling of lines, rectangle, circle & ellipse, arcs, polygons, text & fonts, creating a font class, font objects, text, coloring object. **Streams:-**Introduction, Abstract stream classes, file input & output. **AWI Applications**: -Creating a GUI using AWT toolkit, using component class, frames. **Components & Control: -**Textfield, textarea class, label, button, choice, list, checkbox, class, and combo. **Menus: -**Creating a popup menus. **Image**: - Type of image, Properties of an image, Displaying an image. **Layouts**: -Using Window Listener interface, Different types of Layout, Layout manager, Flow manager, Grid manager. **Container**: -Different types of container (Frame, Dialog, Panel)

Text Books:

1. Programming with Java a primer II edition:-E Balaguruswamy(Tata McGraw-Hill)
2. Java Programming (For absolute beginners) Russell PHI

Reference Books:

1. Black Book on Java
2.Java-Complete References

B.Sc. Part II Semester IV
Paper II

LINUX OPERATING SYSTEM

UNIT - I :
Logging In and Logging Out, Anatomy of Linux OS, Directory Structure, /usr Directory, File Types: User datafiles, System data files, Executable files. Naming files and directories, Spawning Processes. **Shell:** Creating User Account, Shell Program, bash shell, Changing shell prompt. **Commands:** Basic Syntax for a command, Exploring the Home Directory, ls, mkdir, rmdir, stat, cat, rm, mv, cp

UNIT - II :
Editor: Vi editor. **Hooking up Hardware Devices:** Formatting a Floppy Disk**,** Gathering important system information. Backing Up and restoring the File **System:** Simple Backup, gzip, gunzip, tar. **Printing files:** Print Spool directory, Sending files to Printer.

UNIT - III :
Sharing Files with other Users: Maintaining User Accounts, Changing Password, Creating Group Accounts, Granting Access to files, Changing File Ownership, Protecting Files, Making a File Read-Only. Working with Processes**:** Types of processes, ps Command, Creating process, killing process, free command and top utility.

UNIT - IV :
Managing Disk Space: df, du commands, Creating Additional Free Disk Space, Locating Unused Files, Setting System Clock. Communication Utilities: who, who am i, finger, mesg, write, wall, talk, Creating a message of the day. X Window System, Graphical User Interfaces: KDE and GNOME Desktop Environment.

Text Books:
1. **SAMS Teach Yourself Linux by Craig and Coletta Witherspoon [Techmedia]**

Reference Books:
1. LINUX complete reference by Richard Peterson

B.Sc. Part II Semester IV
Practical List

JAVA PROGRMMING

1) a) Write a program that declares a class, object and also it access the data member of it's class.
   b)Write an applet that accepts a value from the user and display it.
2) a) Write a program that accept marks of 5 subject, calculate total, percentage and display the grade according to their percentage.
   b) Write a program that will print the multiplication table from 1 to 10.
3) a) Write an program to accept a set of values from the user into an array, display the values as well as their average.
   b) Accept string into a text field, sort the characters in the string and display the sorted string in another text field.
4) a) Write a program to demonstrate the overloading & constructor.
. b)Write an applet that accepts two numbers from the user and display all the numbers between them.
5) a) Write a program to demonstrate the single inheritance.
   b) Write an applet to accept ten numbers into array, sort the array and display the sorted array. Accept the ten numbers into the ten different text fields.
   c) Write a program to create a multiple selection list and also display the list of items selected by the user.
6) a) Write an applet to demonstrate the user menu Bar.
   b) Write a sample program that will convert the applet to application.
   c) Write a program to demonstrate the Interfaces.
7) a)Write a program for exception handling that accept two no as textfields, the values are added & their sum is displayed. The code traps the error when user could enter text instead of an numbers.
   b)Write a program that would accept it input for the user & store it in a file called Test. java.
8) a) Write a program to implement graphic class draw (line, rectangle, fill rectangle, Circle, oval).
   b) Write an applet that display a choice menu of three buttons (Add, Modify, Delete) selecting a choice from the menu should display the appropriate button Use the show () method of the layout Manager.
9) a)Write a java program to read & display the information from the file ABC. dat.
   b) Write a program to implement the concept of loading & displaying images.
   c) Write a program to demonstrate the Animation in Java.

B.Sc. Final Semester V (From 2015-2016)

Paper I

VISUAL BASIC PROGRAMMING

UNIT - I :

Working with Visual Basic Window Components: Menu Bar, Tool Bar, Project Explorer Window, Form Layout Window, properties Window, Toolbox, Code Editor Window **Working with Forms:** Properties, Events, Methods Working with Basic Controls:Label, CommandButton, TextBox, OptionButton, Frame, CheckBox, ListBox, ComboBox, Image, Scroll, Picture, Timer, DriveListBox, DirListBox, FileListBox and Shape Controls. **Basic Programming Fundamentals:** Variables, Data types, Constant, Conversion Function. Scope of Variable: Public, Private Static. Operators: Logical, Arithmetic, Concatenation, Comparison. Decision Structure: If.. Then, If..Then..Else, Select Case.. End Case. Loop Structure: Do..While, While.. Wend, For.. Next, With..EndWith. DoEvents()

UNIT - II :

Arrays: Dynamic Array, Preserve and Control arrays. **Procedure:** General procedure, General Methods for Passing Arguments to a Procedure, **Functions:** User-Interaction, String, Math, Date, Conversion Functions.
Modules: Form, Standard.

UNIT - III :

Menus: Creating, Adding Menu Items, Creating Shortcut, Adding Separators Bars, Submenus, Code for Menus. Creating Popup Menu: System, Custom. **Database Handling:** Database Concepts, Creating and Accessing Database, Using Data Control.
Using DAO: Creating Search Programs, Numeric Search and Complex Search Programs.

UNIT - IV :

Using ADO Data Control, Data Link, ODBC Data Source name, Using Connection String, Creating Navigating buttons. Working with Advanced Data Controls **:** DataList Control, DataCombo Control, DataGrid Control and Msflexgrid Control. **Handling Errors** : Run Time, Trapping and Handling Error, ERR Object. Data Environment and Data Reports.

Text Books:

1) VISUAL BASIC – to Advance by Soma Dasgupta [BPB Publication]

Reference Books:

1. Evangelos Petroutsos, Mastering Visual Basic 6.0 BPB Publication.
2. VISUAL BASIC 6 COMPLETE REFRENCE (TMH PUB)
3. Visual Basic 6 Deitel & Deitel (Pearson Education)
4. Mastering VB 6.0 Black Book -Peter - Norton-Techmedia.

B.Sc. Final Semester V

Paper II

DATA BASE MANAGEMENT SYSTEM

UNIT - I :

DBMS : Definition: Databases, DBMS, Problems with traditional file processing system, Objectives of the database systems, Three level architectures of DBMS, Component of DBMS, Database Administrator, Database Users, Data model, Different types of data models, Concepts of Hierarchical, Network Models.

UNIT - II :

E-R Models : Basic Concepts, Entity, Attributes, Relation Ship, Mapping, Keys, Weak and Strong Entity Set, Problems on E-R Diagrams, Extended E-R Features: Specialization, Generalization, Aggregation, Problems on Reduction of an E-R Schema to Tables, Tabular representation of Strong, Weak entity Sets and Relationship Sets.

UNIT - III :

Relational Model: Structure, Relational Algebra, Fundamental Operations, Set – Intersection, Natural Join, Division and Assignment Operation. Extended Relational Algebra Operations, Aggregate Functions.

UNIT – IV :

Functional Dependency: Functional Dependency, Fully Functional Dependency, Partial Dependency, Transitive Dependency, Multi Valued Dependency.

Normalization, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF, 5NF). Problems on Normal forms.

Text Books:

1) Data Base System Concepts By A SilbersChatz By Henry Korth And S.Sudarshan [Mcgraw-Hill ltd. New Delhi] 3rd Edition.
2) Introduction to Data Base Management by NAVEEN PRAKASH [Tata McGrawHill ltd.]

Reference Books:

1. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications.
2. Raghu Ramakrishnan & Johannes Gerhrke, "Data Base Management Systems", Mc Graw Hill International Edition, 2000
3. Muzumdar, Introduction to Database Management Systems. TMH

B.Sc. Final Semester V
Practical List

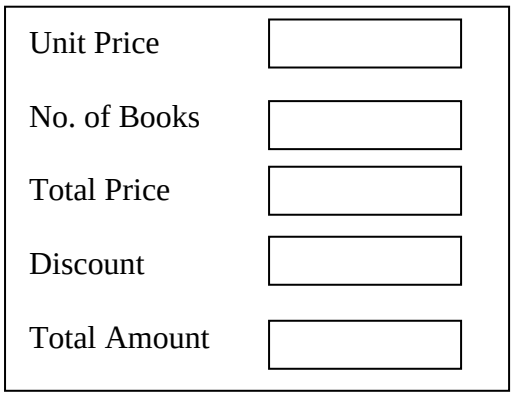
VISUAL BASIC PROGRAMMING

1. a) Make an application in Visual Basic, which display a picture when
   i) Command button with caption " click here" is clicked.
   ii) After delay time 100ms (by using Timer control)
   b) Design an Application to find
   iii) sin x = x- x^3/3!+ x^5/5! –x^7/7! + ---------
   iv) cos x = 1- x^2/2! + x^4/4!-x^6/6!+---------.
   v) Find a even/odd no.
   vi) Find Factorial of no.
   vii) Find if number is a Prime Or not prime

2. a) A book stall gives discount on the books as per following conditions,

No. of books purchased	Discount
<=5	Nil
>5 and <=10	10%
>10 and <=15	12%
>15	20%

Create a form as follows to calculate the discount.



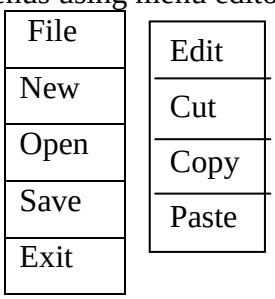
b) Design a form for speed control program using scrollbars.

3. a) Design an application, which display a text and given choice to change text to bold, italic, underline (any one or in combination) using check box controls.
   b) Write a VB code to give five choices of colors. Design an application to choose any one color using option button and change the forecolor of TextBox Caption.

4.a)Write a program in VB to build application to display sorted list of group A & group B student in two list boxes. Make provision to shift name (s) on either side using List Box control.
   b)Write a program in VB to build application which display list of states. Make provision to display capital of the state and cities when a particular state is selected using combo box.

5. a)Write a VB Program to create an array of N elements. Find the frequency of element and display the positions in an array.
   b) Create an application, which counts no. of characters and no. of words entered in TextBox.

6) Create Menus using menu editor as follows.

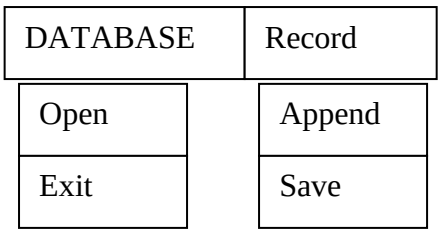


And Write appropriate code on click event of New & Exit Menu Options.

7) Create a database pay.mdb using Visual Database Manager with fields code number (n), Name of Employee (T), Designation (T), Address (T), Joining date (d), Basic pay (n), Status (T) [permanent / temporary], Department (T) [purchase, sales, account]. Achieve connectivity using Data control. Develop an application in V.B. to display the data of employees using MSFlexgrid control as shown below with company's logo.

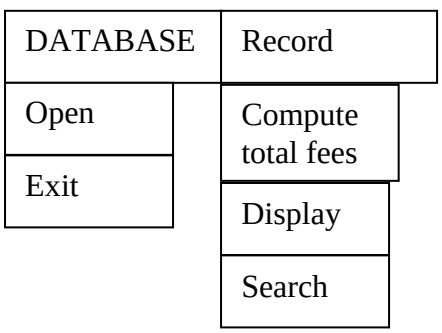
EMPLOYEE INFORMATON						< logo>	
I.D.	NAME	ADDRESS	DESIGNATION	DEPT.	Date of Joining	Status	BASIC

8) Design a Menu as shown below.



Create table pay.mdb using Visual Data Manager and connect it to vb application using Data Control. Display/view records using DbGridControl.
Create an application in V.B. to open database of employee pay.mdb by using menu option "OPEN" .Use APPEND and SAVE options to Add & Save records in DATABASE.

9) Open DataBase fees.mdb with fields: -
Name, class, fees Using Visual Data Manager. Use Data control for connectivity.
Develop a menu driven application in V.B. to: -
I) Compute total fees class wise
II) Search a record of a particular student belonging to a particular class.



10) Create a DataBase College.mdb containing fields:-

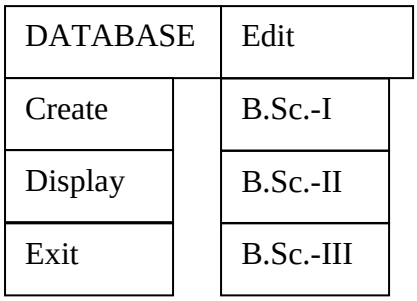
Name, Class, Marks in phy, Comp. Sc., Maths and Percentage Using Visual Data Manager.Connect database to vb application using Data Control.

Develop a Menu driven application in V.B. to

I) Edit a records class wise.

II) Calculate class wise passing percentage where a student is declared "pass", if he/she gets percentage > = 45.

Display Class wise list of students who are placed in Ist Division. (Percentage>=60)



11) Create a table book.mdb using VDM containing fields:-

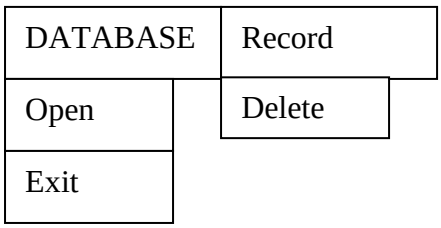
Name of book, subject, price, date of purchase, Name of publication,

Develop a menu driven application in V.B. to: -

I) Open Database

I) Delete a record of book.

II) Display subject wise list of book in proper format.



Use DataControl for connectivity.

12) Create a table using VDM to store required information for computing Electricity Bill.

Charges are as follows

1) 1.25 /units for 1st 30 units
2) 2.90 / units from 31 to 300 units
3) 4.0 /units from 301 to onwards.

Develop a menu driven application . to: -

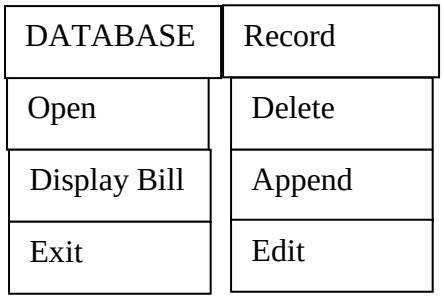
I) Open Database

II) Display Electricity Bill in proper format.

III) Delete a record of book

IV) Append a record

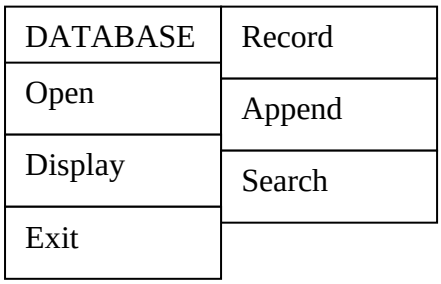
V) Edit record



Use ADODC to achieve connectivity.

13) Create the database emp.mdb having table emp_biodata directly through MSACCESS and Display records using datagrid control.
Develop a menu driven application . to: -

I) Open Database II) **Display records using datagrid control**.
III) Search a record IV) Append a record

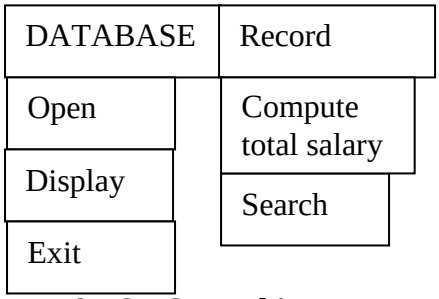


Use ADODC to achieve connectivity.

14) Create an application for employee salary sheet.

IF BASIC >5000
HRA=40 % OF BASIC
DA=50 % OF BASIC
IF BASIC >= 2500
HRA = 35 % OF BASIC
DA=45 % OF BASIC
IF BASIC >=1500
HRA = 30 % OF BASIC
DA=40 % OF BASIC
OTHER WISE
HRA= 20 % OF BASIC
DA =30 % OF BASIC
TA= 150
PF= 15 % OF BASIC
PT = 18% OF BASIC

Develop a menu driven application in V.B. to: -Compute total Salary
Search a record of a particular employee belonging to a particular department.



Use ADODC to achieve connectivity.

Note -: While designing menu MDI forms are expected wherever required.

B.Sc. Final Semester VI
Paper I

COMPILER CONSTRUCTION

UNIT - I :
Compilers and translators, need, the structure of a compiler, Lexical Analysis, Syntax analysis, Intermediate code Generation, Optimization, Code Generation, Book keeping, Error Handling

UNIT - II :
High Level programming languages, Definitions of programming languages, The lexical and syntactic structure of a language, Data elements, structures, Operators, Assignment Statements, Data Environments, Parameter transmission, Storage management.

UNIT - III :
The role of the lexical analyzer, Approach to the design of lexical analyzer, Implementation of lexical analyzer, Context free grammars, Derivations and parse trees, Ambiguous grammar.

UNIT - IV :
Parsers, Shift-reduce parsing, Operator precedence parsing, Top-down parsing, predictive parsers, Symbol Table , Code Optimization: The principal source optimization, Loop optimization, The DAG representation of basic blocks, Code Generation : A machine model, a simple code generator, Register Allocation and assignment.

TEXT BOOKS :
1. Principles of Compiler Design - A.V. Aho, J. D.Ullman : Pearson Education.

Reference Books:
1. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech.
2. Engineering a Compiler-Cooper & Linda, Elsevier.
3. Compiler Construction, Louden, Thomson.

B.Sc. Final Semester VI

Paper II

SQL AND PL/SQL

UNIT - I :

CODD'S Rules, Oracle Database Objects, Sub Languages of SQL, Data types, Operators. **DDL Statement**: Creating Tables, Deriving Table from existing table, Altering, Dropping Tables. Integrity Constraints, Specifying Names for the Constraints, Viewing Integrity Constraints, Adding and Dropping Constraints. DML Statements: SELECT statement, Insert, Update, Delete, Working with Sequences and Synonyms. Built-in functions: Arithmetic, Date, Character, Conversion, Single row, Aggregate, Decode.
Joins, Set Operators and Sub queries. DCL and TCL Statements: Grant, Revoke, Commit, Rollback and Savepoints.

UNIT - II :

VIEWS: Creating Views, Dropping Views, Inserting, Updating and Deleting Data using Views, Types of Views. PL/SQL Programming: PL/SQL Data Types, Identifiers, Operators and Expressions, Iterative Statements, Conditional Statements, emphasis on Problems

UNIT - III :

Exception Handling : Predefined Exceptions, User defined Exceptions. Cursors: Declaring Cursors, Opening and Retrieving Records, Closing cursors. Attributes of Explicit and Implicit Cursors, Parameter Passing in Cursors. Procedures : Create and Drop Procedure, Creating Procedures with Parameters, Calling Procedures, Granting the EXECUTE Permission Problems on Exception Handling, Cursors and Procedures.

UNIT - IV :

Function: Creating and Dropping Function, Purity Levels in Functions, Executing Functions. **Triggers:** Create Triggers, Type of Triggers, Creating BEFORE and AFTER Triggers, INSTEAD-OF Triggers, Trigger Predicates, Inserting, Updating and Deleting Triggers, Enabling , Disabling and Dropping Triggers. Problems on Functions and Triggers

Text Books:

1. Understanding ORACLE By Ivan Bayross [BPB Publication]

Reference :

1. Database System Using Oracle: A Simplified Guide to SQL & PL-SQL: Nilesh Shah, PHI Publication.
2. Database Management Systems (Complete practical approach) by Sharad Maheshwari & Ruchin Jain, Firewall media
3. Dr. P.S.Deshpande SQL & PL/SQL for Oracle 10g Black Book
4. Scott Urman Programming PL/SQL TMH

B.Sc.Final Semester VI
Practical List

SQL and PL/SQL (ORACLE)

1) DDL Statements :

1.a) **Create the table Invoice** with fields inv_no(char, Primary key), mv_no(number), cust_id(char), issue_date(date), return_date(date).

Insert data in the table invoice as follows:

Inv_no	mv_no	cust_id	issue_date	return_date
I01	1	a01	21-Dec-06	25-Dec-06
I02	3	a02	19-Oct-06	30-Oct-06
I03	5	a03	14-Jul-06	1-Aug-06
I04	5	a04	15-Sep-06	30-Sept-06
I05	6	a05	19-Oct-06	21-Oct-06
I06	7	a06	1-Jan-06	15-Jan-06
I07	8	a07	15-Aug-06	30-Aug-06
I08	2	a05	1-Oct-06	15-Oct-06
I09	4	a01	12-sep-06	19-Sep-06
I10	9	a02	1-Dec-06	15-Dec-06
I11	6	a05	2-feb-06	14-feb-06
I12	3	a06	1-Jan-06	10-Jan-06

1.b) Modifying Table Structure by adding the new field price (number) and increasing the size of inv_no.

1.c) Add and Drop Constraints

i) Add primary key constraint
ii) Drop primary key constraint
iii) Add Unique key constraint
iv) Drop Unique key constraint
v) Add check constraint

2) DML Statements:

2.a) Add a records in above table

2.b) i)Change inv_no of I12 with 'I111'.
ii)Change issue_date of customer of cust_id 'a01' to '22-Dec-06'.
iii)Change movie no of cust_id 'a05' to 11.
iv)Display all movies with issue_date between 01-jan-06 to 01-sep-06
v)Display information for cust_id 'a01' & 'a02'.

2.c) i) Delete records with inv_no 'I11'from invoice table.
ii)Delete records having return date <='20-Jan-06'.

3**)** DCL and TCL Statements

i) Grant insertion and deletion privileges on invoice table to another user XYZ.
ii) revoke the deletion privileges from user XYZ.
iii) after insertion of 2 records in invoice table create savepoint A.
iv) delete a record and create savepoint B.
v) rollback to A

4) Create the table **Movie** with fields mv_no(number, Primary Key), title(Char), Type(char), star(char), price(number), releasedate(date)

i) Add few records in above table
ii) Count total number of customer
iii) Calculate total price of all the movies.
iv) Calculate average price of all the movies.
v) Determine the maximum & minimum movies prices and rename the title as MAX-PRICE and MIN-PRICE.

vi) Count the number of movies having price greater than or equal to 150.
vii) display total no. of movies released in the current year.
viii) display all the movie which start with letter 'K'.

5) i) **Create a View** of table Invoice with following column inv_no(char, Primary key), mv_no(number), cust_id(char)
ii) Insert and delete records
iii) drop view

6) PL/SQL Programming:

Write a PL/SQL block
i) to find largest of 2 numbers
ii) to reverse the number

7) **Cursor**
i) Write a Cursor to fetch all rows of table invoice
ii) Write a Cursor to display all movies with issue_date between 01-jan-06 to 01-sep-06. If no record found then use Exception to display proper message.
iii) Write a Pl/SQL to accept the name and age of student and insert into table STUD after validating age not less than 18 otherwise raise exception

8) **Create Procedure**
i) to swap two values
ii) to display the cust_id, mv_no and call the procedure through main program

9) **Create Function**
i) to find gcd of two numbers.
ii) to find the total price of all the movie start with letter 'K' and call the function through main program

10) **Create Trigger**
i) that restricts the user from performing a DML on movie table on 'Monday'
ii) Covert all the movie name into the upper case on insertion of each row.

B.Sc. ELECTRONICS ***Semester 1 Paper 1***

Electronic Components, Network Theorems

Unit 1

Definition, types, identification and uses of electronic components: Resistors, Capacitors, Inductors, Switches, Transformers and Relays

Block diagram of C. R. O.

Unit 2

Ideal Voltage and Current sources (Internal impedance of battery and its effect on its performance), Kirchoff's current and voltage laws, Voltage and current divider circuits, Superposition, Thevenin, Norton, Maximum power transfer theorems (Statement and simple numerical)

(DC circuits only)

Unit 3

Introduction to semiconductors: Concept of energy band diagram (Conductor, Semiconductor, Insulator) , Intrinsic and extrinsic semiconductor (P type, N type), diffusion junction, depletion layer, Barrier potential, PN Junction diode, forward and reverse bias characteristics of diode, Avalanche and Zener effect; Zener diode, L.E.D.

Unit 4

The bipolar junction transistor, construction of B. J. T. , modes of B.J.T. (CE, CC, CB), transistor equation; α, β and their relationship, junction biasing, Input, output and transfer characteristics of BJT in CE mode, Transistor Biasing (Voltage divider and emitter biasing only), DC load line, Q point, transistor as switch

B.Sc. I ELECTRONICS PRACTICAL *Semester 1 Section A*

1. Study of laws of series resistor and application as voltage divider.
2. Study of laws of parallel resistor and application as current divider.
3. Study of laws of series capacitor and application as voltage divider.
4. Study of laws of parallel capacitor and application as current divider.
5. Verification of Terman's equation for inductance. Reactance characteristics of inductor
6. Study of transformer.
7. Study of battery as practical (i) voltage source (ii) current source.
8. Study of maximum power transfer.
9. Study of Forward Bias characteristics of diode. (PN & LED)
10. Study of Reverse Bias characteristics of ZENER diode.
11. Study of Characteristics of BJT. (Input, Output, Transfer)
12. Study of voltage divider biasing of transistor.
13. Verification of Norton's Theorem.
14. Verification of Thevenins Theorem.

B.Sc. ELECTRONICS *Semester 1 Paper 1*

Reference Books

1	Basic Electronics solid state physics	B.L.Theraja S.Chand and company
2	Electronic Devices and circuits	Allen Mottershed Prentice hall of India pvt.ltd.
3	An Introduction to Electronics	R.G.Kale,U.K.Puranik,V.N.Pendse,A .A.Sakale Kitab mahal
4	Basic Electronics	Grob Tata McGraw Hill
5	Electronic Devices	T.L.Floyd Pearson Education Asia
6	Electronic Principles	Malvino Tata McGraw Hill
7	Electronic components and materials	Madhuri Joshi Schroff pub. And distributors
8	Electronic components and materials	S.M.Dhir TMH
9	Network analysis	Van valkenburg PHI

B.Sc. ELECTRONICS ***Semester 1 Paper 2***

Fundamentals of Digital Electronics

Unit 1

Number Systems and Codes: Decimal, Binary, Octal, Hexadecimal, representation of integer, fraction, mixed numbers and their mutual conversion, Complement of numbers-1's, 2's, complements, addition and subtraction using 1's and 2's complement method sign and magnitude of numbers. Codes- BCD, 8421, Excess 3, Parity and gray code

Unit 2

Logic gates- OR, AND, NOT, NAND, NOR, XOR and XNOR gates and their truth table, Boolean Laws, double inversion, De Morgans and Duality theorems, use of NAND and NOR as universal building blocks

Unit 3

Karnaugh Maps: pair, quads, octets , minterm, max term in K Map, K-map for 2,3,4 variables, concept of SOP and POS, simplification of SOP and POS logic expressions using K-map, Design of binary to gray code converter, gray to binary code converter using K-map

Unit 4

Combinational Logic Circuits- Half Adder, full adder, half subtracter and full subtracter, Concept of Encoder , Concept of Decoder: BCD to gray converter, BCD to seven segment converter, parity generator checker, 4-bit Full Adder/ subtracter, Concept of multiplexer, 4:1 mux using gate , Concept of demultiplexer, 1:4 demux using gate

B.Sc. I ELECTRONICS PRACTICAL *Semester 1 Section B*

1. Study of basic logic gates.
2. Study of NAND as universal gate.
3. Study of NOR as universal gate.
4. Verification of Demorgan's Theorem.
5. Simplification of logic expressions using Boolean algebra.
6. Study of binary to gray code converter using K map.
7. Study of gray to binary code converter using K map.
8. Study of Multiplexer using gates.
9. Study of De Multiplexer using gates.
10. Study of Multiplexer using IC.
11. Study of De- Multiplexer using IC
12. Study of BCD to 7 segment decoder.
13. Construction and study of half adder and full adder.
14. Construction and study of half subtractor and full subtractor.
15. Verification of Boolean laws & Verification of duality theorem.

B.Sc. ELECTRONICS ***Semester 1 Paper 2***

Reference Books

1	Digital principles and applications	A.P.Malvino,D.P.Leach McGraw Hill Book Co.
2	Principles of digital Electronics	M.B.Matsagar,V.S.Kale Vision publication
3	Modern digital Electronics	R.P.Jain Tata McGraw Hill publishing co.ltd
4	Digital fundamentals	Floyd,Jain Pearson
5	2000 solved problems in digital Electronics	S.P.Bali Tata McGraw Hill publishing co.ltd.
6	Electronic circuits and systems Analog and digital	Y.N.Bapat Tata McGraw Hill publishing co.ltd.
7	Digital electronics and logic design	B.S.Nair Prentice hall
8	digital computer electronics	Malvino,Brown Tata McGraw Hill
9	Fundamentals of Digital Electronics	C.V.Dhuley and V.M. Ghodki

B.Sc. ELECTRONICS ***Semester 2 Paper 1***

Semiconductor Devices

Unit 1

Construction, working, characteristics and applications of JFET, MOSFET (depletion and enhancement type), parameters of JFET and their relationship parameters of MOSFET and their relationship

Unit 2

Construction, working, characteristics and applications of Silicon Controlled Rectifier, DIAC, TRIAC and UJT, UJT as relaxation oscillator

Unit 3

Amplifier parameters, notations, concept and definition of h-parameters, open circuit and short circuit tests, Introduction to input impedance, output impedance, current, voltage and power gains using h parameters, classification of amplifiers (Descriptive ideas only)

Unit 4

Introduction to power transistor, difference between Voltage and power amplifiers, transformer coupled class A power amplifier and its efficiency, class B Push-pull amplifier, derivation for efficiency, complementary symmetry power amplifier with two power supplies

B.Sc. I ELECTRONICS PRACTICAL *Semester 2 Section A*

1. Study of JFET characteristics.
2. Study of MOSFET characteristics.
3. Study of SCR characteristics.
4. Study of DIAC characteristics.
5. Study of UJT characteristics.
6. Study of UJT as relaxation oscillator.
7. Study of Transistor as a switch.
8. Study of transistor as voltage amplifier using CRO.
9. Study of class A power amplifier.
10. Study of TRIAC characteristics.
11. Study of Band width in single stage amplifier.
12. Study of complementary symmetry power amplifier.

B.Sc. ELECTRONICS *Semester 2 Paper 1*

Reference Books

1	Principles of Electronics	V.K.Mehta,Rohit Mehta
2	Functional circuits in Electronics	S.G.Pimpale,Sushama Pimpale Mcmillan India ltd.
3	Electronics,Fundamental and applications	Ryder PHI
4	Elements of electronics	M.K.Bagde,S.P.Singh,Kamal singh S.Chand and co.
5	Op-Amp and linear circuits	Gaikwad PHI
6	Electronic Instrumentation	Khedkar
7	Monograph on electronic design principles	Goel, Khaitan Khanna publisher
8	Basic electronics and linear cicuits	Bhargava,KUlshreshtha,Gupta Technical education series
9	EDC I, EDC II	A.P. Godse, U.P.Bakshi Technical Publishers pune

B.Sc. ELECTRONICS ***Semester 2 Paper 2***

Advanced Digital Electronics

Unit 1

Logic Families: Characteristics of digital ICs, construction and working of TTL NAND and NOR gates, construction and working of CMOS NAND and NOR gates, Tristate logic, comparison of TTL and CMOS logic families with respect to propagation delay, power consumption, noise immunity, noise margin, fan in and fan out.

Unit 2

Sequential Logic Circuits- Concepts of Edge and Level Triggering, Propagation Delay, set up time, hold time, R-S Flip Flop, Clocked R-S Flip Flop, Limitations of R-S FF, D FF, JK FF, preset and clear , Limitations of JK FF: Race around Condition, JKMS FF

Unit 3

Counters: Asynchronous, up/down, Decade, Synchronous, Modified counter, Ring Counter, Johnson counter (Truth tables and timing diagrams) (4 bit)

Unit 4

Registers: Buffer , left shift, right shift, SISO, SIPO, PISO, PIPO Registers , introduction to memories, classification, Memory expansion (word size and word capacity)

B.Sc. I ELECTRONICS PRACTICAL *Semester 2 Section B*

1. Switching characteristics of NOR.
2. Switching characteristics of NAND.
3. Study of RS Flip Flop using NAND/NOR gate.
4. Study of clocked RS Flip Flop using NAND/NOR gate.
5. Study of D Flip Flop using NAND/NOR gate.
6. Study of JK MS FF.
7. Construction and study of decade counter.
8. Study of mod-counter.
9. Study of ring counter.
10. Study of Johnson counter.
11. Study of SISO register.
12. Study of SIPO register.
13. Study of PISO register.
14. Study of PIPO register.
15. Construction and study of synchronous counter.

B.Sc. ELECTRONICS *Semester 2 Paper 2*

Reference Books

1	Digital principles and applications	A.P.Malvino,D.P.Leach McGraw Hill Book Co.
2	Principles of digital Electronics	M.B.Matsagar,V.S.Kale Vision publication
3	Modern digital Electronics	R.P.Jain Tata McGraw Hill publishing co.ltd
4	Digital fundamentals	Floyd,Jain Pearson
5	2000 solved problems in digital Electronics	S.P.Bali Tata McGraw Hill publishing co.ltd.
6	Electronic circuits and systems Analog and digital	Y.N.Bapat Tata McGraw Hill publishing co.ltd.
7	Digital electronics and logic design	B.S.Nair Prentice hall
8	digital computer electronics	Malvino,Brown Tata McGraw Hill
9	Fundamentals of Digital Electronics	C.V.Dhuley and V.M. Ghodki

B.Sc. ELECTRONICS ***Semester 3 Paper 1***

OP AMP And Power Supply

Unit 1

Introduction to DC amplifier, difference amplifier, Need of two power supplies, working of difference amplifier, differential mode gain, common mode gain, C.M.R.R., IC OP-AMP (block diagram), parameters of OP AMP and characteristics of an ideal OP AMP.

Unit 2

OP AMP as an inverting amplifier, concept of virtual ground, non-inverting amplifier, unity gain amplifier, adder, subtractor, integrator, differentiator, comparator, zero crossing detector, Schmitt trigger

Unit 3

Half wave rectifier, full wave rectifier, bridge rectifier; concept of filter (capacitive). Unregulated, regulated PS, power supply parameters – ripple factor, efficiency, line regulation, load regulation, Zener regulator, Regulated power supply design using series pass transistor, short circuit protection

Unit 4

General features of IC regulators, design of fixed and variable power supply, 78xx,79xx , LM 317, design of dual power supply, LM 317 as variable regulator, Limitations of linear regulator, Switching regulator- (SMPS), Concept of Low Drop Out regulator (LDO)

B.Sc. II ELECTRONICS PRACTICAL *Semester 3 Section A*

1. Study of Op-amp as inverting and sign changer amplifier.
2. Study of Op-amp as Non-inverting and unity gain amplifier.
3. Op-amp as adder and averaging amplifier.
4. Op-amp as difference amplifier. (Subtractor)
5. Op-amp as integrator.
6. Op-amp as Differentiator
7. Op-amp as comparator and zero crossing detector.
8. Op-amp as Schmitt trigger.
9. Study of Half wave rectifier.
10. Study of Full wave rectifier.
11. Study of Full wave Bridge rectifier.
12. Study of Zener regulator.
13. Regulated P.S. using series pass transistor.
14. Study of LM-317 (variable regulator)
15. Study of 78XX
16. Study of 79XX
17. Study of difference using transistors.

B.Sc. ELECTRONICS ***Semester 3 Paper 1***

Reference Books

1	Principles of Electronics	V.K.Mehta,Rohit Mehta
2	Functional circuits in Electronics	S.G.Pimpale,Sushama Pimpale Mcmillan India ltd.
3	Electronics,Fundamental and applications	Ryder PHI
4	Elements of electronics	M.K.Bagde,S.P.Singh,Kamal singh S.Chand and co.
5	Op-Amp and linear circuits	Gaikwad PHI
6	Electronic Instrumentation	Khedkar
7	Monograph on electronic design principles	Goel, Khaitan Khanna publisher
8	Basic electronics and linear cicuits	Bhargava,KUlshreshtha,Gupta Technical education series
9	EDC I, EDC II	A.P. Godse, U.P.Bakshi Technical Publishers pune

B.Sc. ELECTRONICS ***Semester 3 Paper 2***

Electronic Circuit Design

Unit 1

Concept development: defining inputs, process and output, generating ideas, screening ideas, developing and testing ideas, Simulation, Prototyping or Trial Production, Design Review, techno-commercial feasibility, product development, Erogonomic & asthetic design, quality assurance and compliance.

Unit 2

Introduction to circuit maker, basics, accessing tools& features, saving schematic options, file management, drawing a schematic, creating simple RC circuit, setting up the analysis, running the simulation, mix signal simulation example.

Unit 3

Digital logic simulation, setting of parameters, analysis of simple circuits, Analog / mixed signal simulation setting of parameters, analysis of simple circuits.

Unit 4

Introduction to Virtual Instrumentation,

Virtual Instrumentation System: Interface Bus, Input devices, Output devices, Software, Advantages of Virtual Instrumentation, Applications of Virtual Instrumentation, Virtual Instruments beyond the Personal Computer:

B.Sc. II ELECTRONICS PRACTICAL *Semester 3 Section B*

1. Study transient & AC analysis of RC circuit
2. Study transient & AC analysis of different OP-Amp as comparator
3. Study transient & AC analysis of different OP-Amp as inverting amplifier
4. Study transient & AC analysis of different OP-Amp as IA
5. Study CE amplifier parameters
6. Study CB amplifier parameters
7. Study CD FET amplifier parameters
8. Study of MOSFET Characteristics
9. Study of Low Pass Filter
10. Study of VI for Function Generator
11. Study of VI for Display(CRO)
12. Study of Average / Running average VI

B.Sc. ELECTRONICS ***Semester 3 Paper 2***

Reference Books

1	Measurements of high frequency acoustic characteristics	Vilas Ghodki, Satish Sharma and S Rajagopalan
2	Circuit maker mannual	

B.Sc. ELECTRONICS ***Semester 4 Paper 1***

Analogue And Digital Techniques

Unit 1

Feedback: type, positive and negative feedback, Barkhausen criterion, Oscillators, types (AF and RF), basic oscillator action, L-C oscillator :Colpitts oscillator, RC oscillator using OP Amp ,phase shift oscillator, Wein bridge oscillator, oscillator stability, crystal oscillator, NOT gate based crystal oscillator.

Unit 2

Study of OP AMP as: astable multivibrator (asymmetric and symmetric), monostable multivibrator (simple circuit) , concept and working of sample and hold circuit, concept of Instrumentation Amplifier (three OP Amp circuit) and working

Unit 3

D/A converter, parameter: range, resolution, linearity and speed, weighted type D/A, limitations of weighted type D/A, R-2R D/A using Op Amp, limitations, types of D/A output (voltage , current, differential), dual bias D/A

Unit 4

Need for A/D conversion, parameters: range, resolution and speed, single slope A/D converters, dual slope A/D converter, Counter type, successive approximation type, Flash type, sampling theorem, Reference voltage and ADC stability

B.Sc. ELECTRONICS PRACTICAL II *Semester 4 Section A*

1. Study of OP-amp based Wein bridge oscillator.
2. Study of OP-amp based Phase shift oscillator.
3. Study of Colpitt's oscillator.
4. Study of Op-amp as astable multi vibrator.
5. Study of Op-amp as Mono stable multi vibrator.
6. Study of Instrumentation amplifier.
7. Study of successive approximation ADC.
8. Study of Flash type ADC.
9. Study of Single slope ADC.
10. Study of Dual slope ADC.
11. Study of Binary weighted DAC.
12. Study of ladder type DAC
13. Study of NOT gate based crystal oscillator.
14. Study of Sample and hold circuit.

B.Sc. ELECTRONICS ***Semester 4 Paper 1***

Reference Books

1	Digital and analogue Techniques	G.N.Navaneeth,V.M.Gokhale,R.G.Kale Kitab mahal
2	Digital principles and applications	A.P.Malvino,D.P.Leach McGraw Hill Book Co.
3	Op-Amp and linear circuits	Gaikwad PHI
4	Principles of digital Electronics	M.B.Matsagar,V.S.Kale Vision publication
5	Modern digital Electronics	R.P.Jain Tata McGraw Hill publishing co.ltd.
6	Digital fundamentals	Floyd,Jain Pearson
7	2000 solved problems in digital Electronics	S.P.Bali Tata McGraw Hill publishing co.ltd.
8	Electronic circuits and systems Analog and digital	Y.N.Bapat Tata McGraw Hill publishing co.ltd.
9	Digital electronics and logic design	B.S.Nair Prentice hall
10	Digital computer electronics	Malvino,Brown Tata McGraw Hill
11	Fundamentals of Digital Electronics	C.V.Dhuley and V.M. Ghodki

B.Sc. ELECTRONICS ***Semester 4 Paper 2***

Electronic Instrumentation

Unit 1

Block diagram for electronic system, Defining the system, characteristics, Analog, digital, real, virtual, dedicated, versatile, stand alone, PC based instruments.

Concept of calibration, standards for calibration

Unit 2

Sensors, actuators, transducers, active & passive transducers, characteristics,

Passive : Thermister (NTC & PTC), LM35, L.D.R. photo-transistor

Active : Piezo-electric transducer

Digital: pressure sensor (MPXV4006DP)

Unit 3

Block diagram of :

temperature measurement using thermister,

temperature measurement using LM35, advantage over thermister

lux meter using LDR,

colorimeter using LDR

insect repellent using piezo buzzer

Unit 4

Man-Instrument system, components, introduction to physiological system, generation of bio potential, Block diagram and working of EEG, ECG & EMG, electrical shock hazards, precautions, safety codes biomedical

B.Sc. II ELECTRONICS PRACTICAL *Semester 4 Section B*

1. Study transfer characteristics of NTC type thermister
2. Study resolution in characteristics of NTC type thermister
3. Study transfer characteristics of LM 35
4. Study transfer characteristics of Water heater (around 300W)
5. Study of ON/ OFF type thermo-state using LM 35
6. Study transfer characteristics of LDR
7. Study transfer characteristics of Piezo-electric transducer
8. Comparative study of accuracy in 3 ½ digit, 4 ½ digit 5 ½ digit Multimeters
9. Directivity study of carbon Mic.
10. “Look up table” based o/p using microcontroller

B.Sc. ELECTRONICS ***Semester 4 Paper 2***

Reference Books

1	Applied electronics and Instrumentation	C.M.Dhir	Tata McGraw Hill
2	Digital Instrumentation	Bouwens	Tata McGraw Hill
3	Electronic Instrumentation	Khedkar	
4	Modern . electronic Instrumentation and measurement techniques	Cooper	Prentice hall

B.Sc. ELECTRONICS ***Semester 5 Paper 1***

Electronics Communication

Unit 1

Introduction to Electronics communication, block diagram of communication system, Types of communication: analog, digital; simplex, duplex; baseband, modulated, concept of modulation, need for modulation, types of modulation (AM, FM, PM)

Unit 2

Propagation modes of signals: ground waves, sky waves, Ionosphere and satellite; antenna fundamentals, basic principles and types.

Unit 3

Digital communication: Introduction, synchronous, asynchronous transmission, Shannon theorem, ASK, FSK, and PSK modulation.

Unit 4

Fiber optic communication system, Advantages of FOC, concept of Fax, concept of cellular telephone, block diagram of cellular telephone, advantages

B.Sc. ELECTRONICS PRACTICAL III *Semester 5 Section A*

1. Study of Half duplex communication system using PC/µC (2 wire interface)
2. Study of Full duplex communication system using PC/µC (3 wire interface)
3. ASK using op-Amp
4. FSK using op-Amp
5. Study of AM detector
6. Study of narrow band amplifier using op-amp/ Transistor
7. Study of intensity characteristics of LASER diode
8. X-bee interface using PC/ µC / field strength study
9. IR Link study
10. Wire impedance measurement

B.Sc. ELECTRONICS *Semester 5 Paper 1*

Reference Books

1	Electronic communication system	John kennedy	Tata McGraw Hill
2	Communication electronics principles and application	Frenzel	Tata McGraw Hill
3			
4			

B.Sc. ELECTRONICS ***Semester 5 Paper 2***

Fundamentals of Microprocessor

Unit 1

Block diagram of Intel 8085, ALU, Timing and control unit, General purpose registers, Accumulator, PC, SP, IR, ID, Interrupt, Address and Data bus multiplexing, Flags. Instruction Cycle: T-states, Fetch operation, Execute operation, Machine cycle

Unit 2

Addressing mode, instruction Set- Data transfer group, arithmetic group, logic group, simple programs

Unit 3

Instruction set: branch control group, I/O and machine control group, simple programs, stack and subroutines

Unit 4

Need for interfacing, modes of data transfer, synchronous and asynchronous, interrupt driven, DMA, PPI 8255- Block diagram, modes, control word format

B.Sc. ELECTRONICS PRACTICAL III *Semester 5 Section B*

1. Program based on Data transfer instructions.
2. Program based on Arithmatic instructions.
3. Program based on Logical instructions.
4. Program based on Branch instructions.
5. Program based on Control instructions.
6. Study of PPI 8255.

B.Sc. ELECTRONICS ***Semester 5 Paper 2***

Reference Books

1	Fundamentals of Microprocessor and Microcomputers	B.Ram Dhanpat Rai publications
2	Microprocessor Architecture, programming and applications with 8085/8080 A	Ramesh S. Gaonkar Wiley eastern ltd.
3	Introduction to microprocessor	A.P. Mathur Tata McGraw Hill
4	Microprocessor and interfacing	D.V.Hall Tata McGraw Hill
5	Introduction to Microprocessors	Vilas Ghodki and Satish Sharma

B.Sc. ELECTRONICS ***Semester 6 Paper 1***

Programming in "C"

Unit 1

Constant, Variables and Operators: Character set, C tokens, constant, Keyword, identifiers, variables, data types, declaration of variables, Arithmetic, relational logical, assignment, increment, conditional, bitwise, operators, Arithmetic expression, evaluation of expression, precedence of operators, input/output functions

Unit 2

Control Structures & Arrays: if- statements, if-else statement, switch statement, go-to statement, while statement, do-while statement, for statement, one dimensional array

Unit 3

User Defined Functions, Types of functions, return values and their types, scope and lifetime of variables in function; basic concept of structure and unions, difference between structure and union

Unit 4

Pointers: Basic concept, expression, variables Defining and opening file, closing a file, I/O operations on file, command line arguments, port interfacing.

B.Sc. III ELECTRONICS PRACTICAL *Semester 6 Section A*

1. Programs based on use of Variables, Operators, Input Output function
2. Programs based on Control Structure using if, if-else, switch, goto, while & do while
3. Programs based on use of one dimensional Array , Operations on array
4. Programs based on function writing, Use of structure and Union
5. Programs based on pointer operation, file operation
6. Programs based on communication with external data source like Printer & serial port

B.Sc. ELECTRONICS ***Semester 6 Paper 1***

Reference Books

1	Let us C	Y.Kanetkar
2	Gate to C programming	Kishor S B, Vilas Ghodki and Madhavi
3	C in depth	Shrivastava BPB publication
4	Programming in ANSI C-E	Balgurusamy Tata McGraw Hill
5	Programming with C	Byron Gottfried Schaums outline series Tata McGraw Hill
6		

B.Sc. ELECTRONICS ***Semester 6 Paper 2***

Microcontroller 8051

Unit 1

Architecture and features, Internal and External memory, Flags, SFR Map, SFR Function, Accumulator, Register B, Port registers (P0, P1, P2 and P3), Power Management (PCON)

Unit 2

Instruction set: Data transfer, logical, arithmetic, interrupt handler, Addressing Modes

Unit 3

Subroutine and Stack, Need for Subroutine LCALL and RETURN Instructions, ACALL Instructions, Nesting of subroutine, Stack Operation and Stack Instruction, Branching (Jump Instruction), simple programs

Unit 4

Interfacing with Keyboard, display - LCD (16 x 2), ADC and DAC, LED Matrix and Serial communication with personal computer

B.Sc. ELECTRONICS PRACTICAL III

Semester 6 Section B

1. LED Blink
2. Relay interface
3. Stepper Motor Interface
4. 16x2 Interface
5. Study of bit operation on port(A,B,C,D)
6. LED Blink using timer
7. Frequency Generator using timer
8. External frequency counting timer
9. Interrupt driven operation
10. Single blink on key I/P
11. Opto- triac interface
12. Key to clk/CC
13. Serial interface with PC
14. ADC 0808 interface
15. DAC 0808 interface
16. IIC interface using R.T.C.

B.Sc. ELECTRONICS ***Semester 6 Paper 2***

Reference Books

1	8051 microcontroller	V.Udayshankara, Mallikarjuna swamy	Tata McGraw Hill
2	Microcontroller theory and applications	A.V.Deshmukh	Tata McGraw Hill
3	Microcontroller	Rajkamal	Pearsons
4	Microcontroller	Mazidi and Mazidi	

PHYSICS

(B. Sc. Part- I)

Semester I

(Paper-101, 102, 103)

Semester II

(Paper-201, 202, 203)

(2013-2014)

B. Sc. First Year (Semester I)

Course - PHYSICS – Paper - I (101)

(Properties of Matter and Mechanics)

Marks- 50 **Time- 30 hours**

Unit I:

Elasticity- Introduction, Hooke's law, Elastic constants (Y, K, η) and relation between them, Poisson's ratio, Elastic limit, Work done in stretching a wire, Bending of beam, Bending moment, External and internal bending moment, Cantilever supported at one end and at both end, Torsional pendulum, and Maxwell needle.

Unit II:

Viscosity- Streamline and turbulent flow, Coefficient of viscosity, Equation of continuity, Euler's equation, Bernoulli's theorem and its applications (Lift of an Airplane, Atomizer) , Poiseuilli's formula, Reynolds number, Terminal velocity, Stokes law by the method of dimension, Variation of viscosity with temperature.

Unit III:

Surface tension- Introduction, Angle of contact and wetting, Surface energy, Surface tension by Jaeger's, Quincke's and Capillary rise methods.

Mechanics- Newton's law of motion, motion in a plane, components of velocity and acceleration in different coordinate system, Centripetal acceleration, Coriolis force and its applications.

Unit IV:

Mechanics- System of particles, Center of mass, Equation of motion, Conservation of linear and angular momentum, Conservation of energy, Single stage and multistage rockets, Elastic and inelastic collisions, Moments of inertia and their products, Moment of inertia of cylinder and sphere, Principal moments and axes.

References & Text books-

1. Applied Fluid Mechanics, by- Mott Robert, Pearson Benjamin Cummir, VI Edition, Pearson Education/Prentice Hall International, New Delhi
2. Properties of Matter, by- D. S. Mathur, Shamlal Chritable Trust New Delhi
3. Properties of matter, by- Brijlal
4. Physics for Degree Students B.Sc.-Part-I, by- C. L. Arora, Dr. P. S. Hemne, S Chand & Company.
5. General Properties of matter, by- J. C. Upadhyay, Ram Prasad & Sons
6. Mechanics, by- D. S. Mathur, S Chand.
7. Mechanics, by-B. M. Roy, Das Ganu Publications.

8. Mechanics & Electrodynamics, by- Brijlal & Subramaniam.
9. A text book of properties of Matter, by- N. S. Khare& S. Kumar.
10. Mechanics & Properties of Matter, by-J. C. Upadhyaya.

B. Sc. First Year (Semester I)

Course - PHYSICS - Paper-II (102)

(Electrostatics, Time varying fields & Electric Currents)

Marks- 50 **Time- 30 hours**

Unit I:

Electrostatics- Coulombs law in vacuum in vector form, Force between two charges, Electric field intensity, Electric potential, Electric field intensity due to a point charge, Electric dipole, Electric dipole moment, Electric field intensity due to an electric dipole, Electric field as a negative gradient of potential, Conservative nature of the electric field.

Unit II:

Dielectric- Introduction, definition of polar and non polar molecules, Polarization of charges in a dielectric, Clausius - Mossitti equation, Three electric vectors D, E and P and relation between them, Concept of capacitance, Parallel plate capacitor without and with dielectric, application of Gauss's law to parallel plate capacitor.

Unit III:

Time varying fields-Electromagnetic induction, Faradays laws in differential and integral form, Lenz's law, self and mutual induction, Transformer, Construction, working and its parameters, Energy losses.**Electric Currents**- Current density, Equation of continuity, Kirchhoff's law, Rise and decay of current in LR and CR circuits, Decay of charge in LCR circuits.

Unit IV:

Electric Currents- Application of complex number in solving an a. c. circuit, j- operator method, A.C. applied to pure resistive, pure inductive and pure capacitive circuit, application of j- operator in LR, CR and LCR circuit, Resonance, Sharpness of resonance, Series resonance circuit (Calculate I, Z, Φ and f_r),Q factor, Power in an a. c. circuit, Power factor.

References and Text books -

1. Electricity and Magnetism, by- Brijlal , Subramanyam.
2. Fundamental of Magnetism and Electricity, by- D. N. Vasudiva.
3. Electricity and Magnetism with Electronics, by- K. K. Tiwari.
4. Electricity and Magnetism, by K.K. Tiwari.
5. Elements of Electronics, by- M. K. Bagde, S. P. Singh, K Singh S - Chand.
6. Solid State Physics and Electronics, by- R. K. Puri, and V. K. Babbar.
7. Solid state Electronic Devices II Edition, by-B. G. Strretman.
8. Introduction to Electrodynamics, by- D. J. Griffiths.

9. Electromagnetic fields, by- T. V. S. Arun Murthy.
10. Electronics Fundamental and Applications II nd Edition, by-J. D. Ryder.

B. Sc. First Year (Semester I)
Course - Physics Practical (103)

1. A student will have to perform at least **ten** experiments per semester and **two** experiments (from different fields) at the time of university practical examination in 6 hours.
2. The distribution of practical/laboratory work of 30 marks is-

Two experiments (9 Marks each)	- 18 Marks
Record book	- 06 Marks
Viva Voce	- 06 Marks
Total	30 Marks

List of the experiments-

1. Range and least count of Instruments, measurements using various instruments and error analysis (vernier caliper, screw gauge, traveling microscope, spectrometer etc.)
2. Young's modulus by cantilever.
3. Young's modulus by bending of beam.
4. Young's modulus by vibrational method.
5. Modulus of rigidity by Torsional pendulum.
6. Modulus of rigidity by Maxwell's needle.
7. Determination of η by statical method.
8. To determine Coefficient of Viscosity of water by Poiseulle's method.
9. Surface tension of a liquid by Quincke's method.
10. Surface tension of a liquid by Jagers method.
11. Surface tension of a liquid by Capillary rise method.
12. To determine the moment of inertia of a body using torsion pendulum.
13. To determine the moment of inertia of a fly-wheel.
14. Measurement of Inductance by phasor diagram method.
15. Measurement of Capacitance by phasor diagram method.
16. To study charging and discharging of a condenser through a resistor R.
17. To study growth/decay of current in LR circuit.
18. Study of growth of current in CR Circuit using microammeter.
19. Frequency of A.C. Mains by sonometer.
20. Study of frequency response of series LCR circuit and determination of Q- factor.
21. Study of Transformer (parameters determination).
22. Verification of Kirchhoff's law, using electrical network.
23. To calculate low resistance by potentiometer.

24. Calibration of an ammeter by potentiometer.
25. Determination of dielectric constant of a solid.

B. Sc. First Year (Semester II)

Course – PHYSICS - Paper-I (201)

(Oscillations, Kinetic theory of gases and Thermodynamics)

Marks- 50 **Time- 30 hours**

Unit I:

Free oscillations- Introduction to linear and angular S.H.M., Differential equation of S.H.M. and its solution, Composition of two perpendicular linear S.H.M.s for 1:1 and 1:2 (analytical method), Lissajous's figure.

Damped oscillations- Differential equation of damped harmonic oscillator and its solution, Energy equation of damped oscillations, Power dissipation and quality factor.

Unit II:

Forced oscillations- Forced oscillation with one degree of freedom, Differential equation of forced oscillation and its solution, Resonance (Amplitude), Sharpness of resonance, Power dissipation, Quality factor and bandwidth.

Kinetic theory of gases -Assumptions, Boyle's law, Equipartition of energy, Molecular collision, Mean free path and collision cross section, Estimate of molecular diameter and mean free path.

Unit III:

Transport phenomenon in gases- Transport of mass, momentum, energy and their relationship, dependence on temperature and pressure, Van der wall's gas (Real gas, Equation of state), Critical constants. **Thermodynamic** -Thermodynamic variables, Thermal equilibrium and temperature, Zeroth law of thermodynamics, Thermodynamic processes (Reversible and Irreversible), Indicator diagram, First law of thermodynamics, Carnot's cycle and it's efficiency, Carnot's theorem.

Unit IV:

Thermodynamic-Entropy, Second law of thermodynamic, Thermodynamic scales of temperature, Third law of thermodynamics, Maxwell general relationship[$\delta(T,S)/\delta(x, y) = \delta(P,V)/\delta(x, y)$] and it's applications, Joules coefficient, Porous plug experiment, Liquefaction of gases- Boyle's temperature and inversion temperature, Liquefaction of Helium, Air conditioning (Concept only).

References and Text books -

1. Waves and Oscillations, by-Stephenson.
2. A Text Book of Oscillations, waves and Acoustic, by- Dr. M. Ghosh, Dr. D. Bhattacharya.
3. Oscillation, waves and sound, by- Sharma and Saxena.
4. Waves and oscillation, by- N. Subrahmanuam and Brijlal.
5. The Physics of waves and oscillation, by- N. K. Bajaj, Tata McGraw-Hill, publishing co. ltd.
6. Heat, Thermodynamics and Statistical Physics, by- Pragati Prakashan , Singhal, Agrawal.
7. Heat and Thermodynamics, by- Brijlal, Subramanyam.
8. A Text Book of Heat, by- J. B. Rajam.

9. Heat, thermodynamics and statistical physics, by- Brijlal, Subramayam and Hemne.
10. Heat and thermodynamics, by- C. L. Arora.
11. Treatise on heat, by- Shah, Srivastava.

B. Sc. First Year (Semester II)

Course-PHYSICS - Paper-II (202)

(Gravitation, Astrophysics, Magnetism and Magneto statics)

Marks- 50 **Time- 30 hours**

Unit I:

Gravitation- Kepler's laws of Planetary motion (statement only), Newton's law of gravitation, Relation between G and g, Gravitational field, Gravitational potential, Gauss's theorem, Gravitational potential and intensity due to uniform solid sphere at a point inside and outside the sphere, Gravitational self energy of a galaxy.

Unit II:

Astrophysics- The constituents of universe (Solar system, Stars, Galaxies), Introductory study of solar systems, To measure size of a planet ($d=D.\alpha$), To measure distance of a planet by parallax method ($D=b/\theta$), Mass of the sun and the planets($M=4\pi^2r^3/GT^2$), Structure of sun, Solar interior, surface temperature of sun ($T=[R/r]^{1/2}.[S/\sigma]^{1/4}$), Solar luminosity, Stellar spectra, The Milky way (shape, size, clusters), Cosmological theories of the universe (Concept only).

Unit III:

Magnetism- Introduction, Magnetic materials, Langevin's theory of diamagnetism, its application as superconductor, Critical magnetic field and Meissner effect, Langevin's theory of para magnetism, Ferromagnetism, Ferromagnetic domain, Curie temperature, Ferrimagnetisms, Ferrites and its applications, Antiferromagnetism, Neel temperature.

Unit IV:

Magneto statics- Concept of magnetic field, Lorentz force equation, Magnetic dipole moment, angular momentum and gyro magnetic ratio, Biot- Saverts law, It's applications (B due to steady current in a long straight wire, B along the axis of circular coil), Ampere's law, It's applications(B for a solenoid, A Toroid), Magnetization current, Magnetic vectors, Gauss law of magnetization.

References and Text books -

1. Modern's abc of physics, Vol. II, by- Satish K. Gupta. (For Astro Physics, Unit 13).
2. The Great Universe, by- G. K. Sasidharan, S Chand publications.
3. University physics, by- H. D. Young, R. A. Freedman.
4. Astronomy structure of the universe, by- A. E. Roy, D. Clarke, Adam Hilger Pub.
5. Electricity and Magnetism, by- D. C. Tayal
6. Electricity and Magnetism, by- Rakshit, Chottopadhay

7. Electricity and Magnetism, by- S. S. Atwood.
8. Electricity and Magnetism, by- K. K. Tiwari.
9. University physics, by-I. J. C. Upadhayay, Himalaya publications.
10. Foundation of Electrodynamics, by- Theory, Rietz and Millford.

B. Sc. First Year (Semester II)

Course - Physics Practical (203)

1. A student will have to perform at least **ten** experiments per semester and **two** experiments (from different fields) at the time of university practical examination in 6 hours.
2. The distribution of practical/laboratory work of 30 marks is-

Two experiments (9 Marks each) -	18 Marks
Record book	- 06 Marks
Viva Voce	- 06 Marks

Total	30 Marks

List of the experiments-

1. Acceleration due to gravity by compound pendulum.
2. To study damping of a bar pendulum.
3. To study oscillations of a rubber band and to draw potential energy curve for it.
4. To study the oscillation in a bifilar suspension arrangement.
5. To determine acceleration due to gravity by Kater's reversible pendulum.
6. Study of Lissajous's figure
7. To determine the pressure coefficient of air by constant volume air thermometer.
8. To verify the Stefan's law of radiation by using an incandescent lamp.
9. Thermal conductivity of a metal rod using Forbes method.
10. Thermal conductivity of a bad conductor by Lee's disc method.
11. To determine the critical temperature and critical pressure of a gas.
12. To determine the coefficient of thermal conductivity of glass in the form of a tube.
13. To determine specific heat of a given liquid by method of cooling.
14. To find Υ ratio of specific heat of gas by Clamert and Desormi's method.
15. Mechanical equivalent of heat by Calender- Barne's constant flow method.
16. To determine the mechanical equivalent of heat (J) with the help of Joule's calorimeter.
17. To determine temperature coefficient of resistance of platinum using platinum resistance thermometer
18. Study of heating efficiency of electrical kettle with varying voltages.
19. To study the variation of total thermal radiation with temperature using the torch bulb filament.
20. To determine height of a building, altitude of sun and angular diameter of sun with the help of a sextant.
21. To determine the horizontal component of Earth's magnetic field and magnetic moment of the magnet.
22. To study the variation of magnetic field along the axis of a current carrying circular coil.

23. Study of magnetic field by vibration magnetometer.
24. To determine the dipole moment of a given liquid.
25. To determine magnetic susceptibility of $FeCl_3$.

PHYSICS

(B. Sc. Part- II)

Semester III

(Paper-301, 302, 303)

Semester IV

(Paper-401, 402, 403)

(2014-2015)

B. Sc. Second Year (Semester III)

Course-PHYSICS - Paper-I (301)

(Sound waves, Applied acoustic, Ultrasonic and Power supply)

Marks- 50 **Time- 30 hours**

Unit I:

Waves in media- Speed of transverse wave on a string, Group velocity and phase velocity and their relation and measurement, Standing waves, Harmonics, Quality of sound, Human ear and its response (Diagrammatic introduction only), Limit of human audibility, Intensity and loudness, bel and decibel, the musical scale, Temperaments and musical instruments.

Unit II:

Applied acoustic- Transducers and their characteristics (Crystal microphone, Moving coil loud speaker), Recording and reproduction of sound (Magnetic tape, Cine film, Compact disc), Acoustic of building, Reverberation and reverberation period, Sabine's formula, Factors affecting the acoustics of building, Requirements for good acoustics.

Unit III:

Ultrasonic- Introduction, Properties and production of ultrasonic waves, piezoelectric effect, piezoelectric generator, Magnetostriction effect and oscillators, Frequency of ultrasonic waves, Application of ultrasonic waves (measurement of depth of sea, SONAR system and Medical science).

Unit IV:

Power supply-Introduction, rectification using half wave and full wave rectifiers (Find $I_{d.c.}$, $V_{d.c.}$, I_{rms}, η and ripple factor), Working of Full wave bridge rectifier, Filters, Difference between regulated and unregulated power supply, line and load regulation, voltage stabilization, Zener diode as voltage regulator, IC voltage regulation.

References and Text books -

1. A Text Book of sound, by- Khanna , Bedi
2. A Text Book of sound, by- L. P. Sharma, Saxena (S. Chand)
3. Properties of Matter and Acoustics, by- R. Murugeshan, Kiruthign Sivaprakash.
4. Fundamental of Acoustics 4th Edition, by- Kinsler , John Wiley and Sons.
5. Basic Acoustics, by- D. E. Hall, Oxford University Press.
6. A Text Book of Oscillations, Waves and Acoustics, by- Dr. M. Ghosh, Dr. D. Bhattacharya (S. Chand)

7. Oscillation, Waves and Sound, by- Sharma and Saxena.
8. Science and Technology of Ultrasonics, by- Baldevraj, Narosa.
9. Elements of Electronics, by- M. K. Bagde, S. P. Singh, K Singh S- Chand.
10. Solid State Physics and Electronics, by- R. K. Puri, and V. K. Babbar.
11. Solid State Electronic Devices II Edition, by- B. G. Strretman

B. Sc. Second Year (Semester III)

Course-PHYSICS - Paper-II (302)

(Physical optics and Electromagnetic waves)

Marks- 50 **Time- 30 hours**

Unit I:

Interference of light- Introduction, Interference in equal thickness thin film, Phase change on reflection, refraction and transmitted system. Newton's ring and its application to determine the wavelength and refractive index, Michelson Interferometer and its application to wavelength determination and wavelength difference, Fabry- Parrot Interferometer and its application.

Unit II:

Diffraction of light- Introduction, Fresnel's diffraction- Half period zones, Zone plates, Diffraction due to straight edge and due to narrow slit.

Fraunhoffer diffraction- Fraunhoffer diffraction at a single slit, at circular aperture, Plane diffraction grating and its application, Resolving power of grating, Rayleigh's criterion for resolution.

Unit III:

Polarization- Introduction, Brewster's law, Polarization by scattering (concept only), Blue color of the sky(only idea), Uniaxial and biaxial crystal , positive and negative crystal, ordinary and extraordinary rays, Nicol prism, its application as an analyzer and polarizer, Double refraction in uniaxial crystal, phase retardation plate (Half and Quarter wave), Double prism.

Unit IV:

EM Waves- Introduction to EM spectrum related to wavelength, origin and characteristics of EM waves, Physical significance of Maxwell's equations, EM wave equations (in conducting medium and in free space), It's transverse nature, Plane polarized EM wave ($E_0/H_0= \sqrt{\mu}/_{\varepsilon}$), Characteristics impedance of dielectric, Poynting vector, Poynting theorem.

References and Text books -

1. Physics for Degree students for B. Sc. Second year, by- C. L. Arora, Dr. P. S. Hemne.
2. Optics and Spectroscopy, by- R. Murugeshan , Kiruthign Sivaprakash.
3. Optics, by- Brijlal and Subramayam.
4. Optics, by- Ajay Agatak.
5. A text book of optics, by- Dr. Subrahmanyam, Brijlal and M. N. Avadhanulu.
6. Optics, by- J. K. Sharma, K. K. Sarkar.
7. Fundamentals of optics, by-Jenkins and white.

8. Optics, by- D. P. Khandelwal.
9. Electromagnetic field and waves, by- Paul Lorrain and Dale R. Corson.
10. Foundation of Electromagnetic theory, by- John R. Retitz, Fredrick, J. Milford.
11. Electromagnetic, by- B. B. Laud.
12. Electrodynamics, by- Jordon

B. Sc. Second Year (Semester III)

Course - Physics Practical (303)

1. A student will have to perform at least **ten** experiments per semester and **two** experiments (from different fields) at the time of university practical examination in 6 hours.
2. The distribution of practical/laboratory work of 30 marks is-

Two experiments (9 Marks each)	- 18 Marks
Record book	- 06 Marks
Viva Voce	- 06 Marks

Total	30 Marks

List of the experiments-

1. Study the speed of waves on stretched string.
2. Determination of velocity of sound using volume resonator.
3. To determine frequency of A. C. Mains with a Sonometer using single/two magnetic wire.
4. To determine unknown frequency and to verify the law of inverse variation of frequency and volume of air by Helmholtz resonator.
5. To determine the velocity of sound wave in air (gas) with Kundt's tube.
6. To determine the radius of curvature of the lower surface of a plano-convex lens by using Newton's ring apparatus.
7. Study of wavelength of light using Newton's ring.
8. To study the variation of the fine width with color of light.
9. To study the characteristics of micro phone.
10. Study of loudspeaker (woofer, squawker, tweeter) as a transducer.
11. Study of Piezoelectric effect.
12. To Study the current regulation and ripple factor of half wave / full wave rectifier using semiconductor diodes with L and Π type filter.
13. To study the characteristics of zener diode.
14. To study the zener diode voltage regulating characteristics.
15. To study the regulation characteristics of zener regulated and IC 741 regulated power supply.
16. To determine the velocity of ultrasonic waves in a given liquid.
17. To produce interference pattern using Lloyd's mirror and to determine the wavelength of sodium light.
18. To determine the dispersive power of a prism.
19. Study of polarization of light by reflection (Brewster's law).
20. To find R.I. of glass by using Brewster's law.

21. To determine the resolving power of a grating.
22. To study diffraction at straight edge and to determine the wavelength of monochromatic light.
23. To determine the resolving power of a telescope.
24. Study of wavelength of light using plane diffraction grating.
25. To determine the wavelength of prominent lines of mercury by plane transmission grating.

B. Sc. Second Year (Semester IV)

Course-PHYSICS - Paper-I (401)

(Solid state physics, X-ray and Laser)

Marks- 50 **Time- 30 hours**

Unit I:

Solid state physics- Introduction, Crystal structure, periodicity, lattices and basis, fundamental translation vector, unit cell and primitive cell, Miller indices, allowed rotations, lattice types, lattice planes, Bravais lattices, packing fraction, coordination number, Inter-planer distances, Crystal structures-Na Cl, diamond, CsCl, ZnS etc.

Unit II:

X-ray-Introduction, discrete and continuous X-ray spectra, Main feature of continuous X-ray spectra, Characteristics X-ray spectra, Duane-Hunt law, X- ray emission spectra, Moseley law its importance and applications, Auger effect, X-ray absorption spectra, applications of X-rays in various fields.

Unit III:

Solid state physics- Reciprocal lattice, Wigner Seitz cell, Geometrical relation between direct and reciprocal lattice, Laue's theory of X-ray diffraction, Bragg's law and Bragg's diffraction conditions in direct and reciprocal lattice, Laue's pattern, Bragg's spectrometer and its applications (wavelength determination and simple cubic structure determination).

Unit IV:

Laser- Introduction to Laser (purity of spectral line, spatial and temporal coherence), Einstein's relation, absorption, spontaneous and stimulated emission, Population inversion, Optical pumping, characteristics of laser beam, three level and four level laser system, Ruby laser, He-Ne laser, Semiconductor laser, Application of lasers.

References and Text books –

1. Solid State Physics, by- S. U. Pillai.
2. Cryptography Applied to SSP, by- O. N. Shrivastave
3. Solid State Physics, by- Gupta Kumar.
4. Introduction to Solid State Physics, by- C. Kettel.
5. Modern Physics, by- R. Mugadesham
6. Modern Physics, by- J. B. Rajam

7. Modern Physics, by- Kumar , Krishane, Nandeem
8. A Text Book of Modern Physics, by- K. C. Lal, S. T. Ahmad.
9. Modern Physics, by- Aurther Biser.
10. Lasers and Non linear optics. By- B. B. Laud
11. LASERS- Theory and Applications, by- Thyagarajan and A. K. Ghatak
12. Optics and LASER, by- V. K. Sewane
13. Introduction to Lasers, by- Dr. Avadhanulu, Dr. P. S. Hemne.

B. Sc. Second Year (Semester IV)

Course - PHYSICS - Paper-II (402)

(Solid state electronics, and Molecular physics)

Marks- 50 **Time- 30 hours**

Unit I:

Solid state electronics- Light emitting diode, Solar Cell, Photovoltaic cell, **Bipolar transistor**- Construction and working, transistor characteristics in CE and CB Mode, Graphical analysis of CE configuration. Hybrid parameters, Equivalent circuit at low frequency in CE mode, Thermal Runaway, Stabilization, Heat sink, Stability factor, Bias stabilizing circuits.

Unit II:

Field Effect Transistor- Construction, and working principal of JFET, Difference between BJT and JFET, Characteristics of JFET, Parameters , JFET as an amplifier (input and output impedance, voltage gain), Advantage of JFET over BJT. **MOSFET**- Types of MOSFET, Construction and working of MOSFET, Characteristics of MOSFET, Special features of MOSFET.

Unit III:

Molecular physics- Quantization of vibrational and rotational energies, types of molecules based on moment of inertia, rigid diatomic molecules, Intensity distribution in rotational levels, Diatomic molecules as harmonic and anharmonic oscillator, Rotational-vibrational spectra, Born Oppenheimer approximation.

Unit IV:

Raman spectroscopy- Raman effect, Classical and quantum explanation, Experimental set up, Raman spectra and molecular structure, Applications of Raman effect, Electronic spectra, Dissociation energy, Frank-Condon principle, Elementary ideas of NMR and ESR and their applications in spectroscopy.

References and Text books -

1. Elements of Electronics, by- M. K. Bagde, S. P. Singh, K Singh S- Chand.
2. Solid State Electronic Devices II Edition, by- B. G. Strretman
3. Electronics Fundamentals and Applications II Edition, by- J. D. Ryder
4. Principals of Electronics, by- V. K. Mehta, Rohit Mehta.

5. Basic Electronics (Solid State) by- B. C. Theraja.
6. Atomic and Molecular Physics, by- ULP publications, Prof. C. Mande.
7. Elements of Spectroscopy, by- Pragati prakashan, Gupts kumar Sharma.
8. Optics and Spectroscopy, by- R. Murugeshan and Kiruthiga Sivaprakash, S Chand publication.
9. Advanced Molecular Physics, by- Shriram and Sharma.

B. Sc. Second Year (Semester IV)

Course - Physics Practical (403)

1. A student will have to perform at least **ten** experiments per semester and **two** experiments (from different fields) at the time of university practical examination in 6 hours.
2. The distribution of practical/laboratory work of 30 marks is-

Two experiments (9 Marks each)	- 18 Marks
Record book	- 06 Marks
Viva Voce	- 06 Marks

Total	30 Marks

List of the experiments-

1. To determine wavelength of LASER beam using plane diffraction grating or cylindrical obstacle.
2. To study the divergence of a LASER beam.
3. To study LASER as a monochromatic coherent source.
4. Study of total internal reflection using LASER.
5. Measurement of the focal length of a given convex lens using LASER.
6. Goniometric study of crystal faces using models.
7. To construct SC, BCC, FCC and to find packing fraction, coordination number.
8. To determine lattice parameter 'a' of a unit cell of a cubic crystal using X-ray diffraction film.
9. To determine the energy gap of a semiconductor using four probe method.
10. To determine energy gap of a semiconductor using PN junction diode in reverse bias mode.
11. To determine the dielectric constant of a solid and its polarisability by resonance method.
12. Study of IR Spectra of HCl molecule.
13. Identification of unknown element from line emission spectra.
14. To determine the Rydberg constant for Hydrogen.
15. Study of characteristics of LED.
16. To study the characteristics of photo diode and use as light sensor (LDR).
17. Study of Solar cell as a Photo voltaic cell.
18. Study of characteristics of transistor in common base mode.
19. Study of characteristics of transistor in common emitter mode.
20. To study the variation of gain with frequency of single stage common emitter amplifier.

21. To study the frequency response of a single stage transformer coupled transistor amplifier.
22. To study variation of gain of CE amplifier with load at fixed frequency.
23. Study of characteristics of field effect transistor.
24. Study of FET as an amplifier.
25. To determine the Hybrid parameters of a transistor.

PHYSICS

(B. Sc. Part- III)

Semester V

(Paper-501, 502, 503)

Semester VI

(Paper-601, 602, 603)

(2015-2016)

B. Sc. Final Year (Semester V)

Course-PHYSICS - Paper-I (501)

(Atomic physics, free electron theory and Statistical physics)

Marks- 50 **Time- 30 hours**

Unit I:

Atomic physics- Introduction (Revision of Bohr's model, Somerfield and Chadwick), Vector atom model, Stern-Gerlach experiment, Spinning of electron, Space quantization, Selection rules, Quantum numbers, L-S and J-J Coupling, Pauli's exclusion principal, Hunds rule, Zeeman effect, Normal Zeeman effect, Anomalous Zeeman effect, Stark effect.

Unit II:

Free electron theory- Drude Lorentz model, Mean free path, Electrical and thermal conductivity, Wiedemann Franz law (Derivation), Density of states, Fermi energy, Fermi temperature. **Band theory of solids**- Bloch theorem (statement only), Kroning Penny model, Concept of hole, Hall effect, Energy bands in solid, distinction between metal, semiconductor and insulator.

Unit III:

Statistical physics- μ- space, Gamma space, probability distribution, thermodynamic probability, Principle of a priori probability, Boltzmann's entropy relation, accessible and inaccessible estates, macro and micro states, Maxwell- Boltzmann distribution law, its application to molecular speed, distinction between mean, r. m. s. and most probable speed values.

Unit IV:

Statistical physics- Bose-Einstein statistics, its application to black body radiation, Planck's radiation law, Estimation of temperature of sun, Bose- Einstein condensation.Fermi-Dirac distribution and its application to free electrons in a metal, concept of negative temperature, Fermi level and Fermi temperature, comparison between M-B, B-E and F-D statistics.

References and Text books –

1. Atomic and Molecular Physics, by- ULP publications, Prof. C. Mande.
2. Introduction of Atomic Physics, by- White
3. Atomic and Nuclear Physics, by- T. A. Littlefield, N. Thorley
4. Atomic and Nuclear Physics, by- S. N. Ghoshal.
5. Atomic Physics (Modern Physics), by- S. N. Ghoshal.
6. Atomic Physics, by- J. B. Rajam.

7. Solid state physics, by-R. K. Puri, V. K. Babbar, S Chand.
8. Atomic and Nuclear Physics, by- N. Subramanyam, Brijlal.
9. Statistical Mechanics, by- Kamal Singh
10. Quantum Mechanics ,Statistical Mechanics and Solid state physics, by- Chattopadhyay and P. C. Rakshit
11. Heat, Thermodynamics and Statistical Physics, by- Pragati Prakashan , Singhal, Agrawal.
12. Fundamental of Statistical Mechanics, by- B. B. Laud, New Age International publications.

B. Sc. Final Year (Semester V)

Course-PHYSICS - Paper-II (502)

(Quantum mechanics, Nanomaterials and Nanotechnology)

Marks- 50 **Time- 30 hours**

Unit I:

Quantum mechanics- Failure of classical physics to explain black body spectra, Planck's radiation law, Compton Effect, Wave particle duality, de Broglie's hypothesis, Concept of wave and group velocity, Experimental demonstration of matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle and Thought experiment.

Unit II:

Quantum mechanics- Schrodinger's equation (Time dependent and time independent equations), Physical significance of wave function Ψ, Operators, Expectation values of a dynamical quantities, Ehrenfest's theorem, Eigen value and Eigen functions, Particle in a box, Application to free particle in a one and three dimension.

Unit III:

Nanomaterials-Introduction to Nanoscience and Nanotechnology, Difference between nanomaterials and bulk materials, Reduction of dimensions 3D, 2D, 1D, 0D materials, various morphologies of nanomaterials, Bottom up and top down approaches, size dependent physical properties, Nano cluster.

Unit IV:

Nanotechnology- Different methods of synthesis of nanomaterials (Wet chemical, Sol-gel, and HCR Technique), Determination of size of nanoparticles by particle analyzer(BET) and Debye- Scherer's formula, Characterization technique of SEM and TEM , application of nanomaterials in various fields (General).

References and Text books -

1. Quantum Mechanics, Statistical Mechanics and SSP, by- D. Chattopadhay, P. C. Rakshit.
2. Fundamentals of Quantum Mechanics, by- P. R. Waghmare
3. Quantum Mechanics, by- John L. Powel, Bernd Crasemann.
4. Quantum Mechanics, by- Mathews and Venketesan.
5. Quantum Mechanics, by- A. K. Ghatak, S. lokanathan.

6. Quantum Mechanics, by- S. P. Singh, M. K. Bagde and Kamal Singh.
7. Quantum Mechanics, by- Chatwal, Anand, Himalaya publications.
8. Advanced Quantum Mechanics, by- Satya Prakash, Pragati Publications.
9. Introduction to Nano Technology, by- C. P. Poole, Jr. F. J. Owens.
10. Nano Technology, by- T. J. Daming.
11. Nano Structure and Nano Materials, by- M. Balkrishanarao, K. Krishana Reddy.
12. Nano Technology, by- Rakesh Rathi.

B. Sc. Final Year (Semester V)

Course - Physics Practical (503)

1. A student will have to perform at least **ten** experiments per semester and **two** experiments (from different fields) at the time of university practical examination in 6 hours.
2. The distribution of practical/laboratory work of 30 marks is-

Two experiments (9 Marks each)	- 18 Marks
Record book	- 06 Marks
Viva Voce	- 06 Marks

Total	30 Marks

List of the experiments-

1. To study the absorption spectra of iodine vapour and to determine its dissociation energy and force constant.
2. To estimate the temperature of sodium flame by studying the reversal of the spectral lines (D-line).
3. To determine the electric charge of an electron by Millikan's oil drop method.
4. To determine the value of e/m of an electron by Busch's helical beam method.
5. To determine the value of e/m of an electron by Thomson method.
6. To determine electronic charge and work function of the cathode material using photocell.
7. To determine the plank's constant 'h' by vacuum type photocell using DPMS.
8. To determine Planck's constant by photo cell.
9. To determine Planck's constant by solar cell.
10. To determine Hall coefficient and mobility of charge carriers in a semiconductor.
11. To verify the laws of probability distribution throwing one coin, two coins and ten coins.
12. Study of statistical distribution from the given data and to find most probable, average value and RMS value.
13. Study of random decay of nuclear disintegration and determination of decay constant using one colored face dices.
14. To show that deviation of probability of an event from theoretical value decreases with increase in number of events.
15. Determination of average grain size of a particle from X-Ray diffraction spectra using Debye-Scherrer Formula.
16. Study of particle size of nano particles by SEM /TEM method.
17. Determination of size of nano particles by particle analyzer (BET).
18. To determine the transmission coefficient of a transmitting plate using photometer.
19. To determine the electro-chemical equivalent of hydrogen using Hoffman's tube.

20. To measure A. C. / D. C. voltage using a C. R. O. and to calculate it's deflection sensitivity.
21. To determine the unknown frequency /to compare the frequency of two unknown signals using C. R. O.
22. To study and trace different wave forms of oscillator using C. R. O.
23. Measurement of thermo emf.
24. To determine the concentration of sugar solution by half shade polarimeter.
25. Measurement of global and diffuse radiation using pyranometer.

B. Sc. Final Year (Semester VI)

Course-PHYSICS - Paper-I (601)

(Relativity, Nuclear physics and Bio Physics)

Marks- 50 **Time- 30 hours**

Unit I:

Relativity- Frame of reference, Inertial and non inertial frames, Galilean transformation equations, Galilean invariance, Michelson-Morley experiment, Postulates of the special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, , Variation of mass with velocity, Mass energy equivalence.

Unit II:

Nuclear physics- G. M. counter, Wilson cloud chamber, Cyclotron, Linear accelerator, Nuclear reaction, Discovery of neutron, Packing fraction, Mass defect and binding energy, Nuclear fission, Liquid drop model, Chain reaction, Nuclear reactors, Nuclear fusion, Cosmic ray, Elementary particles, Shell model of the nucleus.

Unit III:

Nuclear physics- Alpha decay, Range of α particle, Geiger Nuttal law, Magnetic spectrometer for energy of α particle, Tunneling, Gamow's theory of α decay, β- decay, Measurement of energy of β particle and end point energy, Neutrino theory of β- decay, γ- decay, Energy of γ photon.

Unit IV:

Bio physics-History of bio physics, Bio Potential- compound action Potentials of the human body, Electrocardiogram for heart (ECG), Electroencephalogram for brain (EEG), Electroretinogram for eye retina (ERG), Electromyogram for muscle (EMG) and Sonography (Working mechanism).

Bioinstruments- Basic principle, construction and working of colorimeters, Spectrophotometer, PH-Meter and centrifuge measurement.

Reference and Text books -

01. Nuclear Physics, by- S. N. Ghoshal.
02. Atomic and Nuclear physics, by- N. Subramanyam, Brijlal.
03. Introduction to Nuclear physics, by-H. A. Enge.
04. Atomic and Nuclear physics, by- T. A. Littlefield, N. Thorley.
05. Introduction to special theory of Relativity, by- Shrivastava

06. Elements of special theory of Relativity, by- S. P. Singh and M. K. Bagde.
07. Introduction to theory of Relativity, by- P. G. Bergmann
08. Introduction to Bio Physics, by- P. Narayanan, New Age Publications.
09. Medical Instrumentation, by- Khandpur TMH.
10. Text Book of Bio Physics, by- R. N. Roy
11. Laboratory manuals of Bio Physics Instruments, by- P. B. Vidyasagar.
12. Bio physics, by- Vatsala Piramal, Dominant Publications and Distributions, New Delhi.

B. Sc. Final Year (Semester VI)

Course-PHYSICS - Paper-II (602)

(Electronics, Fiber optics, Communication and Digital electronics)

Marks- 50 **Time- 30 hours**

Unit I:

Amplifiers- Classification of amplifiers, multistage amplifiers, **Operational amplifier**- parameters, Basic idea of IC-741, Application of Op. Amp. as inverting, Non inverting, Adder, Subtractor, Integrator and Differentiator, **Oscillators**- Concept of feedback, Physical consideration of tuned circuits, Phase shift oscillator, Hartley oscillator, Colpitts oscillator.

Unit II:

Fiber optics- Importance of optical fiber, Propagation of light waves in optical fiber, Basic structure, Stepped index monomode fiber, Graded index fiber, Acceptance angle and acceptance cone, Numerical aperture, Fiber losses and their units (basic concept), Electrical and optical band width, bandwidth length product, Dispersion in optical fiber.

Unit III:

Communication- Introduction, amplitude modulation - Frequency spectrum, Modulation factor, over modulation, Percentage modulation, Expression for Power and Currents in AM wave, disadvantages, **Frequency modulation** - Frequency deviation, Carrier swing, Modulation index, Deviation ratio, Expression for FM wave, Frequency spectrum, significant side band terms, FM band width, Merits and demerits.

UNIT IV:

Number Systems- Unitary systems, Binary, decimal, octal, hexadecimal and their interconversions, Binary coded decimal (BCD), Addition and subtraction of binary numbers, 1S, 2S and 10S compliment, basic logic gates, NOR, NAND, Ex-OR, Ex-NOR and their truth table, Half adder, Full adder, Half subtractor and full subtractor, Boolean equations, De Morgan's theorem and its verification.

References and Text books -

1. Op. Amps and Linear Intergated circuits 2nd Edition, by- Ramakant Gaikwad, PHI Publications.
2. Digital and Analog Technique 1st Edition, by- Navneet, Gokhale, Kale, Kitab Mahal Nagpur.
3. Basic Electronics (Solid State), by- B. C. Therja.
4. Optoelectronics and fiber optics communication, by- C. K. Sarkar, D.C. Sarkar.

5. Laser and Optical fiber communication, by- P.Sarah.
6. An introduction to fiber optics, by-R. Allen Shotwell.
7. Optical fiber communication, by-John M. Senior.
8. Communication Electronics, by- A. Kumar
9. Digital Electronics, by- V. K. Jain
10. Digital Principle and Application, by- Malvino and Leach
11. Digital Electronics and It's Application, by- R. P. Jain
12. Digital computer Electronics, II nd Edition, by- Malvino, TMH Edition.

B. Sc. Final Year (Semester VI)

Course - Physics Practical (603)

1. A student will have to perform at least **ten** experiments per semester and **two** experiments (from different fields) at the time of university practical examination in 6 hours.
2. The distribution of practical/laboratory work of 30 marks is-

Two experiments (9 Marks each)	- 18 Marks
Record book	- 06 Marks
Viva Voce	- 06 Marks

Total	30 Marks

List of the experiments-

1. To draw the histogram of theoretical Gaussian curve.
2. Recording and analysis of ECG Signals.
3. Verification of Beer's- Lambert's law.
4. To determine pH value of Amino acids.
5. Measurement of BP and recording of Kortov sound.
6. Measurement of body temperature using GSR and thermister probe.
7. Measurement of skin resistance using GSR.
8. To draw the plateau curve of a given Geiger Mueller counter
9. Study of Op. Amp. as an Inverting and Non Inverting amplifier.
10. Study of Op. Amp. as an Adder and Subtractor.
11. Study of Op. Amp. as an Integrator and differentiator.
12. To construct and study the working of a phase shift oscillator.
13. Study of Hartley Oscillators.
14. Study of Colpitts Oscillators.
15. Study of Amplitude modulation.
16. Study of diode as an AM detector.
17. Study of diode as clipper, clamper and voltage doublers.
18. Study of Frequency modulation using IC.

19. Study of F M detector using IC.
20. Study of basic gates (AND, OR, NOT)
21. Study of logic gates (using IC) and verification of De Morgan's theorem.
22. To study the characteristics of NAND/NOR gate and its use as a universal gate.
23. Verification of laws of Boolean algebra using NAND gate.
24. Study of Ex- OR gate as a half adder and full adder.
25. Study of Ex- OR gate as a half subtractor and full subtractor.

Books for Experimental Physics –

1. B. Sc. practical physics, by- Harnam Singh, DR. P.S. Hemne , S Chand Publications
2. Practical Physics, Volume-I, II by- Gupta and Kumar.
3. Advanced practical physics, Volume I, II by- DR. S. P. Singh.
4. Advanced Viva- Voce in physics, Volume I, II by- Gupta and Narain.
5. Laboratory Physics, Part A and B, by- Berkeley Physics Laboratory.
6. Laboratory Physics (Laser Exp.), by- Berkeley Physics Laboratory.
7. University Practical Physics with Viva Voce, by-C. K. Bhattacharya (C. B. S. Publications, Delhi).
8. A Textbook of Practical Physics, by- Brijlal and Subramanyam.
9. Introduction to Experimentation, by- B. J. Brinkwork (The English University Press Ltd.).
10. Advanced Practical Physics, Vol. I and II, by- M. S. Chauhan, S. P. Sinha.
11. Experimental Physics, by-C. Daish (Hodder and Sons, 1970).
12. Practical Physics for B. Sc., by- A. Dhanalaxmi , A Williams .
13. Experiments in Electronics, by-Paunik S. Jabbar.
14. Digital Electronics Practice, by- Jain, Anand Integrated Circuits, (Tata Mc Graw Hill).
15. A Laboratory Manual of Physics for Undergraduate Classes, by- D. P. Khandelwal (Vani Publishing House, New Delhi).
16. Experiments in Modern Physics, by-Olon.
17. B. Sc. Practical Physics, by-K. Hanumantha Rao, D. P. Siva Ramrah, V. Krishna Murthy.
18. Advanced Practical Physics, by S. S. Sharma (Business Promotion Bureau, Delhi).
19. B. Sc. Practical Physics by- Harnam Singh (S Chand).
20. Advanced Practical Physics, by- S. P. Singh (Pragati Prakashan).
21. Experiments in Electronics, by-S. V. Subramanyam (Macmillan India Ltd.).
22. Experimental Crystal Physics, by-W. A. Wooster, A. Breton.
23. Introduction to Biomedical Electronics, by-Joseph Bovy (Mc Graw Hill).

24. Handbook of Biomedical Instrumentation, by-R. S. Khandpur.
25. Acoustic Measurement, by-L. Beranek.
26. Fundamentals of Acoustics, by-Kinsler, Frey.
27. Solar Cells, by-M. A. Green.
28. Electronic Communication, by- Roddy Coolen.

RASHTRASANT TUKADOJI MAHARAJ, NAGPUR UNIVERSITY, NAGPUR

SYLLABUS FOR B.Sc. ZOOLOGY (SEMESTER PATTERN)

(With effect from the academic year 2013-2014)

The semester pattern syllabus for B.Sc. Three Year Degree Course in the Subject - Zoology comprises of six semesters. Each semester is based on six theory periods and six practical periods per week. The examination of each semester shall comprise of two theory papers each of three hours duration and carries 50 marks each and a practical of 4 hours duration carries 30 marks. Internal assessment for each semester based on two theory papers of 10 marks each and shall be conducted by university approved teachers. Internal assessment marks should be submitted to the university one month prior to the final examination. Candidates are expected to pass separately in theory, internal assessment and practical examination.

The Structure of Syllabus for B.Sc. Zoology (Semester Pattern) along with distribution of marks is also displayed in the following Table

Semester	Semesterwise Theory Papers and Practicals	Marks			Total Marks
		Theory	Internal Assessment*	Practical	
Semester - I	**Theory** **Paper – I** : Life and Diversity of Animals-Nonchordates (Protozoa to Annelida)	50	10		150
	Paper -II : Environment Biology	50	10		
	Practical - I (Based on Paper I & II)			30	
Semester- II	**Theory** **Paper - III** : Life and Diversity of Animals- Nonchordates (Arthropoda to Hemichordata)	50	10		150
	Paper - IV : Cell Biology	50	10		
	Practical - II (Based on Paper III & IV)			30	
Semester- III	**Theory** **Paper - V** : Life and Diversity of Animals-Chordates (Protochordata to Amphibia)	50	10		150
	Paper - VI : Genetics	50	10		
	Practical - III (Based on Paper V & VI)			30	
Semester - IV	**Theory** **Paper - VII** : Life and Diversity of Animals-Chordates (Reptilia, Aves and Mammals)	50	10		150

Contd. on Pg. 2

	Paper - VIII : Molecular Biology and Immunology	50	10		
	Practical - IV (Based on Paper VII & VIII)			30	
Semester - V	**Theory** **Paper - IX** :General Mammalian Physiology I	50	10		150
	Paper - X : Applied Zoology I (Aquaculture and Economic Entomology)	50	10		
	Practical - V (Based on Paper IX & X)			30	
Semester - VI	**Theory** **Paper - XI** : General Mammalian Physiology II	50	10		150
	Paper - XII : Applied Zoology II (Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics)	50	10		
	Practical - VI (Based on Paper XI & XII)			30	
		Grand total			900

*****Internal assessment –

- (For Semester I to IV) Based on students attendance and the performance during Unit test exam. and field work
- (For Semester V & VI) Based on students attendance and the performance during Unit test exam., field work and seminar

Semester - I

Paper – I : Life and Diversity of Animals - Nonchordates (Protozoa to Annelida)

Unit – I **(9 Periods)**

1.1 **Protozoa** : General characters and classification up to classes

1.2 ***Paramoecium*** : Structure and reproduction

1.3 ***Plasmodium*** : Structure and life cycle

1.4 **Parasitic Protozoans of Man :** *Entamoeba, Trypanosoma, Giardia and Leishmania* - Mode of infection and its control

Unit – II **(9 Periods)**

2.1 **Porifera** : General characters and classification up to classes

2.2 ***Sycon*** : Structure, reproduction and development, Canal system in sponges

2.3 **Coelenterata** : General characters and classification up to classes

2.4 ***Obelia*** : Structure and life cycle, corals and coral reef formation

Unit – III **(9 Periods)**

3.1 **Helminthes** : General characters and classification up to classes

3.2 ***Ascaris*** : External morphology, reproductive system and life cycle

3.3 ***Taenia solium*** : Structure and life cycle

3.4 **Elementary idea of parasitic adaptations in helminthes**

Unit – IV **(9 Periods)**

4.1 **Annelida** : General characters and classification up to classes

4.2 **Leech** : Morphology, digestive and urinogenital system

4.3 Trochophore larva and its significance

4.4 Vermiculture and its importance

Semester – I

Paper – II : Environmental Biology

Unit – I **(9 Periods)**

1.1 Atmosphere: Major zones and its importance, composition of air

1.2 Hydrosphere: Global distribution of water, Physico-chemical characteristics of water

1.3 Lithosphere: Types of rocks, formation of soil

1.4 Renewable and non- renewable energy sources

Unit – II **(9 Periods)**

2.1 Ecosystem - Definition and types

2.2 Detailed study of pond ecosystem

2.3 Food chain, food web and ecological pyramids

2.4 Energy flow in an ecosystem, Single channel, Y – shape and Universal model

Unit – III **(9 Periods)**

3.1 Biodiversity and its conservation

3.2 Causes of reduction of biodiversity

3.3 Wildlife conservation acts (1972 and 1984), Introductory study of national parks and sanctuaries – Tadoba, Kanha, Bharatpur and Nagzira

3.4 Hot spots of biodiversity in India

Unit – IV **(9 Periods)**

4.1 Sources, effect and control measures of air pollution, Acid rain, green house effect, ozone depletion and global warming

4.2 Sources, effect and control measures of water pollution

4.3 Sources effect and control measures of noise pollution

4.4 Toxic effect of heavy metals (lead, cadmium and mercury) – Bioaccumulation and biomagnification

Semester – I

PRACTICAL – I (Based on Paper – I and II)

Section A : Life and Diversity of Animals – Nonchordates (Protozoa to Annelida)

& Section B : Environmental Biology

Section A : Life and Diversity of Animals – Nonchordates (Protozoa to Annelida)

1. Study of museum specimens (Classification of animals up to orders)

I. Protozoa (Slides) : *Paramoecium ,Euglena,* Amoeba*, Plasmodium vivax*
II. Porifera: *Sycon, Leucosolenia, Hyalonema, Euplectella, Spongilla*
III. Coelenterata : *Obelia, Aurelia, Tubipora, Fungia, Adamsia*
IV. Platyhelminthes : *Planaria, Fasciola, Taenia*
V. Aschelminthes : *Ascaris, Drancunculus, Ancylostoma, Wuchereria*
VI. Annelida : *Aphrodite, Nereis, Chaetopteurs, Tubifix, Hirudinaria*

2. Study of permanent slides

Enatmoeba, Giardia, Sponge gemmules, Sponge spicules,V.S. *Sycon*, T.S. *Sycon, Obelia* medusa, Miracidium, Redia and Cercaria larvae of *Fasciola*,T.S. male and female *Ascaris,* Scolex of *Taenia,* Mature and gravid proglottids of *Taenia solium,* T.S. of Leech through crop pockets, Trochophore larva

3. Dissection

Digestive, nervous and reproductive system of Earthworm

4. Mounting

Spicules and gemmules of Sponge, *Obelia* colony, *Nereis* parapodia, Jaws of Leech, Nephridia of Leech.

Section B: Environmental Biology

1. Estimation of dissolved oxygen of water
2. Estimation of free CO_2 of water
3. Estimation of pH of water sample
4. Estimation of total hardness of water
5. Study of pond ecosystem - Producers, consumers and decomposers
6. Quantitative analysis of plankton

Visit to a National park and Sanctuary

Distribution of Marks – Total Marks 30

i.	Identification and Comment on Spots (4 Museum specimens + 1 Env. bio. spot + 3 slides)	08
ii.	Dissection -	08
iii.	Environmental biology experiment	04
iv.	Permanent stained preparation	03
v.	Submission of certified practical record	03
vi.	Submission of Slides & tour diary	02
vii.	Viva voce	02

Semester – II

Paper – III : Life and Diversity of Animals – Nonchordates

(Arthropoda to Hemichordata)

Unit – I **(9 Periods)**

1.1. **Arthropoda** : General characters and classification up to classes

1.2. **Cockroach** : Mouth parts, digestive system and reproductive system

1.3. **Insects as Vectors** : Mosquito, Housefly, Sandfly, Tse-Tse fly

1.4. **Study of crustacean larvae** : Nauplius, Zoea and Megalopa; Social behavior in honey bees

Unit – II **(9 Periods)**

2.1 **Mollusca** : General characters and classification up to classes

2.2 ***Pila*** : Morphology, digestive, respiratory and reproductive system

2.3 **Pearl formation in Mollusca**

2.4 **Molluscan larvae :** Glochidium and Veliger

Unit – III **(9 Periods)**

3.1 **Echinodermata** : General characters and classification up to classes

3.2 ***Asterias*** : External features and digestive system

3.3 Water vascular system and locomotion in Starfish

3.4 **Echinoderm larvae** : Bipinnaria and Auricularia

Unit – IV **(9 Periods)**

4.1 **Hemichordata** : General characters and phylogeny

4.2 ***Balanoglossus*** : External features and digestive system

4.3 Reproduction in *Balanoglossus* , Tornaria larva

4.4 Affinities of *Balanoglossus*

Semester – II

Paper – IV: Cell Biology

Unit – I **(9 Periods)**

1.1 Ultrastructure of prokaryotic and eukaryotic cell

1.2 Plasma membrane: Structure- Fluid Mosaic Model and functions

1.3 Endoplasmic reticulum: Types, ultrastructure and functions

1.4 Golgi complex: Ultrastructure and functions

Unit – II **(9 Periods)**

2.1 Ultrastructure of mitochondria

2.2 Oxidative phosphorylation – Glycolysis and Kreb's cycle

2.3 Electron Transport Chain and terminal oxidation

2.4 Lysosome: Structure, polymorphism and functions

Unit – III **(9 Periods)**

3.1 Nucleus: Ultrastructure of nuclear membrane

3.2 Structure and functions of nucleolus

3.3 Chromosome: Structure and types, structure of nucleosome

3.4 Giant chromosomes: Lamp-brush and polytene chromosome

Unit - IV **(9 Periods)**

4.1 Ribosome: Structure, types, Lake's model and functions

4.2 Somatic cell division: Cell cycle and Mitosis

4.3 Meiosis (different phases and significance), synaptonemal complex

4.4 Cellular ageing and cell death, Elementary idea of cancer and its causative agents

Semester – II

PRACTICAL – II (Based on Paper – III and IV)

Section A : Life and Diversity of Animals – Nonchordates (Arthropoda to Hemichordata) & Section B: Cell Biology

Section – A : Life and Diversity of Animals – Nonchordates (Arthropoda to Hemichordata)

1. **Study of museum specimens** (Classification of animals up to orders)
   - I. Arthropoda : *Peripatus, Cyclops, Daphnia, Lepas, Sacculina, Limulus,* Crab, *Scolopendra, Julus,* Dragonfly, Grasshopper, Moth
   - II. Mollusca : *Chiton, Dentalium, Aplysia, Pila, Mytilus, Loligo, Sepia, Octopus*
   - III. Echinodermata : *Asterias, Ophiothrix, Holothuria, Antedon, Echinus*
   - IV. Hemichordata : *Balanoglossus, Saccoglossus*
2. **Study of permanent slides**-

   Nauplius, Zoea and Megalopa larva of Arthopoda, Veliger and Glochidium larva of Mollusca, T.S. of arm of star fish, Bipinnaria and Auricularia larva, T.S. *Balanoglossus* through collar and proboscis, Tornaria larva
3. **Dissection -**
   - I. Digestive system of Cockroach
   - II. Reproductive system of Cockroach
   - III. Nervous system of *Pila*
4. **Mounting-**

   Crustacean larvae and plankton**;** Mouth parts, trachea and salivary gland of Cockroach; Gill lamella, osphradium and radulla of *Pila*

Section B: Cell Biology

1. Study of pictures of ultra structure of prokaryotic cell & eukaryotic cell
2. Study of osmosis in human RBCs (hypotonic, hypertonic and isotonic medium)
3. Demonstration of mitotic cell division in onion root tips by squash method
4. Demonstration of meiosis in *Tradescantia* bud/ Grasshopper testis by squash method
5. Demonstration of salivary gland chromosome in Chironomous larva
6. Demonstration of mitochondria in buccal epithelium/ lip mucosa by Janus Green-B method
7. Use of ocular micrometer and measurement of micro objects
8. Demonstration of Barr body in blood smear

Distribution of Marks – Total Marks 30

i.	Identification and Comment on Spots (5 Museum specimens + 3 slides)	08
ii.	Dissection -	08
iii.	Cell biology experiment	04
iv.	Permanent stained preparation	03
v.	Submission of certified practical record	03
vi.	Submission of Slides	02
vii.	Viva voce	02

List of Recommended Books : (For Semester – I & II)

Life and Diversity of Animals – Non Chordates

1. Barnes **– Invertebrate Zoology (Halt-Saunders international)** Philadelphia, USA
2. Barradaile L.A. & Potts F.A. – **The Invertebrate**
3. Nigam **– Biology of Nonchordates**
4. Kotpal, Agrawal & Khetrapal **– Modern Text Book of Zoology - Invertebrates,** Rastogi Publication, Meerut
5. Puranik P.G. & Thakur R.S. **– Invertebrate Zoology**
6. Majupuria T.C. **– Invertebrate Zoology**
7. Dhami & Dhami **– Invertebrate Zoology**
8. Parker & Hashwell, **Textbook of Zoology Vol. I (Invertebrates)** A.Z.T.B.S. Publishers & Distributors, New Delhi
9. Dr. S.S. Lal **Practical Zoology Invertebrates 9th edition,** Rastogi Publication Meerut
10. EJW Barrington– **Invertebrate Structure and Function** ELBS III Edition

11. R.L. Kotpal **– Phylum Protozoa to Echinodermata (series),** Rastogi and Publication, Meerut
12. Parker J. and Haswell W. – **Text Book of Zoology**, ELBS Edition
13. Vidyarthi – **Text Book of Zoology**, Agrasia Publishers, Agra
14. Jordan E.L. and Verma P.S. – **Chordate Zoology**, S. Chand and Co., New Delhi
15. Ayer E. – **Manual of Zoology**
16. M.D. Bhatia – **The Indian Zoological Memories – Leech**
17. Beni Prasad – **The Indian Zoological Memories – Pila**
18. P. K. Gupta – **Vermicomposting for Sustainable Agriculture**, Agrobios India Ltd
19. A manual of Practical Zoology Invertebrates – P. S. Verma

Environmental Biology

1. Ashthana D.K. **– Environmental Problem & Solution**
2. Agrawal K.C. **– Environmental Biology**
3. Agrawal K.C. - **Biodiversity**
4. Mukharjee **– Environmental Biology**
5. S. Arora **– Fundamentals of Environmental Biology**
6. Sharma **– Ecology & Environmental Biology**
7. Verma P.S. & Agrawal V.K. **– Environmental Biology, S. Chand.**
8. Trivedi & Rao **– Air Pollution**
9. Chapman & Reiss – **Ecology-Principles and Applications**, Cambridge
10. Chatterjee B – **Environmental Laws-Implementation and Problems**
11. Sharma P.D. – **Environmental Biology**, Rastogi Publication, Meerut
12. Trivedi R.K. – **Hand Book of Environmental Laws, Rules, Guidelines, Compliances and Standards, Enviromedia**
13. Odum E.P. and Barret – **Fundamentals of Ecology**, Thomson
14. Smith R.L. – **Ecology and Field Biology**, Harper Collins
15. D.N. Saxena **– Environmental Biology**, Studium Press (India)
16. Davis – **Behavioral Ecology**
17. Kumar and Asija – **Biodiversity – Principle of Conservation**
18. Rao and Rao – **Air Pollution**
19. S. Satyanarayan, S. B. Zade, S.R. Sitre and P.U. Meshram – **A Text Book of Environmental Studies**, Allied publisher (India)
20. Smitz – **Introduction to Water Pollution**
21. N.S. Subrahmnyam A V.S.S. Sambamurthy **– Ecology**

Cell Biology

1. C.B. Powar, **Cell Biology** – Himalaya Publication, New Delhi
2. Dr. S.P. Singh, Dr. B.S. Tomar – **Cell Biology** 9th revised edition, Rastogi Publication, Meerut
3. Gupta P.K. – **Cell and Molecular Biology**, Rastogi Publication, Meerut

4. Veer Bala Rastogi – **Introduction to Cell Biology**, Rastogi Publication, Meerut
5. Gerald Karp – **Cell and Molecular Biology-Concepts and Experiments**, John Wiley, 2007
6. De-Robertis – **Cell Biology**
7. Verma and Agrawal **– Concepts of Cell Biology**
8. Dowben **– Cell Biology**
9. Witt **– Biology of Cell**
10. Ambrose and Eastyr – **Cell Biology**

Semester – III

Paper – V : Life and Diversity of Animals - Chordates

(Protochordata to Amphibia)

Unit – I **(9 Periods)**

1.1 **Protochordata** : General characters and classification up to order

1.2 ***Herdmania*** : Structure, digestive system, ascidian tadpole and retrogressive metamorphosis

1.3 ***Amphioxus*** : Structure, digestive system, circulatory system, sense organs and protonephridia

1.4 **Agnatha** : General characters of Cyclostomata (*Petromyzon* and *Myxine*)

Unit – II **(9 Periods)**

2.1 **Pisces** : Salient features of Chondrichthyes and Osteichthyes, Origin of paired fins in fishes

2.2 Migration and Accessory respiratory organs in fishes

2.3 **Amphibia** : General characters and classification up to order

2.4 Parental care and Neotony in Amphibia

Unit – III **(9 Periods)**

3.1 Gametogenesis and type of eggs

3.2 Fertilization of egg

3.3 Post fertilization development of fish

3.4 Types of scales of fishes, Development of placoid scales

Unit – IV **(9 Periods)**

4.1 Frog Embryology - Cleavage , blastulation and gastrulation

4.2 Fate map, Morphogenetic movements in gastrula of frog

4.3 Development of respiratory organs in frog

4.4 Development of Aortic arches of frog

Semester – III

Paper – VI : Genetics

Unit – I **(9 Periods)**

1.1 Mendelian Principles- Dominant recessive relationships, Mendelian laws

1.2 Interaction of genes- Epistasis - dominant and recessive, codominance, incomplete dominance

1.3 Quantitative genetics – Polygenic traits, inbreeding and outbreeding, hybrid vigor

1.4 Extracellular genome – Presence and functions of mitochondrial DNA, plasmids

Unit – II **(9 Periods)**

2.1 Cytoplasmic inheritance- *Kappa* particles in *Paramecium*, CO_2 sensitivity in *Drosophila*, milk factor in mice

2.2 Linkage and crossing over – Basic concepts of linkage, types and theories

2.3 Concepts of genes – Cistron , muton and recon

2.4 Genetic disorders in human beings – Haemoglobin disorders – Thalassemia and Sickle cell anemia. Metabolic disorder: Phenylketonurea

Unit – III **(9 Periods)**

3.1 Sex determination – ZZ, XY, XO, ZW pattern, Sex determination in *Drosiphila* – Genic balance theory, Environmental sex determination in *Bonellia*

3.2 Chromosomal aberrations: addition, deletion, duplication and inversion

3.3 Gene mutations- Spontaneous and induced mutations, mutagenic agents

3.4 Disorders related to chromosomal number- Turner syndrome, Klinefelter syndrome and Down syndrome

Unit – IV **(9 Periods)**

4.1 Lethal genes – Concepts and consequences

4.2 Population genetics: Basic concepts in population genetics, Hardy Weinberg equilibrium and its significance

4.3 Genetic counseling – Introduction , purpose, hereditary diseases and disorders

4.4 Applied genetics - DNA fingerprinting , amniocentesis, sperm banks, karyotyping

Semester – III

PRACTICAL – III (Based on Paper – V and VI)

Section A : Life and Diversity of Animals – Chordates (Protochordata to Amphibia)
& Section B : Genetics

Section A : Life and Diversity of Animals – Chordates (Protochordata to Amphibia)

1. **Identification, classification , distinguishing characters and adaptive features of**
   - I. **Urochordata** : *Herdmania, Salpa, Doliolum*
   - II. **Cephalochordata** : *Amphioxus*
   - III. **Cyclostomata** : *Petromyzon, Myxine*
   - IV. **Pisces** *: Pristis, Torpedo, Notopterus, Exocoetus, Clarius, Ophiocephalus, Catla, Rohu, Mrigal*
   - V. **Amphibia** : *Ichthyophis ,Bufo, Salamander*
2. **Dissection of the locally available culturable fish-**
   - i. Digestive system
   - ii. Reproductive system
   - iii. Brain

3. **Developmental Biology** –
   Study of permanent slides of Frog embryology: T.S. Blastula, T.S. Gastrula, T.S. Neurula, T.S. tadpole passing through internal and external gill stage

4. **Study of permanent slides-**
   Amphioxus through Pharynx, Intestine, Gonad and Caudal region; V.S. skin, T.S. Testis, T.S. Ovary of Frog; T.S. Stomach, T.S. Intestine, T.S. Liver of fish

5. **Permanent stained preparation:**
   Fish scales – Placoid, cycloid, ctenoid; Hyaline cartilage and striated muscle

Section B : Genetics –

1. Study of monohybrid and dihybrid ratio
2. Study of normal human karyotype (Normal male and female)
3. Study of characters and karyotypes of Syndrome like Down, Klinefelter & Turner
4. Study of the genetic traits (Hardy Weinberg law) in human being (Tongue rolling, ear lobe, PTC taster/ non taster)

Distribution of Marks – **Total Marks 30**

i.	Dissection	06
ii.	Identification and comment on spots (4 Museum specimens, 4 slides – 2 from frog embryology and 2 from histology)	08
iii.	Genetics experiment	03
iv.	Genetics study – Karyotypes , syndromes, genetic traits in man	03
v.	Permanent stained preparation	03
vi.	Submission of certified practical record	03
vii.	Submission of slides	02
viii.	Viva voce	02

Semester – IV
Paper - VII : Life and Diversity of Animals – Chordates (Reptilia, Aves and Mammals)

Unit – I **(9 Periods)**

1.1 **Reptilia**- Classification based on temporal vacuities

1.2 Poison apparatus, biting mechanism , snake venom and its importance

1.3 **Aves** – Comparison of Ratitae and Caranitae, Flight adaptations and migration

1.4 **Mammals** – General characters of Prototheria, Metatheria and Eutheria

Unit –II **(9 Periods)**

2.1 Modern theories of evolution : Darwinism and Neo-Darwinism

2.2 Adaptations – Cursorial, Aquatic, Terrestrial, Fossorial and Volant

2.3 Introduction to genetic basis of evolution – Species Deme, Variation

2.4 Races in Man (Caucasoid, Negroid, Mongoloid and Australoid)

Unit –III **(9 Periods)**

3.1 Comparative account of aortic arches and heart in Reptiles, Birds and Mammals

3.2 Structure of hen's egg

3.3 Development of chick up to premitive streak stage

3.4 Development of extra embryonic membranes in chick and functions

Unit –IV **(9 Periods)**

4.1 Blastocyst and implantation in Mammals; Types of placenta on the basis of morphological and histological structure; functions of placenta

4.2 Stem cells : Sources, types and their use in human welfare

4.3 Biological clock : Diurnal and rhythmic behavior in birds and mammals

4.4 Role of pheromones in reproductive behavior

Semester – IV

Paper - VIII : Molecular Biology and Immunology

Unit - I **(9 Periods)**

1.1 DNA: Structure of DNA, forms of DNA, properties of DNA, DNA as a genetic material

1.2 RNA: Structure of RNA, types of RNA, RNA as a genetic material

1.3 Prokaryotic and eukaryotic gene structure

1.4 **Recombination in Bacteria**: Bacterial transformation – Griffith's experiment, Conjugation in bacteria, transduction

Unit - II **(9 Periods)**

2.1 **DNA replication**: Semiconservative model, Meselson Stahl experiments. Process of replication – origin of replication, concept of replication, directionality of replication

2.2 **Genetic code**: Characteristics of genetic code, Wobble hypothesis

2.3 **Protein synthesis**: Transcription mechanism – Initiation , elongation and termination of transcription. Translation – activation of amino acids, transfer of activated amino acids to tRNA, Initiation, elongation and termination of polypeptide chain; inhibitors of protein synthesis

2.4 **Gene regulation models** - Lac operon and tryptophan operon

Unit - III **(9 Periods)**

3.1 **Concepts of immunity –** Innate and acquired immunity, organs of the immune system

3.2 **Antigen -** Structure, diversity, functions and types of antigen

3.3 **Antibody**- Structure, types and functions

3.4 **Antigen-antibody interaction** – Precipitation and agglutination

Unit - IV **(9 Periods)**

4.1 **Types of immune response**: B cell response (antibody mediated), T cell response (cell mediated)

4.2 **Complement system:** Basic concepts of complement cascades, classical, alternative and MBL pathways, implications of complement system in immune defense

4.3 **Cytokines**- General account on cytokines, Cytokine related diseases

4.4 **Autoimmunity and immunodeficiencies**- Autoimmune diseases and their treatment, AIDS and other immunodeficiencies

Semester – IV

PRACTICAL – IV (Based on Paper – VII and VIII)

Section A : Life and Diversity of Animals – Chordates

(Reptilia, Aves and Mammals) & Section B: (Molecular Biology and Immunology)

Section A : Life and Diversity of Animals – Chordates (Reptilia, Aves, Mammals, Embryology)

1. **Identification, classification , distinguishing characters and adaptive features of –**
   - i. **Reptilia** : *Chameleon, Varanus, Pharynosoma, Draco, Tortoise*, Cobra, Krait, Russel's viper, Sea snake
   - ii. **Birds** : Owl, Woodpecker, Kingfisher, Kite, Duck, Parrot
   - iii. **Mammals** : Squirrel, Mongoose, Bat, Loris, Rabbit
2. **Study of skeleton of Rabbit and Fowl**
3. **Developmental Biology** –

Study of permanent slides of chick embryology W.M.: 18 hrs, 24 hrs, 30 hrs, 36 hrs, 72hrs

4. **Study of permanent slides-** V.S. skin of Bird, Filoplume of bird, V.S. Skin of Mammal

Section B: Molecular Biology and Immunology

Molecular Biology :

1. Staining of DNA and RNA in blood smear of fish/human by methyl green pyronin technique
2. Introduction to basic laboratory instruments and equipments- Autoclave, Centrifuge, pH meter, Micropipettes, Digital balance, Homogenizer, Electrophoresis apparatus; Molar and normal solutions calculations
3. Isolation of DNA (Genomic DNA from any available source) by phenol extraction method

Immunology :

1. Determination of blood groups (ABO and Rh) in humans
2. Antigen – Antibody interaction by double diffusion method (Ouchterlony)
3. Study of histological slides of organs of immune system – Thymus, Lymph nodes and Spleen

Distribution of Marks – **Total Marks 30**

i.	Identification and comment on spots- (3 Museum specimens, 5 slides – 2 from chick embryology; from histology and 1 from immunology, 2 bones)	10
ii.	Molecular biology experiment	08
iii.	Immunology experiment	07
iv.	Submission of certified practical record	03
v.	Viva voce	02

List of Recommended Books: (For Semester - III and IV)

Life and Diversity of Animals -Chordates

1. T. B. of Zoology vol II – Parker & Haswell
2. T. B. of Vertebrate Zoology -S. N. Prasad
3. Chordate Zoology –E. L. Jorden and P. S. Verma
4. Vertebrate Zoology – Vishwanath
5. Zoology of Chordates – Nigam H. C.
6. Phylum: Chordata – Newman H.H.
7. Biology of Vertebrates –Walter & Sayles
8. The Vertebrate Body – Romer A. S.
9. Comparative Anatomy of the Vertebrates – Kingslay J. D.
10. The Biology of Amphibia – Noble G. K.
11. Snakes of India – Gharpura K. G.
12. Life of Mammals – Young J.Z.
13. Vertebrates – Kotpal R. L.
14. Introduction to Chordates – Majupuria T.C.
15. Vertebrate Zoology – Dhami & Dhami
16. T. B. Vertebrate Zoology – Agrawal
17. Protochordates – Chatterjee & Pandey
18. Protochordates – Bhatia
19. T. B. of Chordates – Bhamrah and Juneja
20. Chordate Anatomy – Arora M.P.
21. The Chordates – Alexander.
22. T. B. of Animal Embryology – Puranik
23. T. B. of Chordate Embryology – Dalella & Verma
24. T. B. of Embryology – Sandhu
25. T. B. of Embryology – Armugam

26. Early Embryology of Chick – Pattern
27. Chordate Embryology – Verma & Agrawal
28. Chordate Embryology – Tomar
29. The Frog – Rugh
30. An Introduction to Embryology – Balinsky
31. Comparative Vertebrate Embryology – Mcwen
32. Developmental Biology – S. C. Goel
33. Introduction to Embryology – Berry
34. Organic Evolution – N. Armugam
35. Evolution – M. P. Arora
36. Animal Behavior – Smith and Hill
37. Animal Behavior – Arora
38. Animal Behavior – Gundevia and Singh
39. Practical Zoology Vertebrates – Dr. S. S. Lal, Rastogi Publication, Meerut
40. A manual of Practical Zoology Vertebrates – P. S. Verma

Genetics

1. Genetics & Genetic Engineering – Joshi
2. Genetic Engineering & its applications – Joshi
3. Genetics – Gardener
4. Genetics – Winchester
5. Genetics – Gupta
6. Principles of Genetics – Sinnot Dunn, Dobzansy
7. Genetics –Ahluwalia
8. Genetics – Sarin
9. Elementary Genetics – Singleton
10. General Genetics – SRb, Owen & Edger
11. Genetics –Alenberg
12. Foundation of Genetics – Pai
13. Genetics - Stickberger
14. T. B. of Genetics- Veerbala Rastogi
15. Gene VI by Benjamin Lewis, Oxford press
16. Gene VIII by Benjamin Lewis, Oxford press
17. Genetics Vol. I and II by Pawar C. B., Himalaya publication

Molecular Biology

1. Cell and Molecular Biology by De Robertis- E. D. P., I. S. E. publication
2. Molecular Biology by Turner P. C. and Mc Lennan , Viva Books Pvt. Ltd
3. Advanced Molecular Biology by Twyman R. M., Viva Books Pvt. Ltd
4. Molecular Biology by Freifelder D., narosa publication House

5. Molecular Biology of Gene by Watson J. D. et. al., Benjamin publication
6. Molecular Cell Biology by Darnell J. Scientific American Books USA
7. Molecular Biology of the Cell by Alberts B., Bray D. Lewis J., garland publishing Inc
8. Essentials of Molecular Biology by Freifelder D., narosa publication House
9. Molecular Cell Biology by Laodish H., Berk A., Zipursky S. L., Matsudaira P. Baltimore D. and Darnell J., W. H. Freeman and Co.
10. The Cell: Molecular Approch by Cooper G. M.
11. Molecular Biology by Upadhay A and Upadhay K. Himalaya publication
12. Molecular cell Biology by Bamrach
13. Cell and Molecular Biology by P.K. Gupta

Immunology

1. Immunology – R. C. Kuby et al.
2. Immunology - Tizzard
3. Immunology -. Roitt, Brostoff and D. Male
4. Immunology - Abbas

Semester – V

Paper - IX : General Mammalian Physiology –I

Unit – I : Enzymes (9 Periods)

1.1 Enzymes **–** Distribution and chemical nature of enzymes

1.2 General properties of enzymes

1.3 Classification of enzymes

1.4 Factors affecting enzyme activity

Unit-II : Nutrition and Digestion (9 Periods)

2.1 Structure and functions of digestive glands - (Salivary, Gastric, Intestinal, Liver and Pancreas)

2.2 Gastrointestinal hormones

2.3 Digestion and absorption of proteins, carbohydrates and lipids.

2.4 Vitamins- Fat soluble and water soluble vitamins; Sources, deficiency and diseases

Unit-III :Respiration (9 Periods)

3.1 Respiratory pigments - Types , distribution and properties

3.2 Mechanism of Respiration

3.3 Transport of O_2 and CO_2

3.4 Respiratory disorders and effects of smoking

Unit-IV : Circulation **(9 Periods)**

4.1 Composition and functions of blood

4.2 Blood clotting – Intrinsic and extrinsic factors, blood groups and *Rh* factor

4.3 Cardiac cycle

4.4 E.C.G. and Blood pressure

Semester – V

Paper –X : Applied Zoology-I

(Aquaculture and Economic Entomology)

Unit –I : Aquaculture **(9 Periods)**

1.1 Site selection and construction ,Pre stocking and post stocking manangement of nursery, rearing and stocking ponds

1.2 Breeding of fishes by bund and Chinese hatcheries. Induced breeding by hypophysetion. New generation drugs in induced breeding

1.3 Brief study of freshwater aquaculture system – Polyculture, cage culture, sewage fed fish culture, integrated fish farming

1.4 Fish products and byproducts, Fish preservation

Unit-II **(9 Periods)**

2.1 Prawn culture and Pearl culture

2.2 Fabrication and setting up of aquarium and its maintenance

2.3 Breeding of aquarium fishes – Live bearers and egg layers

2.4 Diseases caused by fungi, bacteria, protozoa and helminthes

Unit-III : Economic Entomology (Methods of pest control) **(9 Periods)**

3.1 Chemical control : Insecticides - Pyrethroids, carbomate and HCN – mode of action, merits and demerits

3.2 Biological control – Biological agents – predators and parasites; merits and demerits

3.3 Crop pest: Life cycle, damage and control of

I. Cotton spotted boll worm -*Earias vitella*

II. Stored grain pest- Rice Weevil, *Sitophilus oryzae*

3.4 Animal pest: Life cycle, damage and control of –

I. House fly – *Musca nebulo*

II. Stable fly – *Stomoxys calcitrans*

Unit-IV : Economic Entomology (Industrial entomology) **(9 Periods)**

4.1 Sericulture- Types of Silkworm. Life cycle and rearing of mulberry silkworm, *Bombyx mori*

4.2 Life cycle and rearing of non mulberry silkworm (Tasar), *Antheraea mylitta* ; Brief idea of coccon processing for silk fabric - coccon boiling, reeling, rereeling, winding, doubling, twisting and weaving

4.3 Apiculture – Types of honey bees. Life cycle, culture, movable frame hive, bee product and its economic importance

4.4 Lac culture – Lac insect, *Laccifer lacca* - Life cycle, Lac processing, Lac products and Economic Importance

Semester – V

PRACTICAL – V (Based on Paper IX and X)

Section A: General Mammalian Physiology - I and Section B : Applied Zoology –I (Aquaculture and Economic Entomology)

Section A: General Mammalian Physiology – I

1. Detection of action of salivary amylase on starch
2. Detection of carbohydrates, proteins and Lipids
3. Detection of Vitamin A and Vitamin C
4. Measurement of lung capacity
5. Preparation Haemin crystal
6. Total count of WBC and RBC
7. **Study of histological slides of Mammal** – T.S. salivary gland, T.S. stomach, T.S. intestine, T.S. pancreas, T.S. liver and T.S. lung

Section B : Applied Zoology –I (Aquaculture and Economic Entomology)

Aquaculture:

1. **Collection and identification of fishes**
   a. Freshwater edible fishes – catla, rohu, mrigal, grass carp, silver carp, *Cyprinous carpio* , *Ophiocephalous, Clariaus, Heteropneustes, Wallago, Mystus,*
   b. Aquarium fishes – Gold fish, Molly, Sword tail, Kissing *Gourami*
2. **Dissection**: a. Digestive, reproductive and brain with pituitary of culturable fishes
   b. Gonosomatic index
3. **Fabrication and setting up of aquarium**
4. **Mounting**: Scales of fishes, zooplankton

Economic Entomology:

1. **Study of Insect Pest**
    a. Agriculture pest – Grasshopper , Red Cotton bug, Gram pod borer, Cotton pink bollworm, Cotton spotted bollworm
    b. Medical pest – House fly, Mosquito , *Pediculus humanus*
    c. Veterinary pest – Stable fly , Dog tick, Bird lice
    d. Stored grain pest – Stored grain weevil, Flour moth
    e. Useful Insects – Honeybee, Silk moth, Lac insect, Dragon fly, Lady bird beetle
2. **Mounting** : Mouth parts, Legs, wings of any insects and sting of Honeybee
3. **Visit** to – Fish farm, Apiculture, Sericulture, Agricultural educational centre, Sea shore and Lake

Distribution of Marks		**Total Marks 30**
i.	Physiology experiment	05
ii.	Identification and comment on spots (2 from Mammalian histology,3 from Aquaculture and 3 from Economic Entomology)	08
iii.	Dissection of fish / Gonosomatic index	05
iv.	Permanent stained preparation	02
v.	Submission ,collection and study tour report	02
vi.	Submission of certified practical record	03
vii.	Viva voce	05

Semester – VI

Paper -XI : General Mammalian Physiology - II

Unit –I : Nerve and Muscle Physiology (9 Periods)

1.1 Types of neurons, E.M. structure of neuron

1.2 Conduction of nerve impulse

1.3 Ultrastructure of striated muscle, Sliding filament theory of muscle contraction

1.4 Properties of muscles (Twitch, Tetanus, Tonus, Summation, All or None Principle, Muscle fatigue)

Unit-II : Excretion **(9 Periods)**

2.1 Structure of uriniferous tubule

2.2 Mechanism of urine formation

2.3 Counter – current mechanism

2.4 Normal and abnormal constituents of urine; Elementary idea of dialysis

Unit-III : Endocrinology **(9 Periods)**

3.1 Structure and functions of pituitary gland

3.2 Structure and functions of thyroid and parathyroid gland

3.3 Structure and functions of adrenal gland

3.4 Structure and functions of pineal gland

Unit-IV : Reproduction **(9 Periods)**

4.1 Oestrous and menstrual cycle

4.2 Male and female sex hormones

4.3 Causes of infertility in male and female

4.4 Contraceptives – Mechanical and hormonal ; *In-vitro* fertilization

Semester - VI

Paper - XII : Applied Zoology –II

(Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics)

Unit –I : Biotechniques **(9 Periods)**

1.1 **Concepts of sterilization**: Filtration, autoclaving, dry heat sterilization, wet sterilization and radiation

1.2 **Separation of biomolecules**: Centrifugation (Sedimentation, density gradient); Chromatography (Elementary idea of thin layer, gel filtration and ion exchange - Principles and applications)

1.3 **Electrophoresis**: Agarose gel electrophoresis, SDS-PAGE

1.4 Principles of colorimeter and spectrophotometers

Unit-II : Microtechnique **(9 Periods)**

2.1 Fixation, dehydration, clearing, embedding & section cutting

2.2 Difficulties encountered during section cutting (causes and remedies)

2.3 Double staining with Haematoxylin and Eosin

2.4 Histochemical staining techniques for carbohydrates (Periodic acid schiff), proteins (Mercury-bromophenol blue) and lipids (Sudan black-B)

Unit-III : Biotechnology (9 Periods)

3.1 Basic concepts in recombinant DNA technology, Gene isolation method- Shotgun cloning

3.2 Isolation of gene- DNA manipulation enzymes: Nucleases, ligases, polymerases

3.3 Basic concepts of cloning vectors and splicing : Insertion of DNA and ligation using blunt ends, cohesive ends, Cloning vectors

3.4 Application of biotechnology: Insulin and vaccine production

Unit-IV : Bioinformatics and Biostatistics (9 Periods)

4.1 Bioinformatics: Definition, Basic concepts in bioinformatics, importance and role of bioinformatics in life sciences

4.2 Bioinformatics databases- introduction, types of databases

4.3 Nucleotide sequence databases, Elementary idea of protein databases

4.4 Biostatistics – Tabulation of data, presentation of data, sampling errors, mean, mode, median, probability, standard error and standard deviation

Semester – VI

PRACTICAL – VI (Based on Paper XI and XII)

(Section A: General Mammalian Physiology – II and Section B: Applied Zoology – II , Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics)

Section A : General Mammalian Physiology – II

1. Detection of urea, albumin, sugar and creatin in urine
2. Sperm count in a given semen sample
3. **Dissection:** Endocrine glands of Culturable fishes
4. **Study of histological slides of Mammal** – T.S. kidney, pituitary, thyroid, adrenal, testis, ovary; uterus, placenta, medulated and non medulated nerve fibre, smooth and striated muscle

Section B : Applied Zoology – II (Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics)

1. Separation of amino acids by paper chromatography
2. Separation of proteins by electrophoresis technique
3. Block preparation and section cutting
4. Double staining method (H-E)
5. Demonstration of carbohydrates, proteins and lipids by histochemical methods
6. Determination of mean, mode, median from a given biostatistical data and/or graphical representation of the data using computers

7. Use of internet for survey of literature using protein and nucleotide databases(NCBI)
8. Use of softwares like Microsoft offices
9. **Visit to Biotechnology centre to study working principles of different instruments**

Distribution of Marks		**Total Marks 30**
I.	Physiology experiment	05
II.	Identification and comments on spots (Mammalian histology 3 spots)	03
III.	Microtechnique - Section cutting, spreading and H-E staining of given slide	03
IV.	Dissection of fish	05
V.	Analysis of given biostatistical data	02
VI.	Retrieval of specific literature from given information	02
VII.	Submission of slides and study tour report	02
VIII.	Submission of certified practical record	03
IX.	Viva voce	05

List of Recommended Books: (For Semester V and VI)

Physiology

1. Human Physiology – Chatterjee A. G. vol. I & II
2. Medical Physiology – Gyton
3. T. B. of Animal Physiology – Berry
4. Introduction to Animal Physiology and Related Biotechnology – H. R. Singh
5. Animal Physilogy – Arora M.P.
6. General and Comparative Physiology – Hoar W. S.
7. T. B. of Animal Physiology – Hurkat and Mathur
8. Animal Physiology – Nahbhushan and kodarkar
9. T. B. of Animal Physiology & General Biology – Thakur & Puranik
10. General Endrocrinology – Turner Bagnaro
11. Reproduction and Human welfare – Greep and koblinsky
12. Animal Physiology – Shashtri & Goel
13. Animal Physiology – Verma & Tyagi
14. Human Physiology - Vander and sheman
15. Applied Physiology – Keels, Neils and Joels
16. Animal Physiology – Rastogi S. C.
17. Animal Physiology – Veerbala Rastogi

18. Comparative Vertebrate Endocrinology – Beutley

Aquaculture

1. Wealth of India, Raw Material, Vol. IV – ICAR
2. Fishes of India vol I & II- Day
3. Fish & Fisheries of India – Jhingran
4. Hatchery Manual for Common Indian & Chinese carps – Jhivgan & Pallin
5. Fish Pathology – Roberts
6. Introduction of Fishes – Khanna
7. Fishery Science & Indian Fishes – Khanna
8. Fishery Science & Indian Fisheries – Shrivastava
9. A Manual of F. W. Aquaculture – Santhanam
10. An Aid to Identification of Commercial Fishes of India & Pakistan- Mishra
11. Standard Methods for Examination of Water & Waste Water - APHA
12. Hand Book of Breeding of Major Carps by Pituitary Hormones – S. L. Chonder
13. Principles of Aquaculture – Zade S. B., Khune C. J., Sitre S.R. and Tijare R.V.

Entomology

1. T. B. of Applied Entomology – K. P. Shrivastava
2. T. B. of Agricultural Entomology - II S Pruthi
3. Modern Entomology – D. B. Tembhare (2nd Edition)
4. A Hand Book of Practical Sericulture – Ullar S. R. & Narsimhanna M.N.
5. Destructive and Useful Insects – Metcalf C.L. & Flint W.P.
6. General Text Book of Entomology – Richards O. W. & Davis R. G.
7. Agricultural Pests of India & South East Asia – Atawal A.S.
8. Hand Book of Economic Entomology for South Asia – Ayyar & Ram Krishna.
9. Medical Entomology – Hati A. K.
10. Bee-Keeping in India – Singh S

Biotechnique and Microtechnique

1. Animal Tissue Technique – Humason
2. Histological Technique – Devaenport
3. Microtechnique – Jiwaji & Patki
4. Microtechnique – Wankhede
5. Biophysical Chemistry – Upadhyay, Upadhyay and Nath
6. Techniques in Life Sciences – D. B. Tembhare

Biotechnology

1. Elements of Biotechnology – Gupta
2. T. B. of Biotechnology – Dubey
3. Modern Concept of Biotechnology – Kumar H. D
4. Advances in Biotechnology – Jogdand

5. T. B. of Biotechnology – Chatwal
6. Molecular Biotechnology – Primrose

Bioinformatics and Biostatistics

1. Mount W. 2004. Bioinformatics and Sequence Genome Analysis 2nd Editon CBS Pub. New Delhi.
2. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+Business Media, 2007.
3. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John-Wiley and Sons Publications, New York.
4. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.
5. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, Structure and Databanks. Oxford University Press.
6. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
7. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills: Shroff Publishersand Distributors Pvt. Ltd. (O'Reilly), Mumbai.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

NOTIFICATION

No. Acad/140.

Date :4th June, 2014

To,

The Principal
of all the affiliated Science Colleges
of Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur

Subject:- Direction No. 4 of 2014.

Sir/Madam,

I am forwarding herewith a copy of the Direction No. 4 of 2014 issued by the Hon'ble Vice-Chancellor under Section 14(8) of Maharashtra Universities Act, 1994 **'Direction governing examination leading to the Degree Of Bachelor of Computer Application (Three Years Degree Course – Semester Pattern)"** and Examination Scheme to be implemented from Academic Session 2014-2015.

You are requested to kindly bring it to the notice of all teachers and students of your college.

Thanking you,

Yours faithfully,

Encl: As above.

Sd/-
(**Dr. A.V. Gomashe**)
Registrar,
Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur.

No. Acad/140 Nagpur dated the 4th June, 2014

Copy for information and necessary action along with the Direction and Scheme as mentioned above to :-

1. The Dean, Faculty of Science, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
2. The Chairman, Board of Studies in Computer Science, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.
3. The Controller of Examinations, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
4. The Director, B.C.U.D., Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
5. The Deputy Registrar (Examinations) Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.
6. The Deputy Registrar (Coll. Sec.) Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
7. The Asstt. Registrar (Prof. Exam.), Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
8. The Asstt. Registrar (Conf.), Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.

9. The Asstt. Registrar (Exams & Enqury.), Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
10. The Asstt. Registrar University's Sub-Centre at Gadchiroli, R.T.M. Nagpur University, Nagpur.
11. The Officer-in-Charge, Publication Section, R.T.M. Nagpur University, Nagpur.
12. The Asstt. Registrar, Ordinance Section, R.T.M. Nagpur University, Nagpur
13. The P. A. to the Hon'ble Vice-Chancellor, R.T.M. Nagpur University, Nagpur
14. The P. A. to the Hon'ble Pro-Vice-Chancellor, R.T.M. Nagpur University, Nagpur
15. The P. A. to the Registar, R.T.M. Nagpur University, Nagpur
16. Mrs. Veena Prakashe, Information Scientist, R.T.M. Nagpur University, Nagpur

Sd/-
(**Puran Meshram**)
Deputy Registrar(Acad.)
Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur.

RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY,
NAGPUR

FACULTY OF SCIENCE

BOARD OF STUDIES IN COMPUTER SCIENCE

SYLLABUS FOR

B.C.A. Three Years (SIX SEMESTER) DEGREE COURSE

(FROM SESSION 2014-15)

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FACULTY OF SCIENCE

DIRECTION NO. 4 OF 2014

DIRECTION GOVERNING THE EXAMINATION LEADING TO THE DEGREE OF BACHELOR OF COMPUTER APPLICATIONS

(THREE YEARS DEGREE COURSE – SEMESTER PATTERN)

(Issued under Section 14(8) of the Maharashtra Universities Act,1994)

Whereas, Maharashtra Universities Act No. XXXV has come into force with effect from 22nd July, 1994 and further amended by Maharashtra Universities (Amendment and Continuance)Act, 2003, hereinafter referred as 'Act' has come into force from 8th August 2003.

AND

Whereas, the University Grants Commission, New Delhi vide letter No.D.O.No.F 1-2/2008/(XI Plan), dated.31 Jan.2008 regarding new initiatives under the XIth Plan – Academic Reforms in the University has suggested for improving quality of higher education and to initiate the Academic Reforms at the earliest.

AND

Whereas, the Board of Studies in all the Science subjects in their meeting held during 28.6.2013 prepared the syllabi and scheme of examination for the B.C.A. degree course and recommended for starting of the semester pattern in Faculty of Science from the academic session 2014-15,

AND

Whereas, the recommendations of various Board of Studies in the faculty of Science regarding Up-gradation and Revision of various syllabi and introduction and implementation of Semester Pattern Examination System at under graduate level was considered by the faculty of Science in its meeting held on 9.7.2013 and constituted a Committee to decide the policy decision regarding semester pattern examination system.

AND

Whereas, the Dean, Faculty of Science has consented to the syllabi and the scheme of examination for the award of B.C.A. degree in Faculty of Science,

AND

Whereas, the faculty of Science in its meeting held on 9.7.2013 vide item No. 35, has considered, accepted and recommended to Academic Council, the policy decision regarding introduction of Semester pattern and the draft syllabi of B.C.A. Semester-I & VI along with draft direction and other details.

AND

Whereas, the new scheme of examination as per semester pattern is to be implemented from the Academic Session 2014-15 for B.C.A. First Year & onwards which is to be regulated by this direction and as such there is no direction issued and in existence and framing of an Ordinance for the above examination is a time consuming process.

AND

Whereas, the admission of students in the semester pattern at B.C.A. First Year are to be made in the Academic Session 2014-15.

Now, therefore, I, Anoop Kumar, Vice Chancellor of Rashtrasant Tukadoji Maharaj Nagpur University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called, **"Examination leading to the Degree of Bachelor of Computer Applications (Three Year Degree Course-Semester Pattern).**

2. This direction shall come into force with effect from the date of its issuance.

3. (i) The following shall be the examination leading to the Degree of Bachelor of Computer Applications in the faculty of Science namely:

a. The B.C.A. Semester-I Examination;

b. The B.C.A. Semester-II Examination;

c. The B.C.A. Semester-III Examination;

d. The B.C.A. Semester-IV Examination;

e. The B.C.A. Semester-V Examination; and

f. The B.C.A. Semester-VI Examination.

(ii) The period of Academic Session shall be such, as may be notified by the University.

4. The theory examination of Semester-I, II, III, IV, V and VI shall be conducted by the University and shall be held separately at the end of each semester at such places and dates as may be decided by the University and shall be held as per the schedule given in Table 1.

Table 1

Sr. No	Name of the Examination	Main Examination	Supplementary Examination
1	Semester I, III and V	Winter	Summer
2	Semester II, IV, and VI	Summer	Winter

5. Subject to compliance with the provisions of this Direction and of other Ordinances in force from time to time, the following persons shall be eligible for admission to the examinations:-

(a) A student who has prosecuted a regular course of study for not less than one academic year prior to that examination;

(b) A teacher in an Educational Institution eligible under the provisions of Ordinance No. 18, and

(c) A women candidate who has not pursued a regular course of study.

Provided that in the case of the persons eligible under clauses (b) and (c), an applicant to the examination shall have attended a full course of laboratory instructions in a College in the subject in which laboratory work is prescribed. The candidate shall submit a Certificate to that effect signed by the Principal of the college.

6. Eligibility of every applicant for admission to B.C.A. Semester course shall:-

A)In case of the B.C.A. Semester I examination:-

The candidate should have passed the 12th Standard Examination of the Maharashtra State Board of Secondary and Higher Secondary Education with English and other Modern Indian Languages together with mathematics or an examination recognized as equivalent thereto in such subjects and with such standards of attainments as may be prescribed.

Provided that students passing the 12th Standard Examination of the Maharashtra State Board of Secondary and Higher Secondary Education and offering Vocational Stream with mathematics shall be eligible for admission to the B.C.A. Semester I course.

B) In case of the B.C.A. Semester II, III, IV, V and VI Examinations:- The student should have attended a minimum of 90 days in the respective semester and passed the previous semester examination as per the rules of ATKT as mentioned in Para 7 of this direction.

7) The ATKT rules for admission for the B.C.A. Course **(Theory and Practical as separate passing head and on calculation fraction, if any, shall be ignored)** shall be as given in the following Table- 2.

Table 2

Admission to Semester	**The student should have attended the Session / term satisfactorily**	**Candidates should have passed at least one half of the passing heads of the following examinations (Theory and Practical as separate passing head and on calculation fraction, if any, shall be ignored)**
1	2	3
B.C.A. Semester I	Semester I and admitted As per para 6 of this Direction	---------
B.C.A. Semester II	Semester II	---------
B.C.A. Semester III	Semester III	One half of the total head prescribed for Sem I and Sem II examination
B.C.A. Semester IV	Semester IV	---------
B.C.A. Semester V	Semester V	a) Passed Sem I & II examination and b) One half of the total head prescribed for Sem III & IV examination
B.C.A. Semester VI	Semester VI	---------

8. a) Without prejudice to the other provisions of Ordinance No. 6 relating to the Examinations in General, the provisions of Paragraph 5, 8, 10 and 31 of the said ordinance shall apply to every candidate.

b)The students admitted to this Degree course shall be governed by the general Ordinances / Directions of the University which are applicable to all the regular or ex-students. These Ordinances includes complete as well as relevant provision of Ordinance No. 1, 2, 6, 7-A, 9, 10, 19, 109, Ordinance No. 30 of 2006, (amended Ordinance No. 4 of 2006), Direction 9 of 2008, Direction 5 of 2004 wherever applicable accordingly AND

Direction / Ordinance of ATKT as well as reassessment / provisional admission as issued from time to time.

9. The fee for each Semester examination shall be as prescribed by the University from time to time.

10. Every examinee for the B.C.A. Semester I & II examination shall be examined in:

i)Compulsory English

ii)Any one of the following Languages

Marathi, Hindi, Urdu, Supplementary English, Gujarati, Bengali, Telugu, Sanskrit, French, German, Russian, Persian, Arabic, Pali and Prakrit or Latin

iii) six papers and three practicals at respective semester.

11. The Scope of the subjects of all semesters of B.C.A. examination shall be as indicated in the respective syllabi in force from time to time. The medium of instruction and examination shall be English, except for the courses in Languages.

12. The maximum marks allotted to each subject and the minimum marks which an examinee must obtain in order to pass the examination shall be as per the Appendix **A** appended to this Direction.

13. The practical examination of all semesters shall be conducted at the end of each semester as indicated in Table 3 given below.

Table 3

S. No	Name of the Examination	Main Examination	Supplementary Examination
1	Semester I, III and V	Winter	Summer
2	Semester II, IV, and VI	Summer	Winter

14. The scheme of awarding internal marks shall be as per Appendix- **B** appended with this Direction.

15. Successful examinees at the B.C.A. Sem-VI Examination who obtained not less than 60% marks (aggregate of Sem-I, II, III, IV, V & VI Examinations taken together, excluding Languages) shall be placed in First Division, those obtaining less than 60% but not less than 45% in Second Division, and all other successful examinees in the Third Division.

Explanation :

Division at the B.C.A. Examination shall be declared on the basis of the marks obtained only in the Subjects other than languages at the Sem-I, II, III, IV, V & VI Examinations taken together.

16. There shall be no classification of successful examinees at the Sem-I to Sem-V Examinations.

17. An examinee successful in the minimum period prescribed for the examination, obtaining not less than 75% of the maximum marks prescribed in the subject shall be declared to have passed the examination with Distinction in that subject.

Explanation :

(1) Distinction shall be awarded only in the Science Subjects.

(2) Distinction at the B.C.A. Examination shall be awarded on the basis of the marks obtained at the B.C.A. Semester - I, II, III, IV, V and Semester VI Examination taken together.

(3) Distinction shall not be awarded to an examinee availing of the provision of the exemptions and compartments at any of the examination.

18. Provisions of Ordinance No 7-A relating to the Condonation of Deficiency of Marks for passing an examination and compartment as amended up-to-date vide ordinance No. 45 of 1983 shall apply to the examinations under this Direction.

19. As soon as possible after the examinations, the Board of Examinations shall publish a list of successful examinees at the B.C.A. Sem-I & II; B.C.A. Sem-III & IV and B.C.A. Sem-V & VI Examinations. Such list at the B.C.A. Semester VI Examination shall be arranged in three Divisions. The names of the examinees passing the examination as a whole in the minimum prescribed period and obtaining the prescribed number of places in First or Second Division shall be arranged in Order of Merit as provided in the Examinations in General Ordinance No. 6. While preparing the Merit list for the B.C.A. Examination the marks secured by the candidate in the compulsory languages at their Semester I & II Examination will be taken into consideration in addition to the marks scored by them in their optional subjects.

20. No Person shall be admitted to B.C.A. Sem-I, II, III, IV, V and VI Examinations, if he/she has already passed the corresponding or an equivalent examination of any other Statutory University.

21. Successful examinees at the B.C.A. Sem I, II, III, IV, and V Examinations shall be entitled to receive a **Certificate** signed by the **Registrar** and successful examinees at the end of B.C.A. Sem VI examination shall, on payment of prescribed fees, receive a Degree in the prescribed format, signed by the Vice-Chancellor.

22. The provisions of direction no. 3 of 2007 for the award of grace marks for passing an examination, securing higher grade in subject(s) as updated from time to time shall apply to the examination under this direction.

23. **Absorption Scheme:**

a) While switching over to semester pattern, the failure students of annual pattern will be given three chances to clear the examination.

b) The candidates who have cleared first year annual pattern examination in the subject shall get admission to third semester directly by matchable scheme. However, candidates who are allowed to keep term will not be eligible for admission to third semester unless they clear all the papers and practicals of first year annual pattern examination.

c) The candidates who have cleared second year annual pattern examination in the subject shall get admission to fifth semester directly by matchable scheme.. However, candidates who are allowed to keep term will not be eligible for admission to fifth semester unless they clear all the papers and practicals of second year annual pattern examination.

d) The unsuccessful students of old course (Yearly pattern) shall be permitted to appear for higher class as per the new course (Semester Pattern) examination of the Bachelor of Computer Applications programme (Semester Pattern) provided that they submit a certificate from the Head of the Department/Principal of the College stating that they have satisfactorily undergone a course of study in all the subjects of the new course.

e) The absorption scheme of the Bachelor of Computer Applications programme (Semester Pattern) will be effective till the introduction of new syllabus with the new absorption scheme.
f) For other Statutory University candidates with similar yearly pattern program point No. 23 ‘a’, ‘b’ and ‘c’ shall be applicable.
g) For other Statutory University candidates with Semester pattern Bachelor of Computer Applications program the Candidates shall be admitted to next higher semester provided that he/she shall have cleared previous semester and a R.T.M. Nagpur University Committee constituted form time to time for the purpose shall scrutinize and clear the case on the basis of subject and syllabus contents of his / her previous semester exam of the other Statutory University.

Sd/-

Nagpur (**Anoop Kumar)**

Date : 16.5.2014 **Vice-Chancellor**

Appendix - B:
Guidelines for Internal Assessment, Theory paper pattern and Practical

1. Each semester shall comprise of minimum 90 teaching days.
2. Each semester will comprise
    a. six theory papers – 50 Marks each
    b. internal assessment for each paper - 10 Marks each.
    c. three practicals –30 marks each
3. In addition to the above, Semester I and II will have
    a. One compulsory English paper of 60 marks with 15 marks internal assessment, Total 75 marks.
    b. One second language paper (Marathi, Hindi, Urdu, Supplementary English, Gujarati, Bengali,Telugu, Sanskrit, French, German, Russian, Persian, Arabic, Pali and Prakrit or Latin) of 60 Marks with 15 marks internal assessment, Total 75 marks.

Internal Assessment:

4. The internal assessment shall be done by the College at least 15 days prior to the final examination of each semester. The Marks shall be sent to the University immediately after the Assessment in the prescribed format.
5. Guidelines for Internal Assessment are appended herewith.

a) The internal assessment marks assigned to each theory paper as mentioned in Appendix - A shall be awarded on the basis of assignments like class test, attendance, project assignments, seminar, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.

b) There shall be one / two assignments (as described above) per Theory paper.

c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the Internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.

d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.

e) At the beginning of each semester, every teacher shall inform his / her students unambiguously the method he / she proposes to adopt and the scheme of marking for internal assessment.

f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / principal.

g) Final submission of internal marks to the University shall be before the commencement of the University Theory examinations.

Theory Papers:

6. All Theory papers shall be divided into four units.
7. The theory question papers shall be of 3 hours duration and comprise of 5 questions with equal weightage to all units.
8. The pattern of question papers is appended herewith.

Each theory paper will be of 50 marks each. All questions are compulsory and will carry equal marks.

Question paper for any theory paper will comprise of five questions of 10 marks each. Question No. 1 to 4 will be will be from four units each with an internal choice. The questions can be asked in the form of long answer type for 10 marks.

Question No. 5 shall be compulsory with three questions / notes of very short answer type from

each of the four units having 1 mark each. The student shall have an option of answering any 10
questions out of the 12 questions.

Practical:

9. Practical exam shall be of 4 hours duration.
10. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department.
11. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.
12. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _
Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Kumari /
Shrimati _ of _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
Semester _ _ _ _ _ _
_ _ _ during the academic year _ _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments
prescribed by Rashtrasant Tukdoji Maharaj Nagpur University for the subject _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee
1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Head of the Department

Appendix-A
Teaching & Examination Scheme
Bachelor of Computer Application (B.C.A.)
Three Year (SIX SEMESTER) DEGREE COURSE
B.C.A. Part I (Semester I)

Sr.No.	Papers	Title of Paper	Teaching Scheme			Examination Scheme								
						Theory					Practical			
			Th+Tu (Periods)	Pr (Periods)	Total periods	Duration Hours	Max Marks Th. Papers	Max. Marks IA	Total	Min Passing Marks	Duration Hours	Max Marks Practical	Min Passing Marks	Total (Th,Pr,AI)
1.	-	English	4+1	-	4+1	3	60	15	75	30	-	-		75
2.	-	Marathi/Hindi/Urdu/Gujarati/ Sanskrit / Suppl. English	3	-	3	3	60	15	75	30	-	-		75
3.	Paper-I	Computer Fundamentals	3	-	3	3	50	10	60	24	-	-	-	60
4.	Paper-II	"C" Programming	3	-	3	3	50	10	60	24	-	-	-	60
5.	Paper-III	Statistical Methods	3	-	3	3	50	10	60	24	-	-	-	60
6.	Paper-IV	Discrete Mathematics – I	3	-	3	3	50	10	60	24	-	-	-	60
7.	Paper-V	Operating Systems	3	-	3	3	50	10	60	24	-	-	-	60
8.	Paper-VI	Office Automation	3	-	3	3	50	10	60	24	-	-	-	60
9.	Pactical-I	Practical I – based on paper I & paper II		6	6	-	-	-	-	-	4	30	12	30
10.	Pactical-II	Practical II – based on paper III & paper IV		6	6	-	-	-	-	-	4	30	12	30
11.	Pactical-III	Practical III – based on paper V & paper VI		6	6	-	-	-	-	-	4	30	12	30

Note:
1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately.

Grand Total of Semester I: 450 + 150 = TOTAL = 600 Marks.

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.
- Details of Course of Languages shall be as per B.Sc. I

Teaching & Examination Scheme

Bachelor of Computer Application (B.C.A.)

Three Year (SIX SEMESTER) DEGREE COURSE

B.C.A. Part I (Semester II)

Sr.No.	Papers	Title of Paper	Teaching Scheme			Examination Scheme								
						Theory					Practical			
			Th+Tu (Periods)	Pr (Periods)	Total periods	Duration Hours	Max Marks Th. Papers	Max. Marks IA	Total	Min Passing Marks	Duration Hours	Max Marks Practical	Min Passing Marks	Total (Th,Pr,AI)
1.	-	English	4+1	-	4+1	3	60	15	75	30	-	-		75
2.	-	Marathi/Hindi/Urdu, Gujarati, Sanskrit / Suppl. English	3	-	3	3	60	15	75	30	-	-		75
3.	Paper-I	Programming In 'C++'	3	-	3	3	50	10	60	24	-	-	-	60
4.	Paper-II	System Analysis And Design	3	-	3	3	50	10	60	24	-	-	-	60
5.	Paper-III	Numerical Methods	3	-	3	3	50	10	60	24	-	-	-	60
6.	Paper-IV	Discrete Mathematics – II	3	-	3	3	50	10	60	24	-	-	-	60
7.	Paper-V	Linux Operating System	3	-	3	3	50	10	60	24	-	-	-	60
8.	Paper-VI	E Commerce	3	-	3	3	50	10	60	24	-	-	-	60
9.	Pactical-I	Practical I – based on paper I & paper II		6	6	-	-	-	-	-	4	30	12	30
10.	Pactical-II	Practical II – based on paper III & paper IV		6	6	-	-	-	-	-	4	30	12	30
11.	Pactical-III	Practical III – based on paper V & paper VI		6	6	-	-	-	-	-	4	30	12	30

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately.

Grand Total of Semester II : 450 + 150 = TOTAL = 600 Marks.

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.
- Details of Course of Languages shall be as per B.Sc. I

Teaching & Examination Scheme

Bachelor of Computer Application (B.C.A.)

Three Year (SIX SEMESTER) DEGREE COURSE

B.C.A. Part II (Semester III)

Sr.No.	Papers	Title of Paper	Teaching Scheme			Examination Scheme								
						Theory					Practical			
			Th+Tu (Periods)	Pr (Periods)	Total periods	Duration Hours	Max Marks Th. Papers	Max. Marks IA	Total	Min Passing Marks	Duration Hours	Max Marks Practical	Min Passing Marks	Total (Th,Pr,AI)
1.	Paper-I	Visual Basic Programming	3	-	3	3	50	10	60	24	-	-	-	60
2.	Paper-II	Data Base Management System	3	-	3	3	50	10	60	24	-	-	-	60
3.	Paper-III	Data Structures	3	-	3	3	50	10	60	24	-	-	-	60
4.	Paper-IV	Operations Research – I	3	-	3	3	50	10	60	24	-	-	-	60
5.	Paper-V	Web Technology - I	3	-	3	3	50	10	60	24	-	-	-	60
6.	Paper-VI	Digital Electronics – I	3	-	3	3	50	10	60	24	-	-	-	60
7.	Pactical-I	Practical I – based on paper I & paper II		6	6	-	-	-	-	-	4	30	12	30
8.	Pactical-II	Practical II – based on paper III & paper IV		6	6	-	-	-	-	-	4	30	12	30
9.	Pactical-III	Practical III – based on paper V & paper VI		6	6	-	-	-	-	-	4	30	12	30

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately.

Grand Total of Semester III: 450

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.

Teaching & Examination Scheme

Bachelor of Computer Application (B.C.A.)

Three Year (SIX SEMESTER) DEGREE COURSE

B.C.A. Part II (Semester IV)

Sr.No.	Papers	Title of Paper	Teaching Scheme			Examination Scheme								
						Theory					Practical			
			Th+Tu (Periods)	Pr (Periods)	Total periods	Duration Hours	Max Marks Th. Papers	Max. Marks IA	Total	Min Passing Marks	Duration Hours	Max Marks Practical	Min Passing Marks	Total (Th,Pr,AI)
1.	Paper-I	Software Engineering-I	3	-	3	3	50	10	60	24	-	-	-	60
2.	Paper-II	Sql And Pl/Sql	3	-	3	3	50	10	60	24	-	-	-	60
3.	Paper-III	Theory Of Computation	3	-	3	3	50	10	60	24	-	-	-	60
4.	Paper-IV	Operations Research - II	3	-	3	3	50	10	60	24	-	-	-	60
5.	Paper-V	Web Technology - II	3	-	3	3	50	10	60	24	-	-	-	60
6.	Paper-VI	Digital Electronics – II	3	-	3	3	50	10	60	24	-	-	-	60
7.	Pactical-I	Practical I – based on paper I & paper II		6	6	-	-	-	-	-	4	30	12	30
8.	Pactical-II	Practical II – based on paper III & paper IV		6	6	-	-	-	-	-	4	30	12	30
9.	Pactical-III	Practical III – based on paper V & paper VI		6	6	-	-	-	-	-	4	30	12	30

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately.

Grand Total of Semester IV: 450

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.

Teaching & Examination Scheme

Bachelor of Computer Application (B.C.A.)

Three Year (SIX SEMESTER) DEGREE COURSE

B.C.A. Final (Semester V)

Sr.No.	Papers	Title of Paper	Teaching Scheme			Examination Scheme								
						Theory					Practical			
			Th+Tu (Periods)	Pr (Periods)	Total periods	Duration Hours	Max Marks Th. Papers	Max. Marks IA	Total	Min Passing Marks	Duration Hours	Max Marks Practical	Min Passing Marks	Total (Th,Pr,AI)
1.	Paper-I	Computer Graphics - I	3	-	3	3	50	10	60	24	-	-	-	60
2.	Paper-II	Compiler Construction	3	-	3	3	50	10	60	24	-	-	-	60
3.	Paper-III	VB.Net	3	-	3	3	50	10	60	24	-	-	-	60
4.	Paper-IV	Software Engineering - II	3	-	3	3	50	10	60	24	-	-	-	60
5.	Paper-V	PHP - I	3	-	3	3	50	10	60	24	-	-	-	60
6.	Paper-VI	Data Communication And Network - I	3	-	3	3	50	10	60	24	-	-	-	60
7.	Pactical-I	Practical I – based on paper I & paper II		6	6	-	-	-	-	-	4	30	12	30
8.	Pactical-II	Practical II – based on paper III & paper IV		6	6	-	-	-	-	-	4	30	12	30
9.	Pactical-III	Practical III – based on paper V & paper VI		6	6	-	-	-	-	-	4	30	12	30

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately.

Grand Total of Semester V: 450

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.

Teaching & Examination Scheme

Bachelor of Computer Application (B.C.A.)

Three Year (SIX SEMESTER) DEGREE COURSE

B.C.A. Final (Semester VI)

Sr.No.	Papers	Title of Paper	Teaching Scheme			Examination Scheme								
						Theory					Practical			
			Th+Tu (Periods)	Pr (Periods)	Total periods	Duration Hours	Max Marks Th. Papers	Max. Marks IA	Total	Min Passing Marks	Duration Hours	Max Marks Practical	Min Passing Marks	Total (Th,Pr,AI)
1.	Paper-I	Computer Graphics - II	3	-	3	3	50	10	60	24	-	-	-	60
2.	Paper-II	Programming In Java	3	-	3	3	50	10	60	24	-	-	-	60
3.	Paper-III	ASP.Net	3	-	3	3	50	10	60	24	-	-	-	60
4.	Paper-IV	Software Testing	3	-	3	3	50	10	60	24	-	-	-	60
5.	Paper-V	PHP - II	3	-	3	3	50	10	60	24	-	-	-	60
6.	Paper-VI	Data Communication And Network - II	3	-	3	3	50	10	60	24	-	-	-	60
7.	Pactical-I	Practical I – based on paper I & paper II		6	6	-	-	-	-	-	4	30	12	30
8.	Pactical-II	Practical II – based on paper III & paper IV		6	6	-	-	-	-	-	4	30	12	30
9.	Pactical-III	Practical III – based on paper V & paper VI		6	6	-	-	-	-	-	4	30	12	30

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately.

Grand Total of Semester VI: 450.

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.

Valuation Pattern for practical examination:-

The valuation scheme of practical examination will be as under.

Record - 6

Viva	- 6
Writing	- 09
Execution	- 09
TOTAL	**- 30**

B.C.A. Part I Semester I (From 2014-2015)

B.C.A. Part I Semester I

Paper I

COMPUTER FUNDAMENTALS

UNIT - I :

Basic Components of Digital Computers: Block Diagram**. CPU:** Functions of Each Unit: Primary Memory, ALU and CU, Instruction format. **Bus**: Data, Control and Address Bus **Number Systems:** Binary, Octal, Decimal, HexaDecimal, Their Conversions, Binary Arithmetic. ASCII, BCD, EBCDIC**.**

Language Evolution : Generation of Languages : Machine, Assembly, High Level Languages. Characteristics of Good Language **Translators :** Compiler, Interpreter and Assembler. Source and Object Program.

UNIT - II :

Memory: Static & dynamic, RAM, ROM, PROM, EPROM, EEPROM, flash and Cache.
Storage Devices: Hard Disk, Zip Disk and Optical Disk. Pen Drive, Blue Ray

UNIT - III :

Input Devices: Keyboard, Mouse, Light Pen, Touch Screen, Voice Input , MICR, OCR, OMR, Barcode Reader and Flatbed Scanner.
Output Devices: VDU, Printers: Dot Matrix, Laser and Inkjet.
Plotters: Drum, Flat-Bed and Inkjet.

UNIT - IV :

Network: Network terminology, Topologies : Linear, Circular, Tree and Mesh. Types of Networks: LAN, WAN, MAN. Repeaters, Bridge, Routers, Brouters and Gateway. Modem for Communication between pc's, wi-fi network, Introduction of Bluetooth and Infrared devices. Network protocols. Architecture **:** Peer-to-Peer, Client/Server.

Reference Books:

1. Information technology concepts by Dr. Madhulika Jain, Shashank & Satish Jain, [BPB Publication, New Delhi.]
2. Fundamentals of Information Technology By Alexis And Mathews Leon
[Leon Press, Chennai & Vikas Publishing House Pvt Ltd, New Delhi]

B.C.A. Part I Semester I

Paper II

'C' PROGRAMMING

UNIT- I :

Programming Structure : Sequence, Selection, Iteration and Modular. **Problem Solving techniques**: Development Tools**:** Algorithm, Flowcharts and Pseudo code (Definition and its characteristics) **Developing Algorithm and Drawing flowcharts**

UNIT- II :

C Character set, Tokens, Identifier, Keywords, Variables**,** Data types, Qualifiers. Operators and Expressions: Arithmetic, Relational, Logical, Bit-Wise, Increment, Decrement, Conditional and Special operators. typedef, Type Conversion, Constants, Declaring Symbolic Constants, Character Strings, Enumerated Data Types, Operator Precedence and Associativity. Library functions. : Maths, string handling Functions. Control Structure: Compound Statement, Selection Statement: if, if-else, Nested if, switch. Iteration statement: for, while, do..while, Nested loops, Jump statement: break, continue, goto. (Special emphasis on problem solving)

UNIT- III :

Arrays: Need, Types: Single and Two Dimensional Array.
Strings: Strings Manipulation, Arrays of Strings, Evaluation order
Function: Function Components, Return Data type, Parameter Passing, Return by Reference, Default Arguments, Recursive Functions, Arrays with Functions, Storage Classes. (Special emphasis on problem Solving)

UNIT- IV:

Structure: Declaration, Definition, Accessing structure members, Initialization, Nesting of Structures.
Union: Unions, Differences between Structure and Union
Pointer: Introduction, Address Operator (&), Pointer variables, Void pointers, Pointer Arithmetic, Pointers to Pointers.
File handling: Hierarchy of File Stream Classes, Opening & closing a file, Testing for errors, File Modes, File pointers and their manipulations, Sequential Access, Random Access, Command Line arguments.

Reference Books:

1. The Art of programming through flowcharts & algorithm by Anil B. Chaudhari Firewall Media, Laxmi publication, New Publication.
2. Programming in C by E. Balagurusamy TMH Publications.
3. C Programming - Kernighen Ritche
4. Programming with C – Y. Kanetkar.
5. C Programming – Holzner, PHI Publication.
6. Programming in C – Ravichandran.

B.C.A. Part I Semester I

Paper III

STATISTICAL METHODS

UNIT- I:

Introduction - Definition of Statistics, Importance and scope of Statistics, Limitations of statistics, Distrust of Statistics. Statistical Data Collection - Primary and Secondary data, Methods of Collecting Primary data, Sources and Secondary Data, Census and Sample Investigation. Presentation of statistical Data - Classification, Tabulation, Frequency Distribution, Diagrams and Graphs. Frequency Distributions and

UNIT- II :

Measures of Central Tendency - Frequency Distribution, Continuous Frequency Distribution, Graphic Representation of a Frequency Distribution Average or Measures of Central Tendency or Measures of Locations, Requisites for an ideal Measure of Central Tendency Arithmetic: Mean Median, Mode, Geometric Mean and Harmonic Mean, Weighted Average, Relationship amongst different Averages.

UNIT- III:

Measures of Dispersion, Skewness and Kurtosis - Meaning and Significance of Dispersion, Methods of Measuring Dispersion - Range, Quartile, Mean Deviation, Standard Deviation, Coefficient of Skewness, Kurtosis, Coefficient of Dispersion, Coefficient of Variation.

UNIT- IV:

Correlation and Regression - Definition of Correlation, . Scatter Diagram, Karl Pearson Coefficient of Correlation, Limits for Correlation Coefficient, Definition of Regression, Lines of Regression, Regression Curves, Regression coefficients, properties of Regression coefficients, Correlation Analysis vs. Regression Analysis.

Reference Books:

1.S Sastry Introduction to Numerical Analysis

2.Y. Rajaraman, Computer Oriented Numerical Methods - Prentice Hall Publication

3.Gupta and Kapoor Fundamental of Mathematical Statistics

4.Brian Flowers Introduction to Numerical Methods in C++ By. (Oxford)

5.E. Balaguruswamy, Numerical Methods - Tata McGraw Hill Publication

6.Srimanta Pal Numerical Methods (Oxford)

7.K Sankara Rao Numerical Methods for Scientists & Engineers [PIlI].

8.Manish Goyal Computer Based Numerical And Statistical Techniques (Laxmi)

B.C.A. Part I Semester I

Paper IV

DISCRETE MATHEMATICS – I

UNIT- I:

Propositional Calculus:

Connectives, Negation, conjunction, Disjunction, statement formulas and truth tables, conditional and Bi-conditional, well formed formulas, Tautologies, Equivalence of formulas, duality law, Tautologies implications, Functionally complete set of, other connectives,

UNIT- II:

Disjunctive normal forms, connective normal forms, Principal disjunctive normal form, Principal conjunctive normal form.

UNIT- III:

Predicate Calculus:

The theory of Inference for statement Calculus, validity using truth tables, Rules of inference, consistency of premises and indirect method of Proof

UNIT- IV:

The statement function, variables and quantifier, Predicate formulas, Free and Bound variables, The universe of Discourse, Theory of inference for predicate calculus.

Reference Books:

1. Discrete Mathematical Structures with applications to computer Science By J,P.Tremblay & R. Manohar, (TMH)
2. Discrete Mathematical Structures by Kolman Busby and Ross (pearson)
3. Discrete Mathematics By Norman Biggs. (Oxford).
4. Logic and Discrete Mathematics : Grassmann, Tremblay (Pearson)
5. Introduction to Automata Theory, Languages, and computation :Hopcroft, Motwani and Ullman(Pearson)
6. An introduction to the theory of computer science , languages and machines : Sudkamp
7. Kenneth H Rosen Discrite Mathematics & it's Applications TMH

B.C.A. Part I Semester I
Paper V
OPERATING SYSTEMS

UNIT - I:
Structure of Operating System, Operating System functions, Characteristics of Modern OS. **Process Management**: Process states, Creation, Termination, Operations on Process, Concurrent process, Processes Threads, Multithreading, Micro Kernels
CPU Scheduling: Schedulers, Scheduling Methodology, CPU Scheduling Algorithm: FCFS, SJF, RR, Priority Scheduling.

UNIT – II:
Performance comparison : Deterministic Modeling , Queuing analysis, Simulators.
Deadlock and Starvation: Resource Allocation Graph, Conditions for Dead Lock, Dead Lock Prevention, Dead Lock Detection, Recovery from Deadlock.

UNIT - III:
Memory Management: Logical Vs. Physical Address Space, Swapping, Memory Management Requirement, Dynamic Loading and Dynamic Linking, Memory Allocation Method: Single Partition allocation, Multiple Partitions, Compaction, paging, segmentation, Segmentation with paging. Protection.

UNIT - IV:
I/O Management: I/O hardware, I/O Buffering, Disk I/O, Raid, Disk Cache. **File Management:** File Management system, File Accessing Methods, File Directories, File Allocation Methods, File Space Management, Disk Space Management, Record blocking. **Protection Mechanisms**: Cryptography, Digital Signature, User Authentication.

Reference Books:

1. Operating Systems by P. Balakrishna Prasad [Scitech Publication]
2. Operating System Concept : Silbershaz (Addision Education)
3. Operating Systems - H.M. Deitel - Addision Wesley.
4. Operating Systems- John J. Donoven.
5. Operating System : A.S.Godbole (TMH)
6. Modern Operating Systems : Tenenenbaum (Pearson Education)
7. Operating System : Peterson.

B.C.A. Part I Semester I
Paper VI
OFFICE AUTOMATION

UNIT – I

Introduction to windows Operating System

Advantages of windows operating system, using different windows applications simultaneously, operating with windows, GUI, use of help features, starting an application, essential accessories, creating shortcuts, windows explorer, control panel, my computer, my documents, recycle bin, finding folders and files, changing system settings, system tools, use of run command, setting peripherals, drivers, editing graphics in windows, new features in windows XP/Vista versions.

UNIT - 2

Introduction, basics, starting Word, creating document, parts of Word window, mouse and keyboard operations, designing a document; Formatting- selection, cut, copy, paste; Toolbars, operating on text; Printing, saving, opening, closing of document; Creating a template; Tables, borders, pictures, text box operations; Mail Merge.

UNIT - 3

Introduction to MS EXCEL, navigating, Excel toolbars and operations, Formatting; copying data between worksheets; entering formula, chart creation; data forms, data sort; Functions in ExcelROUND( ), SQRT ( ), MAX( ), MIN( ), AVERAGE( ), COUNT( ), SUMIF( ), SUMIF( ), ABS( ), ROMAN( ), UPPER( ), LOWER( ), CELL( ), TODAY( ), NOW( ).

UNIT – 4

Introduction to MS POWER POINT Working with Power Point Window, Standard Tool Bar, Formatting tool bar, Drawing tool Bar, Moving the Frame, Inserting Clip Art, Picture, Slide, Text Styling, Send to back, Entering data to graph, Organization Chart, Table,Design template, Master Slide, Animation Setting, Saving and Presentation , auto Content Wizard.

Reference Books:

1. MS Office XP for Everyone By Sanjay Saxena (Vikas Publi, Noida)
2. MS-Office 2000(for Windows) By Steve Sagman
3. A First Course in Computers – Sanjay Saxena

B.C.A. Part I Semester II

Paper I

PROGRAMMING IN 'C++'

UNIT - I :

Object Oriented Methodology:

Elements of Object Oriented programming, Objects, Classes, OOPs features.

Classes & Objects: Specifying a Class, Creating Objects, Accessing Class members, Defining member function, Outside Member Functions as inline, Accessing Member Functions within the class, Static data member, Access Specifiers: Private, Protected and Public Members.

UNIT - II :

CONSTRUCTORS & DESTRUCTORS: Introduction, Parameterized Constructors, Constructor Overloading, Constructors with Default Arguments, Copy Constructor, Destructor, Order of Construction and Destruction, Static data members with Constructor and Destructors.

OPERATOR OVERLOADING: Definition, Overloadable Operators, Unary Operator Overloading, Unary & Binary overloading, Rules for Operators Overloading.

UNIT - III :

DYNAMIC OBJECTS: Pointers to Objects, Creating and Deleting Dynamic Objects: New and Delete operators, Array of Objects, Array of Pointers to Objects, Pointers to Object Members, this Pointer**.**

INHERITANCE: Defining, Abstract classes, Single, Multilevel, Multiple, Hierarchical, Hybrid Inheritance, Constructor and Destructor in Derived Classes.

UNIT - IV :

VIRTUAL FUNCTIONS: Need for Virtual Functions, definition, Pure Virtual Functions, Abstract Classes, Rules for Virtual Functions.

EXCEPTION HANDLING: Exception Handling Model, List of Exceptions, Handling Uncaught Exceptions, Fault Tolerant Design Techniques, Memory Allocation Failure Exception, Rules for Handling Exception Successfully.

Reference Books:

1. Mastering C++ by K R Venugopal Tata McGraw-Hill , New Delhi.
2. The C++ Programming Language –Bjarne Stroustrup
3. Programming with C++ - Ravichandran
4. Programming with C++ - Robert Lafore
5. Object Oriented Programming with C++ by E. Balagurusamy, McGraw Hill

B.C.A. Part I Semester II
Paper II
SYSTEM ANALYSIS AND DESIGN

UNIT - I :

Introduction : System, Subsystems, Components of Computerized Information System, Systems Analysts, SDLC, Prototyping.

Feasibility Study and Analysis: Identifying Problems, Organizing Feasibility Analysis: Economic, Financial, Organizational and Technological. Feasibility Decision, Choice of a solution.

Data Collection: Interviews, Brain Storming, Questionnaires, Document Search, Observation.

UNIT - II :

Structured tools and techniques of Data analysis : Structured English, Process Charts, SOP, Decision Tables and Decision Trees, Data Flow Diagram, Data Dictionary.
(Special emphasis on problem solving)

System Design : Input design: Input Validation, Human factor Consideration, Messages, System Tolerance. Output design: Categories of output, Design Principles, Control of Output. Forms: Principles of Form Design, Ways to ensure Quality Forms.

Codes: Types, Physical Representation of Codes, Principle of Code Design.

UNIT - III :

Implementation: Training, Operational Training and Related Activities, Planning to Implement Change, Change Strategies.

Testing: Preparation for Testing, Test Execution: Levels of Testing, Component, Function, Subsystem, System, Test Evaluation, Acceptance.

Conversion: Cold Turkey, Parallel, Pilot, Modular and Sequential Methods. Conversion Period Length. **System Evaluation.**

UNIT - IV :

Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, **Scheduling:** Work Breakdown Structure, Activity Networks and CPM, Gantt Charts, PERT Charts, Project Monitoring and Control. Risk Management, Software Configuration Management: Necessity, Configuring Management Activities

Software Reliability and Quality Management: Software Reliability, Software Quality, ISO 9000. Software Maintenance: Characteristics of Software Maintenance, Maintenance Process Models, Estimation of Maintenance Cost.

Software Reuse: What can be reused, Why no reuse so far, Basic Issues.

Reference Books:

1. Information Systems Analysis, Design and Implementation By K. M. Hussain Donna Hussain [Tata McGraw-Hill Publishing Company Ltd, New Delhi]
2. Fundamentals of Software Engineering by Rajib Mall [PHI Publication]
3. Workbook on Systems Analysis & Design by V. Garg [PHI Publication]
4. System Analysis and Design- Don Yeates, shiebls, Helmy (M).
5. System Analysis & Design - Edward –TMH
6. System Analysis and Design – Satzinger, Robert Jackson and Stephen Burd, Thomson Learning
7. Introduction to Systems Analysis Design, Igor Hawryszkiewycz, PHI

B.C.A. Part I Semester II

Paper III

NUMERICAL METHODS

UNIT - I :

Roots of Non-Linear Equations : Algebraic equation, Polynomial equation, Transcendental equation, Iterative method, Starting & Stopping Iterative method, Bisection Method, False Position method, Newton Raphson Method: Secant Method, Determining all possible roots, Multiple roots of polynomial, Complex Roots using Muller's Method.

UNIT - II :

Solution to Linear Equations Existence of solution, Gauss Elimination Method, Gauss elimination with pivoting, Gauss Jordan Method, Round off errors and refinement, m Conditioned system, Matrix inversion method.

UNIT - III :

Linear interpolation, Lagrange Interpolation, Spline Interpolation, Interpolation with equidistant points, Least Square regression Fitting, Transcendental equations, Multiple linear regression, m conditioning in Least square

UNIT - IV :

Integration & Differentiation : Trapezoidal Rule, Simpson 1/3 Rule, Simpson 3/8 rule, Gaussian Integration, Solution to differential equation (using Runge-Kutta second and fourth order methods, Multistep method for differential equations (Milne-Simpson method, Adams-bashforth-

Reference Books:

1.S Sastry Introduction to Numerical Analysis

2.Y. Rajaraman, Computer Oriented Numerical Methods - Prentice Hall Publication

3.Gupta and Kapoor Fundamental of Mathematical Statistics

4.Brian Flowers Introduction to Numerical Methods in C++ By. (Oxford)

5.E. Balaguruswamy, Numerical Methods - Tata McGraw Hill Publication

6.Srimanta Pal Numerical Methods (Oxford)

7.K Sankara Rao Numerical Methods for Scientists & Engineers [PIlI].

8.Manish Goyal Computer Based Numerical And Statistical Techniques (Laxmi)

B.C.A. Part I Semester II

Paper IV

DISCRETE MATHEMATICS – 2

UNIT - I :

Set Theory:

Set, Subsets operations on set, Venn diagram, algebra on sets, Cartesian product of sets, Binary relations, Properties of binary relation, Relation matrix and the graph of relation, Partial order relations, Equivalence relations, Equivalence Classes, Composition of relations.

UNIT - II :

Functions - definition, types of function, Invertible functions composition of functions.

Counting - Permutation, Combinations, The pigeonhole principle, recurrence relation, Mathematical Induction.

UNIT - III :

Algebraic Structures

Semi groups & groups: Binary operations, Semi groups, isomorphism and Homomorphism, Product and Quotient of semi groups, Groups, subgroups, products and Quotient of groups.

Lattices: - Lattice concepts, isomorphic Lattices, Properties of lattices, Finite Boolean algebras.

UNIT - IV :

Graph Theory: Basic concepts, types of graphs, Representation of graph in memory, Euler path and circuits, Hamiltonian Path and circuits.

Trees:- Basic concepts, Libeled trees, Undirected trees.

Reference Books:

1. Discrete Mathematical Structures with applications to computer Science By J,P.Tremblay & R. Manohar, (TMH)
2. Discrete Mathematical Structures by Kolman Busby and Ross (pearson)
3. Discrete Mathematics By Norman Biggs. (Oxford).
4. Logic and Discrete Mathematics : Grassmann, Tremblay (Pearson)
5. Introduction to Automata Theory, Languages, and computation :Hopcroft, Motwani and Ullman(Pearson)
6. An introduction to the theory of computer science , languages and machines : Sudkamp
7. Kenneth H Rosen Discrite Mathematics & it's Applications TMH

B.C.A. Part I Semester II

Paper V

LINUX OPERATING SYSTEM

UNIT - I :

Logging In and Logging Out, Anatomy of Linux OS, Directory Structure, /usr Directory, File Types: User datafiles, System data files, Executable files. Naming files and directories, Spawning Processes. **Shell:** Creating User Account, Shell Program, bash shell, Changing shell prompt. **Commands:** Basic Syntax for a command, Exploring the Home Directory, ls, mkdir, rmdir, stat, cat, rm, mv, cp

UNIT - II :

Editor: Vi editor. **Hooking up Hardware Devices:** Formatting a Floppy Disk**,** Gathering important system information. Backing Up and restoring the File **System:** Simple Backup, gzip, gunzip, tar. **Printing files:** Print Spool directory, Sending files to Printer.

UNIT - III :

Sharing Files with other Users: Maintaining User Accounts, Changing Password, Creating Group Accounts, Granting Access to files, Changing File Ownership, Protecting Files, Making a File Read-Only. Working with Processes**:** Types of processes, ps Command, Creating process, killing process, free command and top utility.

UNIT - IV :

Managing Disk Space: df, du commands, Creating Additional Free Disk Space, Locating Unused Files, Setting System Clock. Communication Utilities: who, who am i, finger, mesg, write, wall, talk, Creating a message of the day. X Window System, Graphical User Interfaces: KDE and GNOME Desktop Environment.

Reference Books:

1. SAMS Teach Yourself Linux by Craig and Coletta Witherspoon [Techmedia]
2. LINUX complete reference by Richard Peterson

B.C.A. Part I Semester II

Paper VI

E COMMERCE

UNIT - I :

Introduction to e-Commerce, Scope of electronic commerce, definition, e-Commerce and Trade Cycle, e- Markets, Internet e-Commerce in perspective. Value chain, Supply chain, Porters value chain model, Inter organizational value chains.

UNIT - II :

Business strategy in electronic age: Competitive advantages, Strategy, Porters model, First Movers advantages, Advantages using e-Commerce. Introduction to business strategy, Strategic implications of IT, Technology, Business environment, Business capability, Existing business strategy, Strategy formulation and implementation planning, e-Commerce implementation, e-Commerce evaluation.

UNIT - III :

Business to Business e-Commerce: Inter organizational transactions, The credit transaction trade cycle, A variety of transaction, Pens and things, Electronics Market, Usage of e-Market, Advantages and disadvantages of e-Market, Future of e-Market, EDI, introduction, EDI and Business.

UNIT - IV :

Business to Consumer Electronic Commerce: Consumer trade transaction, Internet e-Commerce, e-Shop, Other e-Commerce technologies, Advantages and disadvantages of comsumer e-Commerce. Elements of e-Commerce: elements, e-Visibility, e-Shop, Online payments, Internet e-Commerce security.

Reference Books:

01. E-Commerce, Strategy, Technologies and Applications By: David Whiteley Tata McGraw-Hill Edition.

B.C.A. Part II Semester III
Paper I
VISUAL BASIC PROGRAMMING

UNIT-I :
Working with Visual Basic Window Components: Menu Bar, Tool Bar, Project Explorer Window, Form Layout Window, properties Window, Toolbox, Code Editor Window **Working with Forms:** Properties, Events, Methods Working with Basic Controls:Label, CommandButton, TextBox, OptionButton, Frame, CheckBox, ListBox, ComboBox, Image, Scroll, Picture, Timer, DriveListBox, DirListBox, FileListBox and Shape Controls. **Basic Programming Fundamentals:** Variables, Data types, Constant, Conversion Function. Scope of Variable: Public, Private Static. Operators: Logical, Arithmetic, Concatenation, Comparison. Decision Structure: If.. Then, If..Then..Else, Select Case.. End Case. Loop Structure: Do..While, While.. Wend, For.. Next, With..EndWith. DoEvents()

UNIT-II :
Arrays: Dynamic Array, Preserve and Control arrays. **Procedure:** General procedure, General Methods for Passing Arguments to a Procedure, **Functions:** User-Interaction, String, Math, Date, Conversion Functions.
Modules: Form, Standard.

UNIT-III :
Menus: Creating, Adding Menu Items, Creating Shortcut, Adding Separators Bars, Submenus, Code for Menus. Creating Popup Menu: System, Custom. **Database Handling:** Database Concepts, Creating and Accessing Database, Using Data Control.
Using DAO: Creating Search Programs, Numeric Search and Complex Search Programs.

UNIT-IV :
Using ADO Data Control, Data Link, ODBC Data Source name, Using Connection String, Creating Navigating buttons. Working with Advanced Data Controls **:** DataList Control, DataCombo Control, DataGrid Control and Msflexgrid Control. **Handling Errors** : Run Time, Trapping and Handling Error, ERR Object. Data Environment and Data Reports.

Reference Books:

1. VISUAL BASIC – to Advance by Soma Dasgupta [BPB Publication]
2. Evangelos Petroutsos, Mastering Visual Basic 6.0 BPB Publication.
3. VISUAL BASIC 6 COMPLETE REFRENCE (TMH PUB)
4. Visual Basic 6 Deitel & Deitel (Pearson Education)
5. Mastering VB 6.0 Black Book -Peter - Norton-Techmedia.

B.C.A. Part II Semester III

Paper II

DATA BASE MANAGEMENT SYSTEM

UNIT- I :

DBMS : Definition: Databases, DBMS, Problems with traditional file processing system, Objectives of the database systems, Three level architectures of DBMS, Component of DBMS, Database Administrator, Database Users, Data model, Different types of data models, Concepts of Hierarchical, Network Models.

UNIT-II :

E-R Models : Basic Concepts, Entity, Attributes, Relation Ship, Mapping, Keys, Weak and Strong Entity Set, Problems on E-R Diagrams, Extended E-R Features: Specialization, Generalization, Aggregation, Problems on Reduction of an E-R Schema to Tables, Tabular representation of Strong, Weak entity Sets and Relationship Sets.

UNIT-III :

Relational Model: Structure, Relational Algebra, Fundamental Operations, Set – Intersection, Natural Join, Division and Assignment Operation. Extended Relational Algebra Operations, Aggregate Functions.

UNIT–IV :

Functional Dependency: Functional Dependency, Fully Functional Dependency, Partial Dependency, Transitive Dependency, Multi Valued Dependency.
Normalization, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF, 5NF). Problems on Normal forms.

Reference Books:

1. Data Base System Concepts By A SilbersChatz By Henry Korth And S.Sudarshan [Mcgraw-Hill ltd. New Delhi] 3rd Edition.
2. Introduction to Data Base Management by NAVEEN PRAKASH [Tata McGrawHill ltd.]
3. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications.
4. Raghu Ramakrishnan & Johannes Gerhrke, "Data Base Management Systems", Mc Graw Hill International Edition, 2000
5. Muzumdar, Introduction to Database Management Systems. TMH

B.C.A. Part II Semester III
Paper III
DATA STRUCTURES

UNIT - I :
LINKED LIST : Linked List, Representation of Single, Double, Header, Circular Single and Double Linked list, All possible operations on Single and Double linked List using Dynamic representation, Polynomial Representation and its Manipulation.

UNIT - II :
STACKS : Stacks terminology, Representation of Stacks in Memory, Operation on Stacks, Polish Notations, Translation of infix to postfix & prefix expression, Infix to Postfix Conversion, Evaluation of Postfix Expression, Recursion, Problems on Recursion, Quick Sort and Tower of Hanoi Problem.

UNIT - III :
QUEUE : Representation of Queues in Memory, Circular Queue. Dequeue and Priority Queue. Operations of above Structure using Array and Linked Representation.
SORTING AND SEARCHING: Selection Sort, Insertion Sort, Merge Sort, Efficiency of Sorting Methods, Big-O Notations.
Hash Tables, Hashing Technique, Collision Resolution Technique.

UNIT - IV :
TREES : Basic Terminologies, Representation of Binary Trees in Memory, Traversing of Binary tree, Binary Search Tree, Operation on Binary Search Tree, Heap Tree, Operation on Heap Tree, Heap Sort Method
GRAPHS : Basic Terminologies, Definition and Representation of Graphs in Memory: Linked List and Matrix Representation. Traversing graphs : BSF, DFS Method.

Reference Books:

1. Classical Data Structures : D. Samanta. PHI, New Delhi.
2. DATA STRUCTURE : LIPSCTUZ SCHUM OUTLINE SERIES
3. Data structure Using C++ : Y. Kanetkar
4. Data Structures Using C++: Tennenbaum
5. Data structures by Tremblay Sorenson
6. Data structures by Bhagat singh Naps

B.C.A. Part II Semester III

Paper IV

OPERATIONS RESEARCH – I

UNIT - I :

Introduction to Operation Research (OR) Origin and development of OR, Nature of OR, Characteristics of OR, Classification of Problems in OR, Models in OR, Phases of OR, Uses and Limitations of OR, Methodologies of OR, Applications in OR. Linear Programming – Concepts of Linear Programming Model, Mathematical Formulation of the Problem, Graphical solution methods.

UNIT - II :

Linear Programming Methods – Simplex Methods, Big M methods, Dual Simplex Method, TwoPhase methods. Duality in Linear Programming – Formulation of Dual Problem, Application of Duality.

UNIT - III :

Transportation Problem

Mathematical model for Transportation Problem, Types of Transportation Problem.

UNIT - IV :

Assignment Problem – Zero-One Programming Model for Assignment Problem, Types of Assignment Problem, Hungarian Method, Branch and Bound Technique for Assignment Problem.

Reference Books:

1. Operation Research by Kanti Swarup, P. K. Gupta, Man Mohan [Sultan]
2. Operation Research by R. Panneerselvam [PHI}
3. Introduction to Operation Research by Billy E. Gillet [TMH]
4. Operation Research by Hira Gupta
5. Operation Research Problems and Solutions by Sharma J. K. [MacMillan]
6. Operation Research Theory and Application by Sharma J. K., [MacMillan]

B.C.A. Part II Semester III

Paper V

WEB TECHNOLOGY - I

UNIT - I :

Introduction to Internet, History of Internet, Internet users, Internet working, Information on Internet, Requirements for connecting to Internet, Basic Internet Terms, Introduction to world wide web, Evaluation of world wide web, basic features, web browsers, popular web browsers, web servers, HTTP, URL, Search Engines, Search Engines categories, how to use Search Engines, Searching criterion.

UNIT - II :

HTML: Introduction, Objective, HTML Browsers, Windows Switching, HTML Command Tags, URLs, links, new web page creation, main body of the text, putting headers, adding paragraph , formatting text in HTML and font mechanism, Color settings, superscripts and subscripts and other manipulations on text and paragraphs, using directory and menu lists, creation of links, inserting graphics, using images, all manipulations on tables and its display, Detailed working with forms, allowing visitors to upload files, active images ,working with frames & framesets, Frames handling, scroll bars, alternatives to frames,

UNIT - III :

Introduction to browsers, Working with e-mail, Parts of e-mail text, working with messages.

DHTML: using DHTML in internet explorer, heading and horizontal line, hidden message, the message at the center of the page, moving boxes ,changeable box.

UNIT - IV :

Cascading style sheets

Introduction to css, creating style sheets, common tasks with CSS, Colors, the font -family, font metrics ,length units ,absolute units ,relative units ,the pixel unit ,percentages as values ,keywords as values, various properties such as the font -size property, font -size property etc, Assigning classes ,tags and attributes for applying classes, applying classes to an HTML tag, applying classes to other document parts ,the layer tag, CSS Tags

Reference Books:

1. Internet and web design by R Bangia, Second edition , firewall media
2. Multimedia and Wed technology by R Bangia
3. Internet and web designing by ITELS (Macmillan)
4. Web Enabled Commercial Application Development Using HTML, DHTML, JS, Perl by Ivan Bayross
5. Deitel, Deitel & Nieto, Internet and Worldwide Web how to Program, Pearson Education, PHI.
6. Internmet Programming with VBScript and Java Script.
   Kathhleen Kalata, (Thomsaon Publication)
7. Programming the World Wide Web By. Robert W. Sebesta. (Pearson)
8. Web Technology Theory and Practice By: M Srinivasan (Pearson Publication)

B.C.A. Part II Semester III

Paper VI

DIGITAL ELECTRONICS – I

UNIT - I :

Number System and Data Representation

Number System : Binary, Octal, Decimal and Hexadecimal number system and their interconvertion.

Binary Codes : BCD, Excess3 , Parity, Gray, ASCII, EBCDIC codes and their advantages and disadvantages.

UNIT - II:

Binary Arithmetic

Data Representation: Positive, negative, maximum and minimum number representation (related to 8 bit number), real number representation, underflow, overflow, range and accuracy. **Binary Arithmetic:** Binary addition, binary subtraction using 1's and 2's compliment.

UNIT - III:

Logic gates: Truth table, properties and symbolic representation of NOT, AND, OR, NOR, NAND, EXOR, EXNOR gates. NOR and NAND gates as a universal gates.

UNIT - IV:

Boolean Algebra.

Laws and Identities of Boolean algebra, DeMorgan's Theorem , use of Boolean Algebra for simplification of logic expression, K-Map for 2,3,4 variables, simplification of SOP and POS logic expression using K-Map.

Reference Books:

1. Digital Electronics by Gothman(PHI)
2. Digital and analogue technique by Navaneeth, Kale and Gokhale
3. Modern Digital Electronics by R. P. Jain

B.C.A. Part II Semester IV

Paper I

SOFTWARE ENGINEERING - I

UNIT - I :

Introduction to Software Engineering : The evolving role of software, Changing Nature of Software, Software myths.

A Generic view of process : Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models.

UNIT - II :

Process models : The waterfall model, Incremental process models, Evolutionary process models, The Unified process. **Software Requirements :** Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document.

UNIT - III :

Requirements engineering process : Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

System models : Context Models, Behavioral models, Data models, Object models, structured methods.

UNIT - IV :

Design Engineering : Design process and Design quality, Design concepts, the design model.

Reference Books:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition.McGrawHill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson education.
3. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers
4. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiely.
5. Systems Analysis and Design- Shely Cashman Rosenblatt,Thomson Publications.
6. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.

B.C.A. Part II Semester IV
Paper II
SQL AND PL/SQL

UNIT - I :
CODD'S Rules, Oracle Database Objects, Sub Languages of SQL, Data types, Operators. **DDL Statement**: Creating Tables, Deriving Table from existing table, Altering, Dropping Tables. Integrity Constraints, Specifying Names for the Constraints, Viewing Integrity Constraints, Adding and Dropping Constraints. DML Statements: SELECT statement, Insert, Update, Delete, Working with Sequences and Synonyms. Built-in functions: Arithmetic, Date, Character, Conversion, Single row, Aggregate, Decode.
Joins, Set Operators and Sub queries. DCL and TCL Statements: Grant, Revoke, Commit, Rollback and Savepoints.

UNIT - II :
VIEWS: Creating Views, Dropping Views, Inserting, Updating and Deleting Data using Views, Types of Views. PL/SQL Programming: PL/SQL Data Types, Identifiers, Operators and Expressions, Iterative Statements, Conditional Statements, emphasis on Problems

UNIT - III :
Exception Handling : Predefined Exceptions, User defined Exceptions. Cursors: Declaring Cursors, Opening and Retrieving Records, Closing cursors. Attributes of Explicit and Implicit Cursors, Parameter Passing in Cursors. Procedures : Create and Drop Procedure, Creating Procedures with Parameters, Calling Procedures, Granting the EXECUTE Permission Problems on Exception Handling, Cursors and Procedures.

UNIT - IV :
Function: Creating and Dropping Function, Purity Levels in Functions, Executing Functions. **Triggers:** Create Triggers, Type of Triggers, Creating BEFORE and AFTER Triggers, INSTEAD-OF Triggers, Trigger Predicates, Inserting, Updating and Deleting Triggers, Enabling , Disabling and Dropping Triggers. Problems on Functions and Triggers

Reference Books:

1. Understanding ORACLE By Ivan Bayross [BPB Publication]
2. Database System Using Oracle: A Simplified Guide to SQL & PL-SQL: Nilesh Shah, PHI Publication.
3. Database Management Systems (Complete practical approach) by Sharad Maheshwari & Ruchin Jain, Firewall media
4. Dr. P.S.Deshpande SQL & PL/SQL for Oracle 10g Black Book
5. Scott Urman Programming PL/SQL TMH

B.C.A. Part II Semester IV
Paper III
THEORY OF COMPUTATION

UNIT - I :
Finite Automation and Regular Expression : Finite State systems, Basic Definitions, Non -deterministic finite Automata, Finite Automata with moves, Regular Expressions, Two way finite automata, Finite automata with output, Application on Finite Automata.

UNIT - II :
Properties of Regular Sets : The pumping lemma for Regular Sets, Close properties of Regular sets, Decision Algorithms for Regular Sets. Context Free Grammars, Context Free Grammar, Derivation Tree,

UNIT - III :
Simplification of context Free Grammars, Chomsky Normal form, Greibach normal form, The existence of inherently ambiguous context free languages. Properties of Context free languages : The pumping lemma for CFL's , Closure properties of CFL's,

UNIT - IV :
Push Down Automata : Informal description, Definitions, Push – Down Automata & Context free languages.

Reference Books:

1. Introduction to Automata Theory, Languages and Computation: John E. Hoperott & Jeffery D. Ullman
2. Theory of Computer Science : E. V. Krishmamoorty. .
3. Theory of computer Science : K. L. P. Mishra.

B.C.A. Part II Semester IV
Paper IV
OPERATIONS RESEARCH - II

UNIT - I :
Game Theory – Terminologies of Game Theory, Two Person Zero-Sum Games, The Maximin-Minimax Principle, Games without Saddle points-Mixed Strategies, Graphical Solution of 2x n and m x 2 games, Dominance Property. Introduction, Decision under Certainty, Decision under Risk, Decision under Uncertainty,
Decision Tree.

UNIT - II :
Network Scheduling by CPM/PERT – Introduction, Basic Concept,
Constraints in Network, Critical Path Method (CPM), PERT Network, PERT calculations, Time-Cost trade-off aspects in Network Technique, Advantage of Network (PERT/CPM).

UNIT - III :
Inventory Control
Introduction, Inventory Control, Selective Control Techniques, Types of Inventory, Economic Lot Size Problem, Problem of EOQ with shortage, Inventory Control Techniques – Uncertainty Demand, Stochastic Problem, Inventory Control with Price Breaks.

UNIT - IV :
Queuing Theory
Introduction, Terminologies in Queuing System, Characteristics of Queuing System, Poisson Process and Exponential Distribution, Classification of Queues, Definition of Transient and Steady states, Poisson Queues, Non-Poisson Queuing Systems, Cost-Profit Models in Queuing, Queuing Control.

Reference Books:
1. Operation Research by Kanti Swarup, P. K. Gupta, Man Mohan [Sultan]
2. Operation Research by R. Panneerselvam [PHI}
3. Introduction to Operation Research by Billy E. Gillet [TMH]
4. Operation Research by Hira Gupta
5. Operation Research Problems and Solutions by Sharma J. K. [MacMillan]
6. Operation Research Theory and Application by Sharma J. K., [MacMillan]

B.C.A. Part II Semester IV

Paper V

WEB TECHNOLOGY - II

UNIT - I :

Introduction, JSP lifecycles, Elements in JSP Pages , values and variables, operators, loops and various statements in java script, Date object, Math object, string object, window events, working with forms, document object, screen object, navigator object, images and animation.

UNIT - II :

Java script objects, Implicit JSP Objects, JSP Object scopes, JSP Tags, Declarations, Directives, JSP Tags, JSP Exceptions, Expressions, Scriptlet, Actions, Expression Language, JSP Standard Tag library, JSP Custom Tag library, Java Script security.

UNIT - III :

VB Script:

Adding VB Script code to HTML, Adding script to your document, Data types, Arrays in script, Messages, Subroutines, functions, if..then..else, for..next loop, do while or do until, Select case construct, Manage your web site with Task and Reports : Keep track of work eith tasks, Check your site with your web site report, Publishing web site to a WPP host server.

UNIT - IV :

Web Services :

Ev0lution of the concept, Purpose, standards, Use cases, programming models, SOAP Based web services, WSDL,, SOAP, Structure of SOAP messages, REST based Web Services, REST principles, Resource Orientation, SOAP vs. REST.

Reference Books:

1. Internet and web design by R Bangia, Second edition , firewall media
2. Multimedia and Wed technology by R Bangia
3. Internet and web designing by ITELS (Macmillan)
4. Web Enabled Commercial Application Development Using HTML, DHTML, JS, Perl by Ivan Bayross
5. Deitel, Deitel & Nieto, Internet and Worldwide Web how to Program, Pearson
    a. Education, PHI.
6. Internmet Programming with VBScript and Java Script. Kathhleen Kalata, (Thomsaon Publication)
7. Programming the World Wide Web By. Robert W. Sebesta. (Pearson)
8. Web Technology Theory and Practice By: M Srinivasan (Pearson Publication)

B.C.A. Part II Semester IV

Paper VI

DIGITAL ELECTRONICS – II

UNIT - I :

Combinational / Sequential Circuits

Combinational circuits: Half adder, Full Adder, Parallel adder, Half subtractor, Full Subtractor, 4-bit binary adder subtractor, Multiplexer, Demultiplexer, Decoder, Encoder, Parity detector.

UNIT - II :

Sequential Circuits: Flip-Flops : Construction and working of RSFF, CkRSFF, DFF, TFF, JKFF, and JKMSFF . **Counters:** Construction and working of asynchronous, synchronous, up-down counter, shift registers and their types.

UNIT - III :

Architecture of 8086 and Assembly Language Programming Block diagram of 8086, Pin diagram of 8086, Addressing modes,

UNIT - IV :

Instruction set: Data transfer, Arithmetic, Logical, String manipulations, Control Transfer, Unconditional branch, Conditional branch, Flag, Processor control. Assembler directives and operators, simple assembly programs.

Reference Books:

1. Digital Electronics by Gothman(PHI)
2. Digital and analogue technique by Navaneeth, Kale and Gokhale
3. Fundamental of Microprocessor by B Ram
4. Microcomputers Systems: The 8086/8088 family by Liu. Gibson
5. Introduction to Microprocessor by Duglas V Hall (McGraw Hill.)

B.C.A. Final Semester V

Paper I

COMPUTER GRAPHICS - I

UNIT - I :

Introduction and Primitives

Introduction: Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

UNIT - II :

Output primitives : Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms .

UNIT - III :

2D Transformations

2-D geometrical transforms : Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.

UNIT - IV :

2-D viewing : The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

Reference Books:

1. "Computer Graphics Principles & practice", second edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.
2. "Computer Graphics", second Edition, Donald Hearn and M.Pauline Baker, PHI/Pearson Education.
3. Procedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.
4. "Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
5. Computer Graphics, Amrendra N Sinha,Arun D Udai TMH
6. Computer Graphics, Steven Harrington, TMH

B.C.A. Final Semester V
Paper II
COMPILER CONSTRUCTION

UNIT - I :
Compilers and translators, need, the structure of a compiler, Lexical Analysis, Syntax analysis, Intermediate code Generation, Optimization, Code Generation, Book keeping, Error Handling

UNIT - II :
High Level programming languages, Definitions of programming languages, The lexical and syntactic structure of a language, Data elements, structures, Operators, Assignment Statements, Data Environments, Parameter transmission, Storage management.

UNIT - III :
The role of the lexical analyzer, Approach to the design of lexical analyzer, Implementation of lexical analyzer, Context free grammars, Derivations and parse trees, Ambiguous grammar.

UNIT - IV :
Parsers, Shift-reduce parsing, Operator precedence parsing, Top-down parsing, predictive parsers, Symbol Table , Code Optimization: The principal source optimization, Loop optimization, The DAG representation of basic blocks, Code Generation : A machine model, a simple code generator, Register Allocation and assignment.

Reference Books:

1. Principles of Compiler Design - A.V. Aho, J. D.Ullman : Pearson Education.
2. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech.
3. Engineering a Compiler-Cooper & Linda, Elsevier.
4. Compiler Construction, Louden, Thomson.

B.C.A. Final Semester V

Paper III

VB.NET

UNIT - I :

VB.NET

Introduction to .Net, The .NET framework, The .NET Programming Framework, .NET Language, The Class .NET Library, Vb.NET, Windows Application using VB .NET

Class: Creating a New Class, defining and using a New Object, Constructor & Destructor

Inheritance: Inheritance Properties and Methods, Inheriting Constructors, Overriding Methods, Creating a Derived Class

UNIT - II :

Interface Design & Implement: Abstraction & Interfaces on Object Oriented Software Design, Interface & Inheritance, Realizing the benefits of Interfaces, Implicit Interface, Explicit Interface – Abstract Class of Explicit Interface, Implementing Interfaces – Interface Implementation Semantics, Implementing ICloneable, Implementing IComparable, Accessing & using the Implement, Compound Interfaces

UNIT - III :

User Interface: Helper Forms, Message Process, Dialog Process, Owned Forms

Menus: Creating a Menu, Functionality to the Menu Items, Enhancing the Menu, Disabling Items on the Windows Form Menus, Creating Context Menu – Step by Step, Add Functionality to the Menu Items

Toolbar: Adding the Toolbar and buttons, Defining an Icon for the Toolbar and Buttons, Defining an ICON for a Toolbar Button, Adding Functionality to the Toolbar

MDI Application: The Basics, Building an MDI Application, Building – In Capabilities of MDI Applications, Accessing Child Forms, Ending an MDI Applications, A Scrollable PictureBox

UNIT - IV :

Advanced Interface Patterns, Adapters, Delegates & Events: Adapters & Wrappers, Interfaces Adaptation in Action – COM - .NET interop, The Adapter Pattern in .NET, The Adapter Pattern Event – Model, Delegates – Understanding Delegates, Declaration of the Delegates, Early Bound Delegates Declares, Late Bound Delegates Declares, Sorting Data with Delegates, Multicast Delegates, .NET Framework Event Model – Delegates & Events, Delegates Events verses Adapter Events, Delegates verses Function Pointers

Error Handling & Prevention: Types of Errors – Design Time Error, Runtime Error, Logic Error

Structured Exception Handling: Exception Structured verses Unstructured Exception Handling, Try……Catch…..Finally Statement, Exception Class.

Debugging: Break Mode, Starting Debugging, Controlling the Flow during Debugging, Debugging Tools

Reference Books:

1. Evangelos Petroutsos, Mastering Visual Basic 6.0 BPB Publication.
2. John Smiley Learn Program with Visual Basic 6
3. Wallace Wang Visual Basic 6 for Dummies (for Windows)
4. VISUAL BASIC 6 COMPLETE REFRENCE (TMH PUB)
5. Deitel & Deitel Visual Basic 6 (Pearson Education)
6. Bradly, VB.Net TMH

B.C.A. Final Semester V

Paper IV

SOFTWARE ENGINEERING - II

UNIT - I :

Creating an architectural design : Software architecture, Data design, Architectural styles and patterns, Architectural Design.

UNIT - II :

Testing Strategies : A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging.

UNIT - III :

Product metrics : Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.

Metrics for Process and Products : Software Measurement, Metrics for software quality.

UNIT - IV :

Risk management : Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

Quality Management : Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

Reference Books:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition.McGrawHill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson education.
3. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers
4. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiely.
5. Systems Analysis and Design- Shely Cashman Rosenblatt,Thomson Publications.
6. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.

B.C.A. Final Semester V

Paper V

PHP - I

UNIT - I :

Introduction to PHP: What Does PHP Do, A Brief History of PHP, Installing PHP, A Walk Through PHP Language **Basics:** Lexical Structure, Data Types, Variables, Expressions and Operators, Flow-Control Statements, Including Code, Embedding PHP in Web Pages, Installing and Configuring PHP on Windows and Linux Platforms

UNIT - II :

Functions: Calling a Function, Defining a Function, Variable Scope, Function Parameters,
Return Values, Variable Functions, Anonymous Functions, Strings: Quoting String Constants, Printing Strings, Accessing Individual Characters, Cleaning Strings, Encoding and Escaping, Comparing Strings, Manipulating and Searching Strings, Regular Expressions, POSIX-Style Regular Expressions, Perl-Compatible Regular Expressions,

UNIT - III :

Arrays: Indexed Versus Associative Arrays, Identifying Elements of an Array, Storing Data in Arrays, Multidimensional Arrays, Extracting Multiple Values, Converting Between Arrays and Variables, Traversing Arrays, Sorting, Acting on Entire Arrays, Using Arrays

UNIT - IV :

Reading data in web pages: Setting Up Web Pages to Communicate with PHP, Handling Text Fields, Text Areas, Check Boxes, Radio Buttons, List Boxes, Password Controls, Hidden Controls, Image Maps, File Uploads. **Handling Buttons:** Making Button Data Persist, Using Submit Buttons as HTML Buttons.

Reference Books:

1. PHP 5.1 for beginners by Evan Bayross and Sharman Shah, SPD Publications
2. PHP 5.2 The Complete Reference by Steven Holzner, Mc Graw Hill Edition 2008.
3. Programming PHP by Rasmus Lerdorf and Kevin Tatroe, Orilly Publications

B.C.A. Final Semester V

Paper VI

DATA COMMUNICATION AND NETWORK - I

UNIT - I :

Data Communication

Data Transmission- Concept and Terminology, Analog & Digital Data Transmission, Transmission Impairment, Transmission Media.

Data Encoding- Digital Data, Analog Data, Digital Signal, Analog Signal.

UNIT - II :

Digital Data Communication: Asynchronous and Synchronous transmission, Error detection technique, Interfacing.

Data Link Control: Line configurations, Flow control, Error control, Data link control protocols. Multiplexing-Frequency division multiplexing, Synchronous Time Division Multiplexing.

UNIT - III :

Circuit Switching: Communication Networks, Circuit switching, Single Node network, Digital switching concept, Control Signaling.

UNIT - IV :

Packet Switching: Packet switching principles, Virtual circuits and diagrams, Routing, Traffic control, X.25. LAN & MAN- LAN,MAN technology, Bus, Tree, Star and Hybrid Topologies, Optical fiber Bus, Ring Topology, Medium Access Control Protocols, LAN/MAN standards.

Reference Books:

1. William Stalling, Data and Computer Communication, PHI Publication.
2. Forouzan, Data Communication and Networks, Tata McGraw Hill.
3. Godbole, Data Communication and Network, TMH
4. Tanenbum, Computer Networks , ,PHI Publication.
5. Comer Internetworking with TCP/IP Vol-1, PHI Publication

B.C.A. Final Semester VI

Paper I

COMPUTER GRAPHICS - II

UNIT - I :

3D Transformations

3-D object representation : Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon rendering methods.

UNIT - II :

3-D Geometric transformations : Translation, rotation, scaling, reflection and shear transformations, composite transformations.

3-D viewing : Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping

UNIT - III :

Visible surface detection methods : Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

UNIT - IV :

Computer animation : Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications.

Reference Books:

1. "Computer Graphics Principles & practice", second edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.
2. "Computer Graphics", second Edition, Donald Hearn and M.Pauline Baker, PHI/Pearson Education.
3. Procedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.
4. "Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
5. Computer Graphics, Amrendra N Sinha,Arun D Udai TMH
6. Computer Graphics, Steven Harrington, TMH

B.C.A. Final Semester VI

Paper II

PROGRMMING IN JAVA

UNIT - I :

Introduction to Java: -History of Java, features of Java, getting started with Java. **Java programs**:-Introduction of Application & Applets. **Variables**: -Variable naming, variable initialization, assign values, Rules of variables, Scope of variable. **Operators**: - Arithmetic, Assignment, Unary, Comparison, Shift, Bit- Wise, Logical, Conditional, New, Special, Relational. Data types:-Integers, Char, String, Float etc. Typecasting: **Tokens**: -Java tokens Order of precedence of operators Streams: - Input and output.

UNIT - II :

Creating a class & subclass: -Declaring a class, Naming class, Rules to assign Class & Subclass, Creating a new object, Class of an object. **Data members**: -Declaring data member, Naming variables, using class members. **Methods**: -Using data members, Invoke a method, passing arguments to a method, calling method. **Access Specifier & Modifiers**: -Public, Private, Protected, Static & Final. **Overloading**: -Method overloading, Constructor overloading. **Java class library**: - Different types of classes. **Decision making & loops**:-If-then-else, Switch,? : operator, While-loop, do-while loop, for. **Array**: -Creating an array, one-dimensional array, two-dimensional array. **String**: - String array, string methods. **Inheritance**: -Single & multiple inheritances **Interfaces**: - Defining interfaces, extending interfaces, implementing interfaces.

UNIT - III :

Packages: -Java API packages, creating packages, accessing packages, adding a class to packages. **Import statement**: - Introduction & implementation of import statement. **Applets**:-Introduction to Applets & Application, how applets application are different creating An applet. Applets life cycle, designing a web page, creating an executable applet, running the applet, applet tags, passing a parameter to applet, HTML tag, Converting applet to application. **Threads**:-Overview of threads, single & multiple threads, lift cycle of threads, stopping & blocking threads, working with threads, priority to thread, synchronization. **Exceptions & Errors**:-Introduction, types of error, exception, syntax of exception, handling techniques, exception for Debugging.

UNIT - IV :

Event: -Event driven programming**,** handling an (AWT) events**. Graphic class:-** Introduction, the graphic classes, drawing & filling of lines, rectangle, circle & ellipse, arcs, polygons, text & fonts, creating a font class, font objects, text, coloring object. **Streams:**-Introduction, Abstract stream classes, file input & output. **AWI Applications**: -Creating a GUI using AWT toolkit, using component class, frames. **Components & Control: -**Textfield, textarea class, label, button, choice, list, checkbox, class, and combo. **Menus: -**Creating a popup menus. **Image**: - Type of image, Properties of an image, Displaying an image. **Layouts**: -Using Window Listener interface, Different types of Layout, Layout manager, Flow manager, Grid manager. **Container**: -Different types of container (Frame, Dialog, Panel)

Reference Books:

1. Programming with Java a primer II edition:-E Balaguruswamy(Tata McGraw-Hill)
2. Java Programming (For absolute beginners) Russell PHI
3. Black Book on Java
4. Java-Complete References

B.C.A. Final Semester VI

Paper III

ASP.NET

UNIT - IV :

Introduction to XML

Introduction to XML, creating DTD,elements and attributes definitions.XML schema.Defining simple and complex types.Namespaaces,Schemas and validation. Cascading style sheets(CSS) L and XML, Anatomy of a style,creating and calling style sheets for an XML/HTML document.Layout with CSS. Setting up various properties of elements using CSS.Formatting text with CSS,XML schemas, writing Simple sheets using XSLT,SAX and DOM Parsers, SOAP introduction.

UNIT - II :

Introduction to ASP .NET

Inroduction to ASP .Net, Types,Object and Namespaces, Setting up ASP .NET and IIS,ASP .NET configuration, ASP .NET Application,Web form Fundamentals, Web Controls,Global.asax Application File,Responding to PostBack Events in ASP .NET.

UNIT - III :

ASP .NET Validations and Rich Controls:Calendar Control,AdRotator,Advertisement File and AdRotator Class, Server-side Validation,Client –side Validation,Validation Controls,Validated Customer Form.Stat Management, Tracing,Logging and Error Handling.

UNIT - IV :

Accessing Data with ADO.NET Relational Databases and SQL,ADO .NET Object model, Working with Data –Bound Controls, Populating a DataGrid, DataList and Repeater, Customizing DataSet and Combining Data Tables,Changing Database records accessing,Updating,Deleting and Creating records, Difference between ADO .NET and XML,Adding Controls, Data binding, Database Connectivity.

Reference Books:

1. Biginning XML By Wrox Press
2. XML how to program By Deitel and Deitel
3. Web Enabled Commercial Application Develeopement using HTML, DHTML, JAVA Script, and PERL-CGI By Ivan Bayross
4. The Complete Reference By Thomas Powell Tata MacGraw Hill
5. ASP .NET-The Complete Reference Tata MacGraw Hill

B.C.A. Final Semester VI

Paper IV

SOFTWARE TESTING

UNIT - I:

Introduction: Testing as an Engineering Activity, Testing as a Process, testing axioms, Basic Definitions Software Testing Principles, The Tester's Role in a Software Development Organization, Origins of Defects, cost of defects, Defect Classes, The Defect Repository and Test Design, Defect Examples, Developer/Tester Support for Developing a Defect Repository, Defect Prevention Strategies.

UNIT - II:

Test Case Design : Test Case Design Strategies, Using Black Box Approach to Test Case Design, Random Testing, Requirements based testing, Boundary Value Analysis, Decision tables, Equivalence Class Partitioning, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, User documentation testing, Domain testing

Using White Box Approach to Test design, Test Adequacy Criteria, static testing vs. structural testing, code functional testing, Coverage and Control Flow Graphs, Covering Code Logic, Paths, Their Role in White–box Based Test Design, code complexity testing, Evaluating Test Adequacy Criteria.

UNIT - III:

Levels Of Testing : The Need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, Scenario testing, Defect bash elimination.

System Testing, Acceptance testing, Performance testing, Regression Testing, Internationalization testing, Ad-hoc testing - Alpha , Beta Tests, testing OO systems, Usability and Accessibility testing, Configuration testing, Compatibility testing, Testing the documentation, Website testing

UNIT - IV:

Test Management : People and organizational issues in testing, organization structures for testing teams, testing services, Test Planning , Test Plan Components, Test Plan Attachments, Locating Test Items – test management, test process, Reporting Test Results, The role of three groups in Test Planning and Policy Development, Introducing the test specialist, Skills needed by a test specialist, Building a Testing Group.

Reference Books:

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson education, 2006.
2. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
3. Ron Patton, " Software Testing", Second Edition, Sams Publishing, Pearson education, 2007
4. Renu Rajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill, 2004.
5. Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
6. Boris Beizer, "Software Testing Techniques" – 2nd Edition, Van Nostrand Reinhold New York, 1990.
7. Aditya P. Mathur, "Foundations of Software Testing – Fundamental algorithms and techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008

B.C.A. Final Semester VI

Paper V

PHP - II

UNIT - I :

PHP Browser-Handling Power: Using PHP's Server Variables, Using HTTP Headers, Getting the User's Browser Type, Redirecting Browsers with HTTP Headers, Dumping a Form's Data All at Once, Handling Form Data with Custom Arrays, Putting It All in One Page.

Data Validation: Performing Data Validation, Checking if the User Entered Required Data, Requiring Text, Persisting User Data, Client-Side Data Validation, Handling HTML Tags In User Input.

UNIT - II :

Classes and Objects: Terminology, Creating an Object, Accessing Properties and Methods, Declaring a Class, Introspection, Serialization, Web Techniques: HTTP Basics, Variables, Server Variables, Server Information, Processing Forms, Setting Response Headers, Session, cookies, files, Maintaining State, SSL.

UNIT - III :

Working With Database: Using PHP to Access a Database: Relational Databases and SQL, Mysql database Basics, Execute SQL Queries In PHP, Accessing The Database In PHP: Connecting To The Database, Reading, Displaying, Closing Connection, Database Manipulation: Inserting, Updating, Sorting and Deleting Records. Advanced Database Techniques.

UNIT - IV :

Setting a Cookie, Reading a Cookie, setting cookies Expiration, Deleting Cookies. Working with FTP: Downloading with FTP, Uploading files with FTP, Deleting a file with FTP, Creating and Removing Directories with FTP, Sending E-mail, Advanced E-mail, Adding Attachments to E-mail, Storing Data in Sessions, Writing a Hit Counter Using Sessions. PHP Code,
Shell Commands.

Reference Books:

1. PHP 5.1 for beginners by Evan Bayross and Sharman Shah, SPD Publications
2. PHP 5.2 The Complete Reference by Steven Holzner, Mc Graw Hill Edition 2008.
3. Programming PHP by Rasmus Lerdorf and Kevin Tatroe, Orilly Publications

B.C.A. Final Semester VI

Paper VI

DATA COMMUNICATION AND NETWORK - II

UNIT - I :

Communication Architecture

Protocols & Architecture: Protocols, The Layers Approach, OSI Model, TCP/IP protocol suite, System Network Architecture.

Internetworking: Principles of Internetworking, Bridges, Routers, Repeaters, Gateways, Connection Oriented Internetworking, Connectionless Internetworking, Connectionless Internetwork Protocol, Router-level protocol.

UNIT - II :

Transport Protocols- Transport services, Protocol Mechanism, Network services, ISO Transport Standards, TCP, UDP, TCP and UDP Packet format, Lightweight Transport Protocol.

UNIT - III :

Session Services & Protocols- Session Characteristics, OSI Session Services, Definition, OSI Session Protocol definition. DNS, FTP, HTTP.

UNIT - IV :

Digital Network

ISDN & Broadband ISDN : Overview of ISDN, Architecture and Interfaces of ISDN, Transmission structure, User Access, ISDN protocols, Broadband ISDN(B-ISDN).

Reference Books:

1. William Stalling, Data and Computer Communication, PHI Publication.
2. Forouzan, Data Communication and Networks, Tata McGraw Hill.
3. Godbole, Data Communication and Network, TMH
4. Tanenbum, Computer Networks, PHI Publication.
5. Comer Internetworking with TCP/IP Vol-1, PHI Publication

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR (Established by Government of Central Provinces Education Department by Notification No. 513 dated the 1st of August, 1923 & presently a State University governed by Maharashtra Public Universities Act, 2016)

DIERCTION NO. 5 ...OF 2020

ADMISSIONS AND EXAMINATIONS LEADING TO THE AWARD OF DEGREE OF BACHELOR OF COMMERCE (COMPUTER APPLICATION) (B.C.C.A.) (NEW) (CREDIT BASED SEMESTER PATTERN) DIRECTION 2020.

Whereas, the Maharashtra Public Universities Act, 2016(VI of 2017) (hereinafter the Act VI of 2017) has come in to force in the State of Maharashtra, with effect from 1st March 2017, repealing the Maharashtra Universities Act,1994;

AND

Whereas, the Rashtrasant Tukkoji Maharaj Nagpur University (hereinafter the 'University'), hitherto governed by the Maharashtra Universities Act,1994, is now being governed by the Act (VI of 2017);

AND

Whereas, under section 34(2) of the Act VI of 2017 the University shall have only four faculties specified in said section;

AND

Whereas, the composition of each faculty in the University is to be such as may be prescribed by the University and the University has issued Direction No. 15 of 2017 prescribing the composition of each faculty in the University; whereby erstwhile faculty of commerce is included in the new Faculty of Commerce and Management;

AND

Whereas, the university has issued the Direction No. 10 of 2019 prescribing certain Common conditions for the entire undergraduate and post-graduate programmes /courses in the university;

AND

Whereas, the University had issued the Direction No. 59 of 2016 introducing the Bachelor of Commerce (Computer Application)-(B.C.C.A.) (Credit Based Semester Pattern) programme in the former faculty of Commerce from the academic session 2016-17;

AND

Whereas, the Board of Studies, in its meeting held on 26.02.2019 recommended minor

changes in the syllabus which were approved and recommended in the Faculty of Commerce and Management in its meeting dated 30.5.2019 and these changes have been approved by the Academic council in its meeting dated 10.6.2019

AND

Whereas, by virtue of the provisions of the proviso to section 12(8) of the Act the Direction No. 59 of 2016 has lapsed, necessitating issuance of the fresh Direction incorporating the provisions of Direction No. 59 of 2019 along with the minor changes in the syllabus as recommended and approved by the various academic bodies;

AND

Whereas, Ordinance making involves a time consuming process and there is necessity to issue a fresh Direction for regulating the admissions and examinations of the programme leading to the award of the degree of Bachelor of Commerce - (Computer Application) (B.C.C.A.) (New)(Credit Based Semester Pattern) in the faculty of Commerce and Management,

Now, therefore, I, Dr. Siddharthavinayaka P. Kane, Vice-Chancellor, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur in exercise of the powers vested in me under Section 12(8) of the Maharashtra Public Universities Act of 2016 do hereby issue the following Direction:

1. This Direction shall be called "**ADMISSIONS AND EXAMINATIONS LEADING TO THE AWARD OF DEGREE OF BACHELOR OF COMMERCE (COMPUTER APPLICATION) (B.C.C.A.) (NEW) (CREDIT BASED SEMESTER PATTERN) DIRECTION 2020".**

2. This Direction shall govern all new admissions and examinations for First semester in the academic session 2019-2020 and onwards.

3. **INTERPRETATION CLAUSE**: In this Direction, unless the context requires otherwise the words and phrases shall have following meaning:-

a. **"Academic Council"** means Academic Council of R.T.M. Nagpur University.
b. **"ATKT"** refers to allowed to keep term in higher semester.
c. **"Board of Studies"** means Board of Studies for various subjects of commerce in the faculty of Commerce and Management in the University.
d. **"Competent Authority"** (for admission purpose) means an "Authority" established or assigned the duty to regulate admissions in the course by the Government of Maharashtra or an authority constituted by the University, for this purpose.

e. **"Credit Points"** refer to the product of No. of credits multiplied by the Grade Point for a given course/paper.

f. **"Credit"** (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours.

g. **"Course"** means a paper/subject (theory or practical) prescribed for any semester of the programme.

h. **"Cumulative Grade Point Average (CGPA)"** refers to the Cumulative Grade Point Average weighted across all semesters (4 semesters)

i. **"Degree"** means the Under Graduate Degree awarded after successful completion of the programme governed by this Direction.

j. **"Fees"** means the fees prescribed by the University/ Shikshan Shulka Samiti of Government of Maharashtra, for the Under Graduate programme under this Direction, from time to time.

k. **"Grade letter"** is an index to indicate the performance of a student in a particular course (Paper). It is the transformation of actual marks secured by a student in a course/paper. Grade letters are O, A, B, C, P, F and AB.

l. **"Grade Point"** is the weightage allotted to each grade letter depending on the range of marks awarded in a course/paper.

m. **"Graduate programme"** means Bachelors' degree programme in Commerce (Computer Application).

n. **"Semester Grade Point Average (SGPA)"** refers to the performance of the student in a given semester. SGPA is based on the total credit points earned by the student in all the courses and the total number of credits assigned to the courses/papers in a Semester.

o. **"Student"** means student admitted to Bachelors degree programme in commerce under this direction.

p. **"University"** means Rashtrasant Tukadoji Maharaj Nagpur University.

4. **ELIGIBILITY FOR ADMISSION**:

a. Subject to the provisions of general ordinances of the university regarding admissions in various courses of the university, including reservation of seats, an applicant for admission to this programme, governed by this Direction, shall have passed:-

i. XII Standard Examination of the Maharashtra State Board of Secondary and Higher

Secondary Education, with English at Higher or Lower level and any Modern Indian Language at higher or lower level with any combination of optional subjects;

OR

ii. XII Standard Examination of Maharashtra State Board of Secondary and Higher Secondary Education in Vocational Stream with one language only, or any other examination recognized as equivalent thereto; in such subjects and with such standards of attainments as may be prescribed to be Minimum Competency Vocation Course (MCVC) by the competent authority.

OR

iii. Any other Equivalent Examination of any other State Board, Central Board or International Board in 10+2 pattern with English language as a compulsory subject and any combination of other subjects.

OR

iv. Any equivalent Qualification from any foreign country recognized by the university.

b. No person shall be admitted to this Programme, if he has already passed the same Programme or a Programme of any other statutory University, which has been recognized as equivalent to this programme.

c. A student admitted to the programme under this Direction shall not be allowed to join any other programme in this University or any other University simultaneously. Any violation of this condition will amount to an unfair practice and shall be actionable as per the relevant rules of the university.

5.**THE DURATION OF THE PROGRAMME:** The duration of the programme shall be of **three** academic years consisting of **six** semesters with university examination at the end of each semester.

6. **THE STRUCTURE OF THE PROGRAMME**:

i. The Bachelor of Commerce Computer Application (B.C.C.A.) (Credit Based Semester Pattern) programme shall consist of Six Semesters. The no. of courses in each semester, the maximum marks and the credits for each course and the minimum passing marks for each course, absorption scheme in respective semesters shall be as detailed in APPENDIX- I to this Direction. Detail syllabus & paper pattern is enclosed in APPENDIX-II.

ii. For all Theory Papers there shall be FIVE Periods Per week per Subject of 48 Minutes duration each. Each Theory Paper must cover minimum 60 Clock Hours of Teaching in each semester.

iii. The college shall offer the subjects of any particular Elective Groups only if 20 or more

students are opting for the particular subject.

iv. The fees for the programme and the University examinations shall be as prescribed by the University from time to time.

v. The name and number of courses, passing marks, pattern of examination and credits assigned etc. shall be as given in APPENDIX -I, AND II to this Direction.

7. **RULES OF EXAMINATION**:

i. The Examinations for Semesters I, II, III, IV, V and VI shall be held twice a year. The university examinations shall be held at such places and on such dates as may be notified by the University.

ii. the passing heads in respect of all the courses, including languages, shall consist of the university theory examination and internal assessment marks taken together.

iii. In order to pass any subject (course) a student must secure not less than 40 % of the maximum marks prescribed for that course, i.e. to say, out of total 100 marks (80 for university examination and 20 for internal assessment), the student must obtained minimum 40 marks together in the university examination and internal assessment.

iv. The results of successful candidates at the end of semester-VI shall be classified on the basis of aggregate marks obtained in all the six semesters.

v. The candidates who pass all the semester examinations in the first attempt and have completed program in minimum prescribed period for the programme, are eligible for ranks.

vi. The results of the candidates who have passed the Semester-VI examination but not passed the lower semester examinations shall be declared as NCL (not completed lower semester examinations). Such candidates shall be eligible for the Degree only after successful completion of all the lower semester examinations.

vii. Percentage of marks for declaring class:

Distinction- 75% and above (First Class with Distinction).

First Class - 60% and above, upto 75%

Second Class - 45% and above but less than 60%.

Third Class - 40% and above but not more than 45%

viii. An unsuccessful examinee at any end semester examination shall be eligible for re-examination on the payment of a fresh Examination fees prescribed by the University.

ix. As examinee who has successfully passed the examination of all the semesters shall, on payment of the prescribed fees be entitled to receive a Degree of Bachelor of Commerce (Computer Application) in the prescribed form signed by the Vice-Chancellor.

5

x. The provisions of Ordinance No. 3 of 2007 for the award of grace marks for passing an examination, securing higher grade in subject(s) as updated from time to time shall apply to the examination under this Direction.

8. CONVERSION OF MARKS INTO GRADES AND CALCULATIONS OF GPA (GRADE POINT AVERAGE) AND CGPA (CUMULATIVE GRADE POINT AVERAGE):

The overall evaluation of a student shall be designated in terms of Grade. The abbreviations used in grade computation and the evaluation mechanism and formulae used are as follows:-

Abbreviations and Formulae :

G :Grade

GP : Grade Points

C :Credits

CP : Credit Points

CG : Credits X Grades (Product of credits & Grades)

SGPA = ΣCG: Sum of Product of Credits & Grades points / ΣC: Sum of Credits points

SGPA : Semester Grade Point Average shall be calculated for individual semesters. (It is also designated as GPA)

CGPA : Cumulative Grade Point Average shall be calculated for the entire Programme by considering all the semesters taken together.

While calculating the CG the value of Grade Point 1 shall be consider Zero (0) in case of learners who failed in the concerned course/s i.e. obtained the marks below 40. After calculating the SGPA for an individual semester and the CGPA for entire programme, the value can be matched with the grade in the Grade Point table as per the Five (05) Points Grading System and expressed as a single designated GRADE such as O,A,B,C, F. (Fail).

Marks	Grade	Grade Points (out of 10)
85 TO 100	O	10
75 TO 84	A+	09
71 TO 74	A	08
61 TO 70	B+	07
55 TO 60	B	06
50 TO 54	C	05
40 TO 49	P	04
00 TO 39	F (Fail)	00
AB	AB(Absent)	00

CGPA	Grade	Division
9.01 to 10	O (Outstanding)	**First Division (outstanding)**
8.01to 9.00	A+(Distinction)	**First Division (Distinction)**
7 .01 to 8.00	A (Very Good)	**First Division (Very Good)**
6.01 to 7.00	B+(Good)	**First Division (Good)**
5.55 to 6.00	B (Above Average)	**Second Division** (Above Average)
5.00 to 5.54	C (Average)	**Second Division (Average)**
4.00 to 4.99	P (Pass)	**Pass**
0.00 to 3.99	F (Fail)	**Fail**
0	AB (Absent)	**Absent**

Note:-Consider Grade Points equal to Zero for (C x G) calculations of failed Learner/s in the concerned course/s.

Conversion formula from CGPA to Percentage: % = (CGPA- 0.75)* 10

The illustration for the conversion of marks into grades in a course and semester Illustrations of Calculation:- Pass

Subjects	Total Maximum Marks	Total Minimum Marks	Total Marks Obtained	Grade(G)	Grade points (GP)	Credit of the Course(C)	(Credit) X (Grade points)(CX GP)	SGPA=ΣCG/ΣC
1T1	100	40	60	A	9	4	36	**SGPA**
1T2	100	40	50	B	8	4	32	=176/20
1T3	100	40	75	O	10	4	40	=8.8
1T4	100	40	70	A	9	4	36	**Grade B RESULT**
P-I	100	40	48	B	8	4	32	**=PASS**
Total	**500**	**200**	**303**	--	**44**	**20**	**176**	

Illustrations of Calculation:- Fail

Subjects	Total Maximum Marks	Total Marks Obtained	Grade (G)	Grade points(GP)	Credit of the Course (C)	(Credit) X (Grade points) (CX GP)	SGPA=ΣCG/ΣC
3T1	100	32	F	0	4	00	**SGPA** =72/20 =3.6 **Grade F** **RESULT** **=FAIL**
3T2	100	34	F	0	4	00	
3T3	100	60	B	8	4	32	
3T4	100	75	O	10	4	40	
P-I	100	33	F	0	4	00	
Total	**500**	**234**	--	**10**	**20**	**72**	

9. **ATKT Rules**: Rules of ATKT shall be as given in the following table:

Admission to Semester	Candidate should have filled in the examination form of the R.T.M. Nagpur University	Requirement of passing Semester and/or courses
II Semester	Semester - I	-
III Semester	Semester - II	Candidate should have passed in at least 50% of passing heads of Semester I and II taken together
IV Semester	Semester III	-
V Semester	Semester - IV	Candidate should have passed Semester I & II and Candidate should have passed in at least 50% of passing heads of Semester III &IV taken together*
VI Semester	Semester V	-

*Note: For calculating the requirement of fifty percent passing heads fraction is to be ignored as per the provisions of Direction no. 10 of 2019.

10. This Direction shall be made applicable to the students who shall be admitted as regular

students in Semester –I of BCCA Part –I from the academic year 2019-2020, and shall be applied to succeeding examinations in phased manner.

11. All the students who had taken admission in BCCA programme under earlier Direction, i.e. 59 of 2016 (Old Course) shall continue to be governed by the said Direction till the New Progrmme reach the respective semester in natural progression, thereafter students of the old course shall be given three additional chances to clear the backlog, if any, thereafter they shall be absorbed in the New Programme under this Direction as per the absorption scheme appended to this Direction.

12. If any question of interpretation of any clause of this Direction arises the same shall be referred to the Dean, Faculty of Commerce and Management whose opinion shall be final and binding.

Nagpur
Date---- 5/3/2020

(Dr. Siddharthavinayaka P. Kane)
Vice-Chancellor

APPENDIX - I

Teaching and Examination Scheme

B.Com. (Computer Application) (BCCA) NEW

(A) BCCA Part –I

Semester – I

Course Code	Subjects	Paper	Teaching Scheme per weeks			Examination Scheme						Total Marks	Credits
						Theory				Practical			
			Theory (Periods)	Practical (Periods)	Total (Periods)	Max Marks-Theory Paper (TH)	Max Marks – Internal Assessment	Total	Min Passing Marks	Max Mark - Practical (PR)	Min Passing Marks		
Theory													
1T1	English and Business Communication - I	I	5	-	5	80	20	100	40	-	-	100	4
1T2	Financial Accounting	II	5	-	5	80	20	100	40	-	-	100	4
1T3	Fundamentals of Computer	III	5	-	5	80	20	100	40	-	-	100	4
1T4	Programming in 'C'	IV	5	-	5	80	20	100	40	-	-	100	4
Practical													
1P1	Fundamentals of Computer **&** Programming in 'C'	P- I	-	6	6	-	-	-	-	100	40	100	4
	Total		**20**	**6**	**26**							**500**	**20**

(B) BCCA Part –I

Semester – II

Course Code	Subjects	Paper	Teaching Scheme per weeks			Examination Scheme						Total Marks	Credits
						Theory				Practical			
			Theory (Periods)	Practical (Periods)	Total (Periods)	Max Marks - Theory Paper (TH)	Max Marks - Internal Assessment	Total	Min Passing Marks	Max Marks - Practical (PR)	Min Passing Marks		
Theory													
2T1	English and Business Communication - II	I	5	-	5	80	20	100	40	-	-	100	4
2T2	Principles of Business Management	II	5	-	5	80	20	100	40	-	-	100	4
2T3	Programming in C++‘	III	5	-	5	80	20	100	40	-	-	100	4
2T4	E-Commerce and Web Designing	IV	5	-	5	80	20	100	40	-	-	100	4
Practical													
2P1	Programming in C++‘& E-Commerce and Web Designing	P- I	-	6	6	-	-	-	-	100	40	100	4
	Total		**20**	**6**	**26**							**500**	**20**

(C)BCCA Part -II

Semester – III

Course Code	Subjects	Paper	Teaching Scheme per weeks			Examination Scheme						Total Marks	Credits
						Theory				Practical			
			Theory (Periods)	Practical (Periods)	Total (Periods)	Max Marks - Theory Paper (TH)	Max Marks - Internal Assessment	Total	Min Passing Marks	Max Marks - Practical (PR)	Min Passing Marks		
Theory													
3T1	Environmental Studies	I	5	-	5	80	20	100	40	-	-	100	4
3T2	Business Economics	II	5	-	5	80	20	100	40	-	-	100	4
3T3	Visual Basic Programming	III	5	-	5	80	20	100	40	-	-	100	4
3T4	Database Management System	IV	5	-	5	80	20	100	40	-	-	100	4
Practical													
3P1	Visual Basic Programming **&**Database Management System	P- I	-	6	6	-	-	-	-	100	40	100	4
	Total		**20**	**6**	**26**							**500**	**20**

(D) BCCA Part -II

Semester – IV

Course Code	Subjects	Paper	Teaching Scheme per weeks			Examination Scheme						Total Marks	Credits
						Theory				Practical			
			Theory (Periods)	Practical (Periods)	Total (Periods)	Max Marks - Theory Paper (TH)	Max Marks - Internal Assessment	Total	Min Passing Marks	Max Marks - Practical (PR)	Min Passing Marks		
Theory													
4T1	Statistical Techniques	I	5	-	5	80	20	100	40	-	-	100	4
4T2	Business Law	II	5	-	5	80	20	100	40	-	-	100	4
4T3	Core Java	III	5	-	5	80	20	100	40	-	-	100	4
4T4	PHP & MySQL	IV	5	-	5	80	20	100	40	-	-	100	4
Practical													
4P1	Core Java**&** PHP & MySQL	P- I	-	6	6	-	-	-	-	100	40	100	4
	Total		**20**	**6**	**26**							**500**	**20**

(E) BCCA Part –III

Semester – V

Course Code	Subjects	Paper	Teaching Scheme per weeks			Examination Scheme						Total Marks	Credits
						Theory				Practical			
			Theory (Periods)	Practical (Periods)	Total (Periods)	Max Marks - Theory Paper (TH)	Max Marks - Internal Assessment	Total	Min Passing Marks	Max Marks - Practical (PR)	Min Passing Marks		
Theory													
5T1	Computerized Accounting using Tally	I	5	-	5	80	20	100	40	-	-	100	4
5T2	VB.Net	II	5	-	5	80	20	100	40	-	-	100	4
5T3	**SEC – I :** (i) Management Information Systems (ii) System analysis &Design	III	5	-	5	80	20	100	40	-	-	100	4
5T4	**DSE– I :** (i) Cost & Management Accounting (ii) Corporate Accounting	IV	5	-	5	80	20	100	40	-	-	100	4
Practical													
5P1	Tally & VB.Net	P- I	-	6	6	-	-	-	-	100	40	100	4
	Total		**20**	**6**	**26**							**500**	**20**

BCCA Part -III

Semester – VI

Course Code	Subjects	Paper	Teaching Scheme per weeks			Examination Scheme						Total Marks	Credits
						Theory				Practical			
			Theory (Periods)	Practical (Periods)	Total (Periods)	Max Marks - Theory Paper (TH)	Max Marks - Internal Assessment	Total	Min Passing Marks	Max Marks - Practical (PR)	Min Passing Marks		
Theory													
6T1	C#.Net	I	5	-	5	80	20	100	40	-	-	100	4
6T2	**SEC– II :** (i) Python (ii) Ruby on Rail	II	5	-	5	80	20	100	40	-	-	100	4
6T3	**DSE– II :** (i) Entrepreneurship Development (ii) Company Law and Secretarial Practice	III	5	-	5	80	20	100	40	-	-	100	4
Practical													
6P1	C#.Net & SEC - II	P- I	-	6	6	-	-	-	-	100	40	100	4
6P2	**Project**	Project	-	6	6	-	-	-	-	100	40	100	4
	Total		**15**	**12**	**27**							**50**	**20**

Notes:

1. TH = Theory, PR = Practical, IA = Internal Assessment, SEC = Skill Enhancement Course, DSE = Discipline Specific Elective.
2. The practical shall be treated as a separate passing head.
3. Practical Record File should be prepared for Practical Subjects. Both subjects should be included in Practical Record File.
4. The Practical batch size shall be of 60 (Sixty) students per batch with Two students sharing one computer terminal.
5. The candidate has to pass theory papers and Practical Paper separately.
6. Above instructions are applicable for all semesters.

ABSORPTION SCHEME

B.Com (COMPUTER APPLICATION) (BCCA) NEW course

(From Annual Pattern Introduced in 2013-2014 & CBS Semester pattern introduced in 2016-17 (referred as **OLD Course** hereafter**) to CBS semester Pattern introduced in Session 2019- 20 (**referred as **NEW Course** hereafter**)**

It is notified for general information of all concerned that the failure students of **B.Com. (Computer Application) (BCCA) Annual pattern Course (introduced in 2013-2014) & CBS Semester pattern (introduced in 2016-2017) old Course shall be absorbed in the NEW Course CBS Semester Pattern introduced from the session 2019-2020 examination with the following scheme.**

1. Those who have completed & passed **B.Com. (Computer Application) (BCCA) Part-I as per Annual pattern course** are eligible for admission in the **B.Com. (Computer Application) (BCCA) SEM - III CBS Pattern introduced from the session 2019-2020 (NEW Course).**

2. Failure students of **B.Com. (Computer Application) (BCCA) Part – I - Annual Pattern course** and having ATKT as per rules mention in direction No. **12** of **2014**, are eligible to take admission in **B.Com. (Computer Application) (BCCA) SEM - III CBS Pattern introduced from the session 2019-2020 (NEW Course).**

Such students will have to compulsorily fill Semester-I and Semester-II exam form and appear for the papers which have no exemptions as mentioned below-

(A) BCCA Part –I

Absorption Scheme B.Com.(Computer Application)								
CBS Semester Pattern Introduced in 2019-2020 (New course) with CBS semester pattern Introduced in 2016-2017 (Old course) and with Annual Pattern introduced in 2013-2014								
BCCA - PART - I - SEMESTER - I								
Sr. No	**CBS Semester Pattern - (New Course) introduced in 2019-2020**	**Max Marks**	**Sr. No**	**CBS Semester Pattern - (Old Course) introduced in 2016-2017**	**Max Marks**	**Sr. No**	**(Annual Pattern) Course introduced in 2013-14**	**Max Marks**
Theory			**Theory**			**Theory**		
1T1	English and Business Communication - I	80	1T1	English and Business Communication - I	80	1	English & Business Communication	80
1T2	Financial Accounting	80	1T2	Financial Accounting	80	3	Financial Accounting	80
1T3	Fundamentals of Computer	80	1T3	Fundamentals of Computer	80	4	Information Systems	80
1T4	Programming in _C'	80	1T4	Programming in _C'	80	6	Introduction to Operating Systems	80
Practical			**Practical**			**Practical**		
1P1	Practical - I :(Semester - I) - Fundamentals of Computer & Programming in _C'	100	1P1	Practical - I :(Semester - I) - Fundamentals of Computer & Programming in _C'	100		**Practical-I :** Microsoft Office	100

Absorption Scheme B.Com.(Computer Application)								
CBS Semester Pattern Introduced in 2019-2020 (New course) with CBS semester pattern Introduced in 2016-2017 (Old Course) and with Annual Pattern course introduced in 2013-2014								
BCCA - PART - I - SEMESTER - II								
Sr. No	**CBS Semester Pattern - (New Course) introduced in 2019-2020**	**Max Marks**	**Sr. No**	**CBS Semester Pattern - (Old Course) introduced in 2016-2017**	**Max Marks**	**Sr. No**	**(Annual Pattern) Course introduced in 2013-14**	**Max Marks**
Theory			**Theory**			**Theory**		
2T1	English and Business Communication - II (Sem - II)	80	**2T1**	**English and Business Communication - II (Sem - II)**	**To be appeared compulsorily**			
2T2	Principles of Business Management	80	2T2	Principles of Business Management	80	2	Principles of Business Management	80
2T3	Programming in C++ (Sem - II)	80	**2T3**	**Programming in C++ (Sem - II)**	**To be appeared compulsorily**			
2T4	E-Commerce and Web Designing	80	2T4	E-Commerce and Web Designing	80	5	Information Technology	80
Practical			**Practical**			**Practical**		
1P1	Practical - I :(Semester - I) - Fundamentals of Computer & Programming in ‗C'	100	1P1	Practical - I :(Semester - I) - Fundamentals of Computer & Programming in ‗C'	100	1P1	Practical - I :(Semester - I) - Fundamentals of Computer & Programming in ‗C'	100
All the students absorbed in semester pattern course will have to compulsorily fill Semester I and Semester II exam forms and appear for these two papers of (New course). Other papers if any to be appeared as per exemption mentioned								

3. Those who have completed & passed **B.Com. (Computer Application)(BCCA) Part-I & B.Com. (Computer Application) (BCCA) Part - II as per (Annual Pattern) course** are eligible for admission in the **B.Com. (Computer Application) (BCCA) (NEW Course) CBS scheme (Part – III) Sem – V.**

4. Failure students of **B.Com. (Computer Application) (BCCA) Part - II (Annual Pattern) course** and having ATKT as per rules are eligible to take admission in **B.Com. (Computer Application) (BCCA) (NEW Course) Part-III Sem – V CBS pattern introduced in 2019-2020. Such students will have to compulsorily fill Semester-III and Semester-IV exam form and appear for the papers which have no exemptions as mentioned below-**

(B) BCCA Part –II

BCCA - PART - II - SEMESTER - III								
CBS Semester Pattern Introduced in 2019-2020 with (New course) CBS semester pattern Introduced in 2016-2017 (Old Course) and with Annual Pattern introduced in 2013-2014								
Sr. No	**CBS Semester Pattern - (New Course) introduced in 2019-2020**	**Max Marks**	**Sr. No**	**CBS Semester Pattern - (Old Course) introduced in 2016-2017**	**Max Marks**	**Sr. No**	**(Annual Pattern) Course introduced in 2013-14**	**Max Marks**
Theory			**Theory**			**Theory**		
3T1	Environment Studies of Sem-III	80	**3T1**	**Environment Studies of Sem-III**	**To be appeared compulsorily**			
3T2	Business Economics	80	3T2	Business Economics	80	2	Business Economics	80
3T3	Visual Basic Programming	80	3T3	Visual Basic Programming	80	4	Programming Skills (C Prog.)	80
3T4	Database Management System	80	3T4	Database Management System	80	6	MIS & System Analysis	80
Practical			**Practical**			**Practical**		
3P1	**Practical - I : (Semster - III) -** Visual Basic Programming & Database Management System	100	3P1	**Practical - I : (Semster - III) -** Visual Basic Programming & Database Management System	100	7	**Practical-I :** Programming Skills	100

BCCA - PART - II - SEMESTER - IV								
CBS Semester Pattern Introduced in 2019-2020 with (New course) CBS semester pattern Introduced in 2016-2017 (Old Course) and with Annual Pattern introduced in 2013-2014								
Sr. No	**CBS Semester Pattern - (New Course) introduced in 2019-2020**	**Max Marks**	**Sr. No**	**CBS Semester Pattern - (Old Course) introduced in 2016-2017**	**Max Marks**	**Sr. No**	**(Annual Pattern) Course introduced in 2013-14**	**Max Marks**
Theory			**Theory**			**Theory**		
4T1	Mathematics	80	4T1	Mathematics	80	1	Statistics Techniques	80
4T2	Business Law	80	4T2	Business Law	80	3	Cost & Management Accounting	80
4T3	Core Java of Sem - IV	80	**4T3**	**Core Java of Sem - IV**	**To be appeared compulsorily**			
4T4	PHP & MySQL	80	4T4	PHP & MySQL	80	5	E-Commerce & Web Designing	80
Practical			**Practical**			**Practical**		
4P1	**Practical - I : (Semester - IV) -** PHP & MySQL	100	4P1	**Practical - I : (Semester - IV) -** PHP & MySQL	100	8	**Practical-II :** HTML	100
All the students absorbed in semester pattern course will have to compulsorily fill Semester III and Semester IV exam forms and appear for these two papers of (New course). Other papers if any to be appeared as per exemption mentioned								

5. Failure students of **B.Com. (Computer Application) (BCCA) Part-III (Annual Pattern) course** are having chances upto **winter 2019** examination **(Last Chance)**. So they should appear **B.Com. (Computer Application) (BCCA) Part-III (Annual Pattern) course examination & is required to clear their backlog**. After that those who will have backlog, **will have to compulsorily fill Semester-V and Semester-VI exam form of BCCA (New course) and appear for papers which have no exemptions as mention below –**

(C) BCCA Part –III

BCCA - PART - III - SEMESTER - V								
CBS Semester Pattern Introduced in 2019-2020 with (New course) CBS semester pattern Introduced in 2016-2017 (Old Course) and with Annual Pattern introduced in 2013-2014								
Sr. No	**CBS Semester Pattern - (New Course) introduced in 2019-2020**	**Max Marks**	**Sr. No**	**CBS Semester Pattern - (Old Course) introduced in 2016-2017**	**Max Marks**	**Sr. No**	**(Annual Pattern) Course introduced in 2013-14**	**Max Marks**
Theory			**Theory**			**Theory**		
5T1	Computerized Accounting using Tally	80	5T1	Computerized Accounting using Tally	80	2	Computerized Accounting (TALLY)	80
5T2	VB.Net	80	5T2	VB.Net	80	5	DBMS and Oracle	80
5T3	**SEC – I : (Any One)**		5T3	**SEC – I : (Any One)**				
	(i) Management Information Systems	80		(i) Management Information Systems	80	3	Software Product and Project Management	80
	(ii) System analysis & Design	80		(ii) System analysis & Design	80			
5T4	**DSE – I : (Any One)**		5T4	**DSE – I : (Any One)**				
	(i) Cost & Management Accounting	80		(i) Cost & Management Accounting	80	1	Business Law	80
	(ii) Corporate Accounting	80		(ii) Corporate Accounting	80			
Practical			**Practical**			**Practical**		
5P1	**Practical - I : (Semester - V) -** Computerized Accounting using Tally & Visual Basic	100	5P1	**Practical - I : (Semester - V) -** Computerized Accounting using Tally & Visual Basic	100	6	Practical-I : Tally	100

BCCA - PART - III - SEMESTER - VI

CBS Semester Pattern Introduced in 2019-2020 with (New course) CBS semester pattern Introduced in 2016-2017 (Old Course) and with Annual Pattern introduced in 2013-2014

Sr. No	CBS Semester Pattern - (New Course) introduced in 2019-2020	Max Marks	Sr. No	CBS Semester Pattern - (Old Course) introduced in 2016-2017	Max Marks	Sr. No	(Annual Pattern) Course introduced in 2013-14	Max Marks
Theory			**Theory**			**Theory**		
6T1	C#.Net	80	6T1	C#.Net	80	4	Front End Development	80
6T2	**SEC-II (Any One)**		6T2	**SEC-II (Any One)**	**To be appeared compulsorily (Any One)**			
	(i) Python	80		(i) Python				
	(ii) Ruby on Rail	80		(ii) Ruby on Rail				
6T3	**DSE-II (Any One)**		6T3	**DSE-II (Any One)**	**To be appeared compulsorily (Any One)**			
	(i) Entrepreneurship Development	80		(i) Entrepreneurship Development				
	(ii) Company Law and Secretarial Practice	80		(ii) Company Law and Secretarial Practice				
Practical			**Practical**			**Practical**		
6P1	**Practical - I : (Semester - VI) -** C#.Net & SEC-II (Any One - Python / Ruby on Rail	100	6P1	**Practical - I : (Semester - VI) -** C#.Net & SEC-II (Any One - Python / Ruby on Rail	100	7	Practical-II : VB & Oracle	100
Project			**Project**			**Project**		
6P2	**Project**	100	6P2	**Project**	100	8	PROJECT	100

All the students absorbed in semester pattern course will have to compulsorily fill Semester V and Semester VI exam forms and appear for these two papers of (New course). Other papers if any to be appeared as per exemption mentioned

APPENDIX – II

QUESTION PAPER PATTERN
First / Second / Third / Fourth / Fifth / Sixth Semester
Bachelor of Commerce(Computer Application)- (BCCA) CBS Examination

Semester – I – (Financial Accounting),
Semester – II - Principles of Business Management),
Semester – III – (Environmental Studies, Business Economics),
Semester – IV- (Statistical Techniques, Business Law),
Semester – V – (Cost and Management Accounting, Corporate Accounting),
Semester – VI – (Entrepreneurship Development, Company Law and Secretarial Practice)

Time: 3 Hours **Total Marks: 80**

N. B. - a) Draw well labeled diagram wherever necessary.
b) All questions are compulsory.

Q1. 4 x 4 = 16

a. Unit – I
b. Unit – II
c. Unit – III
d. Unit - IV

Q2. Either
(A) 8 - Unit – I
(B) 8 - Unit - I
OR
(C) 16 - Unit - I

Q3. **Either**
(A) 8 - Unit - II
(B) 8 - Unit - II
OR
(C) 16 - Unit - II

Q4. **Either**
(A) 8 - Unit - III
(B) 8 - Unit - III
OR
(C) 16 - Unit - III

Q5. **Either**
(A) 8 - Unit - IV
(B) 8 - Unit - IV
OR
(C) 16 - Unit – IV

QUESTION PAPER PATTERN
First / Second / Third / Fourth / Fifth / Sixth Semester
Bachelor of Commerce(Computer Application)- (BCCA) CBS Examination

Semester – I – (Fundamentals of Computer, Programming in C),
Semester – II – (Programming in C++, E-Commerce and web Designing),
Semester – III – (Visual Basic Programming, Database Management System),
Semester – IV – (Core Java, PHP & MySQL),
Semester – V – (Computerized Accounting using Tally, VB.Net, Management Information Systems, System Analysis & Design),
Semester – VI – C#.Net, Python, Ruby on Rail,

Time: 3 Hours **Total Marks: 80**

N. B. - a) Draw well labeled diagram wherever necessary.
b) All questions are compulsory.

Q1. **8 x 2 = 16**

N. B. – 1. Each question carries two marks.
2. Answers should not more than five lines.

A. Unit I
B. Unit I
C. Unit II
D. Unit II
E. Unit III
F. Unit III
G. Unit IV
H. Unit IV

Q2. **8 x 3 = 24**

N. B. – 1. Each question carries three marks.
2. Answers should not more than ten lines.

A. Unit I
B. Unit I
C. Unit II
D. Unit II
E. Unit III

F. Unit III

G. Unit IV

H. Unit IV

N. B. – 1. Each question carries five or ten marks.

2. Answers should not more than 400 words for 5 marks questions and 600 words for 10 Marks questions respectively.

Q3. **Either**

(A) 5 Unit I

(B) 5 Unit I

OR

(C) 10 Unit I

Q4. **Either**

(A) 5 Unit II

(B) 5 Unit II

OR

(C) 10 Unit II

Q5. **Either**

(A) 5 Unit III

(B) 5 Unit III

OR

(C) 10 Unit III

Q6. **Either**

(A) 5 Unit IV

(B) 5 Unit IV

OR

(C) 10 Unit IV

QUESTION PAPER PATTERN OF ENGLISH AND BUSINESS COMMUNICATION

Subject: English and Business Communication – I

SEMESTER – I

Time:3Hours] **[Total Marks:80**

Q1. A. Comprehension of Unseen Passage from Unit-I 10 Marks

(Five VSAQs of 2 Marks each based on the Unseen Passage)

B. Questions on ANY TWO components of Enriching Vocabulary from Unit -I

(**Five items to be solved out of Eight (5 x 1 Mark)X2**) 10 Marks

(Synonyms/Antonyms to be given in match the following format–5 words against 8 options)

Q2. A. ONE out of TWO Letters (Application for Employment/Job Offer Letters) from

Unit II 10 Marks

B. ONE out of TWO Letters (Sales letters / Claim and Adjustment Letters) from

Unit - II 10 Marks

Q 3. A. ONE LAQ out of TWO from Unit - III (10 × 1) =10 Marks

B. TWO SAQs out of THREE from Unit - III (5 x 2) = 10 Marks

Q 4. A. THREE SAQs with internal choice from Prose Section of Unit IV (3 x 5 Marks)=15 Marks

B. ONE SAQ with internal choice from Poetry Section of Unit IV 05 Marks

Total = 80 Marks

LAQ - Long Answer Questions to be answered in about 150words

SAQ - Short Answer Questions to be answered in about 75 words approximately.

INTERNAL ASSESSMENTOF ENGLISH AND BUSINESS COMMUNICATION: 20 MARKS

The Internal Assessment would be done on the basis of the assignments submitted by the student and his/her performance, attendance and conduct during the Semester. The concerned teacher shall provide, in advance, a list of topics/assessment items/Question Bank (to the students) based on the Units prescribed for the Theory Examination. Students shall finalize 2 topics/items from 2 different units with the approval of the concerned teacher and submit the same within the prescribed deadline.

Students may be given freedom to submit a creative writing assignment on human values/world peace/environmental issues inspired by or related to the lessons/poems prescribed in the syllabus.

2Assignments	**–**	**6+6 = 12**
Marks Performance & Conduct	**–**	**4**
Marks Attendance	**-**	**4 Marks**
TOTAL	**–**	**20 MARKS**

QUESTION PAPER PATTERN OF ENGLISH AND BUSINESS COMMUNICATION

Subject: English and Business Communication – II

SEMESTER – II

Time:3Hours] **[TotalMarks:80**

Q1. A. Comprehension of Unseen Passage from Unit-I 10 Marks

(Five VSAQs of 2 Marks each based on the Unseen Passage)

B. Question from Section B of Unit 10 Marks

- **(Five items out of Eight on meanings of the Words often Confused - (1 x 5 Marks))**
- **(Five items out of Eight on Punctuation –(1 x 5 Marks))**

Q2. A. ONE out of TWO Letters (Inviting Quotation / Placing Order) from Unit II 10 Marks

B. ONE out of TWO Letters (Credit Letters - Granting/Refusing Credit, Letter to Bank for overdraft facility) from Unit-II 10 Marks

Q 3. A. ONE LAQ out of TWO from Unit -III (10 × 1) =10 Marks

B. TWO SAQs out of THREE from Unit-III (5 x 2) = 10 Marks

Q 4. A. THREE SAQs with internal choice from Prose Section of Unit IV (3 x 5 Marks) =15 Marks

B. ONE SAQ with internal choice from Poetry Section of Unit-IV 05 Marks

Total = 80 Marks

LAQ - Long Answer Questions to be answered in about 150words

SAQ - Short Answer Questions to be answered in about 75 words approximately.

INTERNAL ASSESSMENTOF ENGLISH AND BUSINESS COMMUNICATION: 20 MARKS

The Internal Assessment would be done on the basis of the assignments submitted by the student and his/her performance, attendance and conduct during the Semester. The concerned teacher shall provide, in advance, a list of topics/assessment items/Question Bank (to the students) based on the Units prescribed for the Theory Examination. Students shall finalize 2 topics/items from 2 different units with the approval of the concerned teacher and submit the same within the prescribed deadline.

Students may be given freedom to submit a creative writing assignment on human values/world peace/environmental issues inspired by or related to the lessons/poems prescribed in the syllabus.

2Assignments	**–**	**6+6 = 12**
Marks Performance & Conduct	**–**	**4**
Marks Attendance	**-**	**4 Marks**
TOTAL	**–**	**20 MARKS**

(A) Project and Classification of Marks on Project

Towards the end of the second year of study, a student will be examined in the course

-Project Work‖

a. Project Work may be done individually or in groups (Maximum 3 students) in case of bigger projects. However if project is done in groups, each student must be given a responsibility for a distinct module and care should be taken to monitor the progress of individual student.
b. The Project Work should be done using the tools covered in B.Com. (Computer Application) (BCCA).
c. The Project Work should be of such a nature that it could prove useful or be relevant from the commercial / management angle.
d. The project work will carry 100marks.
e. Project Work can be carried out in the Institute or outside with prior permission of the Institute.
f. The external viva-voice examination for Project Work would be held as per the Examination Time Table of the Third year of study, by a panel of one external and one Internal Examiner.

Types of Project

As majority of the students are expected to work out a project in some industry / research and development laboratories / educational institutions / software export companies, it is suggested that the project is to be chosen which should have some direct relevance in day-today activities of the candidates in his/her institution. The Applications Areas of project – Financial / Marketing / Database Management System / Relational Database Management System / E-Commerce / Internet / Manufacturing / web Designing / Scientific / ERP etc.

Project Proposal (Synopsis)

The project proposal should be prepared in consultation with the guide. The project guide must be a RTM Nagpur university approved teacher. The project proposal should clearly state the objectives and environment of the proposed project to be undertaken. It should have full details in the following form:

Format of Synopsis for Desktop Application

1. Title of the Project.
2. Objectives of the Project.
3. Project Category (DBMS / RDBMS / OOPS etc.)
4. Tools / Platform and Languages to be used.
5. Complete Structure of the System:
    i. Numbers of Modules and its Description.
    ii. Modular Chart / System Chart.
    iii. Data Structures or Tables.
    iv. Process Logic of each Module.
    v. Types of Report Generation.
6. References.

Note: Synopsis should not be more than 3-4 pages.

Format of Synopsis for Web Application

1. Title of the Project.
2. Objectives of the Project.
3. Project Category (DBMS / RDBMS / OOPS etc.).
4. Tools / Platform and Languages to be used.
5. Complete Structure of the System:
    I. Number of pages and links their short description.
    II. Use / Information of Pages.
    III. Feedback Form (if any).
6. References.

Note: Synopsis should not be more than 3-4 pages.

Project Report Formulation

Front Page.

College Certificate Page. Declaration Page.

Acknowledgment Page. Project Profile.

Index or Content Page.

I. *Contents————————————.
II. Appendices

I. List Figures, Tables& Charts.

II. Approved copy of Synopsis. Glossary

III. Contents.

I. Introduction.

II. Objectives.

III. Preliminary System Analysis.

- Preliminary Investigation.
- Present System in Use.
- Flaws in Present System.
- Need of New System.
- Feasibility Study.
- Project Category.

IV. Software Engineering Paradigm Applied

- Modules
- System / Modular Chart.

V. Software & Hardware Requirement Specification.

VI. Detailed System Analysis.

- Data Flow Diagram.
- Numbers of Modules and Process Logic.
- Data Structures and Tables.
- Entity-Relationship Diagram.

VII. System Design.

- Form Design.
- Source Code.
- Input screen & Output Screen.

VIII. Testing &Validation Checks.

IX. System Security Measures.

X. Implementation, Evaluation and Maintenance.

XI. Future Scope of the project.

XII. Suggestion &Conclusion

XIII. Bibliography & References.

Note :-

i. A Student is expected to complete the Assignments based on Syllabus of Practical subjects and submit the same in the form of a files

(assignment Record) at the end of Academic Session for the evaluation purpose.

ii. A student should submit internal assessment of each theory paper prescribed by the subject teacher.

iii. A Student is expected to deliver a seminar on any course curricular subject / latest trends in IT relevant subject per semester for internal assessment.

Classification Of Marks on Project :-

Report & Documentation	40
Viva-voce (External)	40
Viva-voce (Internal)	20
Total Marks	**100**

The marks of Project shall be notified as a whole out of 100 in Foil/C-Foil

(B) Practical and Classification of Marks on Practical

1. Practical exam shall be of 4 hours duration.
2. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department.
3. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.
4. After Viva-Voice and evaluation of practical records of a student by the Internal & External Examiner, both examiners should sign on the certificate of practical records.

The certificate template shall be as follows:

Name of the college/

Institution name of the department

CERTIFICATE

This is to certify that Mr./Mrs./Ms. _____ of class BCCA ____ **Year** Semester _____ has satisfactorily completed the practical experiments prescribed by The Rastrashant Tukdoji Maharaj Nagpur University, Nagpur for the subject **Practical –** _____ **-** _____ during the academic year **20 - 20** .

Signature Signature

Practical In-charge **Head of the Department**

Signature Signature

Internal Examiner **External Examiner**

Date -

Classification of Practical Marks:-

Practical–I	**Marks**	**Marks**
Writing a Program or Problem (Algorithm & Flowchart)	20	20
2. Execute on a computer		
3. Taking Hard Copy		

Practical – II				
1.Writing a Program or Problem (Algorithm & Program)	10		10	
External Viva Voce	10		10	
Practical Record	10		10	
Total Marks	**50**	**+**	**50**	**=100**

Note:

- Since the practical contains two components (i.e. two subjects), so each components has to be evaluated as above.
- Whereas, the marks of Practical shall be notified as a whole out of 100 in Foil / C-Foil.

Detailed syllabus for theory papers

(BCCA)Part-I

Semester – I

Paper – I
Course name - English and Business Communication – I
Course code - 1T1

UNIT I

A. Comprehension of an Unseen Passage
B. Enriching Vocabulary: Synonyms and Antonyms, Single Word for a Group of Words, Change of Word from Noun to Adjective &vice-versa.

UNIT II

Business Correspondence: Application for Employment, Job Offer Letters, Sales letters, Claim and Adjustment Letters

UNIT III

Communication Process: Sender, Channel, Message,
Receiver and Response
Types of Communication:

a. According to mode: a. Oral b. Written
b. According to Medium: a. Electronic b. Print
c. According to number of participants: a. Dyadic b. Group
d. According to Direction: a. One-way b. Two-way
e. According to Purpose: a. General b. Business(Specific)

UNIT IV

Textbook entitled ‗Prism: Spoken and Written Communication, Prose & Poetry' published by Orient Black Swan

Prose

i) With the Photographer – Stephen Leacock
ii) Socrates and the Schoolmaster – F. L. Brayne
iii) Speech on Indian Independence – Jawaharlal Nehru

Poetry

i) On Television - Roald Dahl
ii) The Felling of the Banayan Tree – Dilip Chitre
iii) Stay Calm - Grenville Kleiser

Reference Books:

(For UNIT I)

i) English Grammar – N.D.V. Prasada Rao (S.Chand)

ii) Developing Communication Skills – Krishna Mohan & Meera Banerji (Macmillan

(For UNIT II)

i) Business Communication: Urmila Rai, S.M. Rai- (Himalaya Publishing House)
ii) Business Correspondence and Report Writing – R. C. Sharma& Krishna Mohan (Tata McGraw-Hill)
iii) Developing Communication Skills – Krishna Mohan & Meera Banerji (Macmillan)

(For UNIT III)

i) Business Communication and Management- Dr. K.R.Dixit (Vishwa Publishers, Nagpur)

(For UNIT IV)

Prescribed Text Book :

i) Prism: Spoken and Written Communication, Prose & Poetry published by Orient BlackSwan

Paper - II

Course Name - Financial Accounting

Course code -1T2

UNIT – I

Accounting Concepts:- Introduction, Accounting Concepts and Conventions, Generally Accepted Accounting Principles(GAAP), Conceptual Basis of a Balance Sheet, Capital and Revenue Income and Expenditure, Indian Accounting Standards AS 1 to AS 10.

Mechanics of Accounting:- Introduction, Classification of Accounts, Double Entry System, Overview of Accounting cycle, Preparing journals, Subsidiary Books, Ledger, Preparation of Trial Balance (Theory & Numerical)

UNIT – II

Preparation of final Accounts of Sole Traders :- Introduction, Describe format of P & L Account, Format of Balance Sheet, Treatment of Adjustments, The components of a set of final accounts for a sole trader. Prepare Trading Account, Profit & Loss Account and Balance Sheet (Theory & Numerical)

UNIT – III

Valuation of Goodwill – Meaning and need for valuation of goodwill, Feature of goodwill, Factors influencing valuation for goodwill, Average profit method (Future

maintainable profit method), Weighted average profit method, Super profit method, Capitalization method, Annuity Method. (Theory & Numerical)

UNIT – IV

Consignment Accounts :- Meaning, Needs, Advantages and formalities in consignment, difference between a consignment and a sale, Performa invoice, Account sales, Accounting procedure of consignment, valuation of consignment stock (Theory & Numerical)

Reference Books:

1. M.N. Arora, K.V.Achalapati, S.Brinda, Finiancial Accounting, Taxmann
2. M. Hanif, A. Mukherjee, Financial Accounting, McGraw-Hill.
3. N. Ramachandran, Ram Kumar Kakani, Financial Accounting for management, McGraw-Hill.
4. Dhanesh K Khatri, Accounting for Management, McGraw-Hill.
5. Shukla, M.C., T.S. Grewal and S.C.Gupta. Advanced Accounts. Vol.-I. S. Chand & Co., New Delhi.
6. S. N. Maheshwari, Financial Accounting, Vikas Publication, New Delhi.
7. T.S, Grewal, Introduction to Accounting, S. Chand and Co., New Delhi
8. P.C. Tulsian, Financial Accounting, Tata McGraw Hill, New Delhi
9. Dr. Pramod Fating, Dr. Vijay Bagde, Dr. Sarang Javkhedkar, Dr. Milind Gulhane – Financial Accounting - Sir Sahitya Kendra, Nagpur
10. Dr. K. Karemore, Dr. Vijay Bagde, Dr. Tekade, Prof. G. Khorgade, Dr. T Chaudhari – Financial Accounting - Sir Sahitya Kendra, Nagpur

Paper - III

Course Name - Fundamentals of Computer

Course Code – 1T3

UNIT – I

Understanding the Computer:- Introduction, Evolution, Generation, Classification and Application of computers. **Memory and Storage Systems:** Introduction, Memory representation, Random Access Memory, Read Only Memory, Storage systems, Magnetic storage systems, Optical storage systems, Magneto optical system, Solid-state storage devices.

UNIT – II

Input Devices: Introduction, Keyboard, Pointing devices, Scanning devices, Optical recognition devices, Digital camera, Voice recognition system, Data acquisition sensors, Media input devices. **Output Devices:** Introduction, Display monitors, Printers, Impact printers, Non-impact printers, Plotters, Voice output systems, Projectors, Terminals. **Computer Codes:** Introduction, Decimal system, Binary system, Hexadecimal system, Octal system, Conversion of numbers

UNIT – III

Computer Software: Introduction, Types of computer software, System management programs, System development programs, standard application programs. **Programming Languages:** Introduction, History of programming languages, Generations of programming languages, Characteristics of good programming languages, Developing a program, Running a program.

Data Communication and Networks: Introduction, Data communication using modem, Computer network, Network topologies, Network protocol and software, Application of network.

UNIT – IV

Operating Systems: Introduction, History of operating systems, Functions of operating systems, Process management, Memory management, File management, Device management, Security management, Types of operating systems, Providing user interface, Popular operating systems. **Microsoft Software:** Introduction, MS-DOS, MS Word systems, MS Excel systems, MS PowerPoint systems, MS Access systems,

Text Book:

1. E Balagurusamy, Fundamentals of Computers, Mc Graw Hill Education.

Reference Books:

1. Dr. Rajiv Midha, S. Brinda, Fundamental of Information Technology, Taxmann.

2. Madhulika Jain, Shashank Jain, Satish Jain, Information Technology Concepts, BPB Publication.

3. Dr. Rajiv Midha, Information Technology, Taxmann

4. B. Ram, Computer Fundamentals (Architecture & organization), New Age International Publisher.
5. Turban, Rainer, Potter, Introduction to Information Technology, Wiley India Edition.
6. Sanjay Saxsena, Introduction to Information Technology, Vikash Publishing House Pvt.Ltd.
7. Dr. Sushila Madan, Information Technology, Taxmann.

Paper - IV

Course Name – Programming in 'C'

Course Code – 1T4

UNIT – I

Data Types, Operators and some statements: Identifiers and keywords, Constants, C Operators, Type Conversion. **Writing a Program in C:** Variable declaration, Statements, Simple C Programs, Simple Input Statements, Simple Output Statements. **Control Statements:** Conditional Expressions, Loop Statements, Breaking control statements.

UNIT – II

Functions*and Program Structures:*Introduction, Defining a Function, Types of User Defined Functions,Return Statement, Actual & Formal Arguments, Local & Global Variables, Scope of Variables, Recursive Functions.**Arrays:**One dimensional array, Array Declaration, Array Initialization, Two dimensional array, Declaration and initialization of two dimensional array, multidimensional array, Character array and Strings functions.

UNIT – III

Pointers: Pointer Declaration, Pointer Arithmetic, Pointers and Functions, Pointers and Arrays, Pointer and Strings, Array of Pointers, Pointers to Pointers. **More on Functions:** Pre-processors, Macros, Header Files, standard Functions.

UNIT-IV

Structures, unions and File handling: Declaration of Structure, Initializing a Structure, Array of Structure, Arrays within Structure, Pointer and Structure,

Union.**Data File Operations:** Review of input/output Functions, Opening and Closing of files, Simple File Operation, Structures and File Operation, Block Read/Write, More on File operations, Random Access File processing.

Text Book:

1. D. Ravichandran, Programming in C, New Age International Publishers.

Reference Books:

1. E. Balaguruswami, Programming in ANSI C,McGraw-Hill.
2. R Subburaj, Programming in C, Vikash Publishing House Pvt. Ltd.
3. S.K.Shrivastava&Dipali Srivastava, C in Depth, BPB Publication.
4. YashwantKanetkar, Let Us C, BPB Publication, 9th Edition.
5. Veugopal Prasad, Mastering C, McGraw-Hill.
6. Schildt, The Complete Reference C, McGraw-Hill.

Semester – II

Paper – I

Course Name - English and Business Communication – II

Course code - 2T1

UNIT-I

A. Comprehension of an Unseen Passage
B. Punctuation, Words often confused

UNIT-II

Business Correspondence: Inviting Quotations, Placing Orders, CreditLetters - Granting/Refusing Credit, Letter to Bank for overdraft facility

UNIT-III

- Elements of communication
- Objectives of communication
- Essentials of effective communication
- Barriers to effective communication
- Suggestions to overcome the barriers

UNIT-IV

Textbook entitled ‗Prism: Spoken and Written Communication, Prose & Poetry' published by Orient Black Swan

Prose

I. An Astrologer's Day – R. K. Narayan
II. The Gift of the Magi – O. Henry
III. The Bet – Anton Chekhov

Poetry

I. Say Not the Struggle Naught Availeth - Arthur Hugh Clough
II. No Men are Foreign- James Kirkup
III. Abou Ben Adhem - James Leigh Hunt

Reference Books:

(For UNIT I)

1. English Grammar – N. D. V. PrasadaRao (S.Chand)
2. Developing Communication Skills – Krishna Mohan &MeeraBanerji (Macmillan)

(For UNIT II)

1. Business Communication: Urmila Rai, S. M. Rai - (Himalaya Publishing House)
2. Business Correspondence and Report Writing – R. C. Sharma& Krishna Mohan (Tata McGraw-Hill)
3. Developing Communication Skills – Krishna Mohan & Meera Banerji (Macmillan)

(For UNIT III)

1. Business Communication and Management- Dr. K. R. Dixit (Vishwa Publishers, Nagpur)

(For UNIT IV) Prescribed Text Book:

Prism: Spoken and Written Communication, Prose & Poetry published byOrient BlackSwan

Paper - II

Course Name – Principles of Business Management

Course Code – 2T2

UNIT- I

Nature And Functions Of Management – Importance Of Management, Definition Of Management, Management Function Or The Process Of Management, Levels Of Management, Organizational Or Business Functions, Role Of A Senior Management, Managerial Skills, Managerial Effectiveness, Management And Administration, Management- A Science Or An Art?, Management- A Profession?, Professional Management Vs Family Management, Management Of International Business.

Planning- Nature Of Planning, Importance Of Planning, Types Of Plans, Steps In Planning, Strategic Planning Process, Limitation Of Planning, Making Planning Effective, Planning Skills, Strategic Planning In The Indian Industry. **Decision Making**- Meaning Of Decision, Types Of Decision, Steps In Relational Decision-Making, Rationality In Decision-Making, Environment Of Decision-Making, Common Difficulties In Decision-Making.

UNIT- II

Organization- What Is An Organization?, Process Of Organizing, Principles Of Organizing, Span Of Management, Departmentalization, Process Departmentalization, Purpose Departmentalization, Organization Structure, What Type Of Structure Is Best?, Emerging Organization Structures, Committees, Teams, International Organization Structures. **Coordination** – Distinction Between Coordination And Cooperation, Distinction Between Coordination And Control, Need For Coordination, Requisites For Excellent Coordination, Types Of Coordination, Techniques Of Coordination, Difficulties Of Coordination, **Staffing**- Importance And Need For Proper Staffing, Manpower Planning, Recruitment, Selection, Placement, Induction, Manpower Planning In India.

UNIT- III

Training And Development- Difference Between Training, Education And Development, Advantages Of Training, Steps In Setting Up A Training And Development Programme, Design And Development Of The Training Programme, Evaluation Of Training And Development, Executive Training Practices In India,

Mentoring, Learning Organization, Knowledge Management **Direction And Supervision-** Requirements Of Effective Direction, Giving Orders, Motivation, Job Satisfaction, Organizational Commitment, Morale, First-Level Or Front- Line Supervision.

UNIT- IV

Communication- Importance Of Communication, Purpose Of Communication, Formal Communication, Forms Of Communication, Informal Communication, The Communication Process, Barriers To Communication, Principles Of Effective Communication. **Managerial Control-** Steps In A Control Process, Need For Control System, Benefits Of Control, Essentials Of Effective Control System, Problems Of The Control System, Control Techniques.

Text Book:

1. P. C. Tripathi, P. N. Reddy, Principles of Management, McGraw-Hill.

Reference Books:

1. Prof. Partho S. Sengupta, Principles and Practices of Management, Vikash Publishing House Pvt. Ltd.
2. Neeru Vaisishth, Vibhuti Vasishth, Principles of Management Text & Cases, Taxmann
3. Harold Koontz, Heinz Weihrich, Essentials of management, McGraw-Hill.
4. Neeru Vaisishth, Business Management, Taxmann.
5. R. S. N. Pillai, S. Kala, Principles and Practices of Management, S. Chand.
6. Chandra Bose, Principles of Management & Administration, PHI.

Paper - III

Course Name – Programming in C++

Course Code – 2T3

UNIT – I

Introduction to Object Oriented Programming: Introduction, What is Object Oriented Programming(OOP)?, Structured Procedural programming(SPP), Object

Oriented Programming OOP, Characteristics of OOPs, Advantages of OOPs, Disadvantages of OOPs, Comparison of SPP and OOP, Steps in Developing OOP Programs, Structure of Object Oriented Programs, Object Oriented Languages, Importance of C++. **Data Types, Operators and Expressions:** Identifiers & Keywords, Data Types, C++ Simple Data Types, Literals, Variables, the Const Data type, C++ Operators, Type Conversion. **Input and Output Streams:** Comments, Declaration of Variables, the Main () Function, Simple C++ Programs, Program Termination, Features of IOStream, Keyboard and Screen I/O, Manipulator Functions, Input and Output (I/O) Stream Flags. **Control Statements:** Conditional Expressions, Loop Statements, Nested Control Structures, Breaking Control Statements.

UNIT – II

Function and Program Structures: Introduction, Defining a Function, Return Statement, Types of Functions, Actual & Formal Arguments, Local & Global Variables, Default Arguments, Structure of C++ Program, Order of the Function Declaration, Manually invocated Functions, Nested Functions, Scope Rules, Side Effects, Storage Class Specifiers, Recursive Function, Pre-processors, Header Files, Standard Functions. **Arrays:** Introduction, Array Notation, Array Declaration, Array Initialization, Processing with Arrays, Character Array. **Pointers and Strings:** Introduction, Pointer Arithmetic, Pointers and Functions, Pointers and Arrays, Pointer and Strings.

Structures and Unions:- Introduction, Declaration of Structure, Processing with Structures, Initialization of Structures, Functions and Structures, Array of Structure, Pointer and Structure, Unions.

UNIT – III

Classes and Objects: Introduction, Structures and Classes, Declaration of Class, Member Functions, Defining the Object of a Class, Accessing a Member of Class, Array of Class Objects, Pointer and Classes. **Special Member Function:** Introduction, Constructors, Destructors, Inline Member Functions, Static Class Members, Friend Function,This Pointer.**Single and Multiple Inheritance:** Introduction, Single Inheritance, Types of Base Classes, Type of Derivation,Multiple Inheritance,Member Access Control.

UNIT-IV

Overloading Functions and Operators: Function Overloading, Operator Overloading, Overloading of Binary Operators, Overloading of Unary Operators. **Polymorphism and Virtual Functions:** Polymorphism, Virtual Functions, Pure Virtual Functions, Abstract Base Classes, Virtual Base Classes. **Data File Operations:** Opening and Closing of Files, Reding/Writing a Character from a File, Binary File Operations.

Text Book: - 1. D. Ravichandran, Programming with C++, McGraw-Hill.

Reference Books:

1. E. Balaguruswami, Object Oriented Programming with C++, McGraw-Hill.
2. Rohit Khurana, Object Oriented Programming with C++, Vikash Publishing House Pvt. Ltd.
3. Anirban Das, Goutam Panigrahi, Object Oriented Programming with C++, Vikash Publishing House Pvt. Ltd.
4. Herbert Schildt, The Complete Reference – C++, McGraw-Hill.

Paper - IV

Course Name – E-Commerce and Web Designing

Course Code – 2T4

UNIT – I

Introduction to Electronic Commerce- Electronic Commerce : The Scope of Electronic Commerce, Definition of Electronic Commerce, Electronic Commerce and the Trade Cycle, Electronic Markets, Electronic Data Interchange, Internet Commerce, e-Commerce in Perspective. **Business Strategy in an Electronic Age: The** Value Chain, Supply Chains, Porter‘s Value Chain Model, Inter Organizational Value Chains. **Competitive Advantage:** Competitive Strategy, Porter‘s Model, First Mover Advantage, Sustainable Competitive Advantage, Competitive advantage using e-Commerce.

UNIT – II

Business to Business Electronic Commerce - Inter Organizational Transactions: Inter Organizational Transactions, the Credit Transaction Trade

Cycle, A Variety of Transaction, Pens and Things. **Electronic Markets: Markets**, Electronic Markets, Usage of Electronic Markets, Advantages and Disadvantages of Electronic Markets, Future of Electronic Markets. **Electronic Data Interchange (EDI):** Introduction to EDI, EDI definition, The Benefits of EDI, EDI Example. **Inter Organizational e-Commerce: Inter** Organizational Transaction, Purchasing Online, After Sales Online, e-Commerce in Desk top Facilities Management, Pens and Things and the Web.

UNIT – III

Business to Consumer Electronic Commerce - Internet Shopping and the Trade Cycle, Other e-Commerce Technologies, Advantages and Disadvantages of Consumer e-Commerce, Consumer e- Commerce at Pens and Things. **The Elements of e-Commerce :** Elements, e-Visibility, The e-Shop, Online Payments, Delivering the Goods, After Sales Service, Internet e- Commerce Security, A Web Site Evaluation Model. **Introduction to HTML:** Designing a Home Page, History of HTML, HTML Generations, HTML Documents, Anchor Tag, Hyper Links, Sample Html Documents. **Header and Body Sections: Header** Section, Title, Prologue, Links, Colorful Web Page, Comment Lines, Some Sample Html Documents. **Designing the body Section:** Heading Printing, Aligning the Headings, Horizontal Rule, Paragraph Tab Setting, Image and Pictures, Embedding PNG Format Images.

UNIT – IV

Ordered and Unordered Lists: Lists, Unordered Lists, Headings in a List, Ordered Lists, Nested List. **Table Handling: Table**, Table Creation in HTML, Width of the Table and Cells, Cells Spanning Multiple Rows/Columns, Coloring Cells, Columns Specification, Some Sample Tables. **Dhtml and Style Sheets:** Defining Styles, Elements of Styles, Linking a Styles Sheet to an HTML Document, In-Line Styles, External Styles Sheets, Multiple Styles. **Frames:** Frameset Definition, Frame Definition, Nested Framesets. **A web Page Design Project:** Frameset Definition, Animals, Birds, Fish. **Forms: Action** Attribute, Method Attribute, Input type Attribute, Drop Down List, Sample Forms

Text Books

1. David Whiteley, e-Commerce Strategy, Technologies and Applications, McGraw Hill Education
2. CXavier, World Wide Web design with HTML, McGraw Hill Education.

Reference Books:

1. Bajaj, Nag, E-Commerce, McGraw-Hill.
2. Eric van der Vlist, Danny Ayers, Erik Bruchez, Joe Fawcett, AlessandroVernet, Professional Web 2.0 Programming, Wiely.
3. Michael P. Papazoglou, Pieter M.A. Ribbers, e-Business, Wiely.
4. Brian P. Hogan, HTML5 and CSS3, Shroff Publishers.
5. Sandeep panda, AngularJS – Novice to Ninja, Shroff Publishers.
6. Web Technologies – Black Book, Dreamtech Press.
7. Mike Mcgrath, Web Design in Easy Steps, McGraw-Hill.
8. Mike Mcgrath, JavaScript in Easy Steps, McGraw-Hill.
9. Mike Mcgrath, CSS3 in Easy Steps, McGraw-Hill.

BCCA – Part – II

Semester – III

Paper - I

Course Name – Environmental Studies

Course Code – 3T1

UNIT - I

Environment, Environment Studies, Need for public Awareness, Environmental Degradation, Shelter Security, Economic Security, Social Security, Effects of Housing on Environment , Effects of Industry on Environment**. Natural Resources-** Introduction, Types of Natural Resource, Forest Resources, Water Resources, mineral Resources, Energy resources, Land Resources, Conservation of Natural Resources, Sustainable Lifestyles, Biogeochemical Cycle.

UNIT – II

Ecosystem- Introduction to Ecology and Ecological Succession, Ecosystem, FoodChain, Ecological Pyramids, Types of Ecosystems, Forest Ecosystems, Aquatic Ecosystems, Grassland Ecosystem, and Desert Ecosystem.

Biodiversity and its Conservation- Biodiversity, Values or Benefits of Biodiversity, Biogeographic Zones of India. Threats to Biodiversity, Human – Wildlife Conflicts, Conservation of Biodiversity.

UNIT – III

Environmental Pollution ,Introduction, Public Health Aspects, Air Pollution, Land Pollution, Soil Pollution, Marine Pollution, Water Pollution, Noise Pollution, Thermal Pollution, Solid Waste Management, Role of Individuals in Pollution Prevention, Disaster Management.

UNIT – IV

Social Issues and the Environment- Introduction, Sustainable Development,Urbanization, Water Conservation, Resettlement and Rehabilitation of People ; Its Problems and Concerns, ACTs for Environmental Protection, Carbon Credits, Initiatives and Roles of Nongovernmental Organization (NGOs) in Environmental Protection, Issues Involved in Enforcement of Environmental Legislation . Environment and Human Health, Environmental Education, Role of Information Technology in Environment and Human Health.

Text Book

1. Shashi Chawla , Environmental Studies, McGraw-Hill.

Reference Books

1. Dr. D. K. Asthana, Dr. MeeraAsthana ,Environmental Studies, S. Chand.
2. Dr. K. Mukkanti, Environmental Studies, S. Chand.
3. Dr. D. D. Mishra,Fundamental Concepts in Environmental Studies, S.Chand.
4. Benny Joseph, Environmental Studies, McGraw Hill Education.

Paper - II

Course Name – Business Economics

Course Code – 3T2

UNIT I

Introduction: Economics and Business Economics– Meaning, Nature, concept & Scope of Business economics. **Basic problem of an Economy and Role of price Mechanism** – Basic problems of an economy, Classification of Economy, Its features, advantages and disadvantages. Free Enterprise Economy: Meaning & Features.

Theory of utility : **Theory of Consumer Behavior –** Nature of Human wants, Utility Analysis - Meaning and definition of utility, Concepts of Marginal Utility, Total Utility, Cardinal and ordinal approach of utility(Difference), Features of Utility, Law of diminishing Marginal utility.

UNIT II

Theory of Demand and supply -Theory of Demand: Concept of Demand, Law of Demand-Meaning, Definition, Assumptions & Exceptions. Elasticity of Demand - Meaning, Types and Factors affecting Elasticity of Demand. **Demand Forecasting** – Meaning, Definition, Importance and scope of Demand Forecasting, Methods of demand forecasting.

Supply Analysis – Supply: Meaning, Determinants and functions of Supply. Law of Supply, Elasticity of Supply: Meaning of Elasticity of Supply, Types of Elasticity of Supply

Unit – III

Theory of Production and cost - Theory of Production: Meaning of Production, Factors of production, Concepts of Total Product, Average product and Marginal Product, Production Function, Short Run Production Function: Law of Variable Proportion, ISO Quant Curve, Long Run Production Function, Law of Returns to Scale.

Theory of Cost – Meaning of Cost, Cost Concepts, Cost Function, Concepts of total Cost ,Average Cost and Marginal Cost, Short Run Average Cost Curves, Long Run Cost Curve, Economies and Diseconomies of Scale

UNIT IV

Market Structure And Pricing theory- Market Structure: - Meaning of market, Classification of Market, Concepts of Total revenue, Average revenue and Marginal revenue, Market Structure - Concept ,Features types.

Price – Cost and Output Determination under Different types of markets- Perfect Competition, Monopoly, Monopolistic Competition, Equilibrium of firms under different market structures in short run and long run. Price Discrimination in monopoly and oligopoly. Kinked demand curve.

Text Book

1. D. N. Dwivedi, Essentials of Business Economics, Vikas Publishing House Pvt. Ltd.

Reference Books

1. David P. Doane, Lori E. Seward, Applied Statistics in Business and Economics, McGraw-Hill.
2. Amit Kumar Upadhyay, Principles of Economics, Vikas Publishing House Pvt. Ltd.
3. P. K. Mehta, Business Economics, Taxmann.
4. Michael Mandel, Economics The basics, McGraw-Hill.
5. SudipChaudhuri, AnindyaSen, Economics, McGraw-Hill.
6. Geetika, PiyaliGhosh, Purba Roy Choudhury, Managerial Economics, McGraw-Hill.

Paper - III

Course Name – Visual Basic Programming

Course Code – 3T3

Unit – I

Introduction to Visual Basic –Advantages of Visual Basic, Features of Visual Basic. **Visual Basic Window Components** – Menu Bar, Standard Toolbar, Project Explorer Window, Form Layout Window, Properties Window, Toolbox, Code Editor Window, Object Browser, **Working With Forms** – Extension & With Function ofthe File, Properties, Events and Method ofthe Form. **Using The Controls Of Visual Basic–**Label Control, Commandbutton Control, Textbox Control, Option Button Control, Frame Control, Checkbox Control, Listbox Control, Combobox Control, Image Control, Scroll Control, Picture Control, sing Timer Control, Drivelistbox Control, Dirlistbox, Filelistbox Control.

Unit – II

Basic Programming Fundamentals– Scope of Variables, Operators, Decision Structure, Loop Structure, Arrays, control array. **Working With Procedure, Functions** Procedure, Functions, Modules **Menus –** Creating Menus, Creating Popup Menu**. Working With Custom Controls –** Imagelist Control,Imagecombo Control, Treeview Control, Listview Control, Toolbar Control, Statusbar Control.

Unit – III

Creating MDI Applications – Features of Child Form, **Database Handling** – Creating the Database, Accessing the Database Using ADO Data Control.**Working With Advance Data Controls** – Datalist Control, Datacombo Control, Datagrid Controls, Setting The Properties Of The Datagrid Control, Mshflexgrid Control,

Unit – IV

Debugging Techniques – Error handling : Types of errors. Debugging, tools for debugging,handling runtime errors.**Working with Data Environment**-Data Environment and Data Report, Data Environment designer adding connection & commands Data reportcontrols, creating & printing reports.

Text Book

1. Soma Dasgupta, Visual Basic – to Advance, BPB Publications.

Reference Books

2. Mohammad Azam, Programming with Visual basic, Vikas Publishing House Pvt. Ltd.
3. Mike Mcgrath, Visual basics in Easy Steps, McGraw-Hill.
4. Michael Vine, Microsoft Visual Basic Programming, PHI.
5. Evangelos Petroutsos, Mastering Visual basic, Wiley India Pvt. Ltd.

Paper - IV

Course Name – Database Management System

Course Code – 3T4

UNIT – I

Introduction: Concept of the System, Types of Decisions, Information System, Classification of information System, Conventional File Processing System, Database System, Components of Database Management System, Economic

Justification of Database Approach. **Database Concepts:** Introduction, Data, Information, Metadata, Terminologies of Files, Association between Fields, Association between Files (Record Types), File Organization.

UNIT – II

Data Models: Introduction, Classification of Data Model, Entity Relationship Model. **Database Design:** Introduction, Steps of Database Design, Normalization, Case Problem, Data Volume and Usage Analysis, Integrated Case Study-Database Design for Academic institution. **Implementation Design:** Introduction, Implementation Design,

UNIT – III

Structured Query Language - I: Table fundamentals, viewing data in the tables, Eliminating duplicate rows when using a select statements, sorting data in a table, creating a table from a table, inserting data into a table from another table, delete operations, updating the contents of a table, modifying the structure of tables, renaming tables, truncating tables, destroying tables, creating synonyms.

UNIT-IV

Structured Query Language - II: Data Constraints, Types of data constraints, defining different constraints on a table, computations done on table data, ORACLE functions, Date conversion functions, Data functions, Miscellaneous functions, Grouping data from tables in SQL, Subqueries, Joins, concatenating data from table columns, using the UNIONS, INTERSECT and MINUS clause.

Text Books

1. R. Panneerselvan, Database Management Systems, PHI Publication.
2. Ivan Bayross, SQL, PL/SQL, BPB Publications.

Reference Books

1. Silberschatz, Korth, Sudarshan, Database System concepts, McGraw-Hill.
2. Gupta, Database Management Systems, McGraw-Hill.
3. Alexis Leon, Mathews Leon, Database Management System, Leaon Vikas.
4. Mike Mcgrath, SQL in Easy Steps, McGraw-Hill.

5. Dr. P. S. Deshpande, SQL & PL/SQL for Oracle 11g, Dreamtech

Semester - IV

Paper - I

Course Name – Statistical Techniques

Course Code – 4T1

Unit – I

Statistics and Measures of Central Tendency: – Meaning, Scope, Importance, Functions and Limitations of Statistics. Collection of data, Primary data and Secondary Data, Tabulation and Classification, Frequency distribution, Type of table, Mean, Media, Mode, Geometric Mean and Harmonic Mean (theory & Numerical)

Unit – II

Measures of Dispersion: – Meaning and significance of dispersion. Method of measuring dispersion, Range, Mean Deviation, Standard Deviation, Quartile Deviation, Co-efficient of variation (Theory & Numerical)

Unit – III

Skewness :- Meaning of Skewness, Type of Skewness, Factor of skewness. Absolute Measures of skewness, relative measures of skewness, Karl Pearson's co-efficient of skewness, Bowley's Co-efficient of skewness (Theory and Numerical)

Unit – IV

Correlation and Regression:- Concept of correlation, Types of correlation, Karl Pearson's co-efficient of correlation, Probable error, Interpretation of "r", Rank correlation method.

Concept of regression, Lines of Regression, Co-efficient of Regression (theory &Numerical)

Text Book

1. N G Das, J K Das, Business Management and Statistics, McGraw-Hill.

Reference Books

1. Mrintunjay Kumar, Business Mathematics, Vikas Publishing House Pvt. Ltd.

2. Ajay Goel, AlkaGoel, Mathematics & Statistics, Taxmann.
3. Walter Rudin, Principals of mathematical Analysis, McGraw-Hill.
4. Dr. Pramod Fating, Dr. Milind Gulhane, Dr. Vijay Badge, Dr. Sarang Javkhedkar – Statistical Techniques – Sir Sahitya Kendra, Nagpur
5. Dr. S. R. Arora, Dr. Kavita Gupta, Business Mathematics and Statistics, Taxmann.

Paper - II

Course Name – Business Law

Course Code – 4T2

Unit - I

THE INDIAN CONTRACT ACT, 1872: Contract – meaning, characteristics and kinds, Essentials of a valid contract - Offer and acceptance, consideration, contractual capacity, free consent, legality of objects., Void agreements, Discharge of a contract – modes of discharge, breach and remedies against breach of contract, Contingent contracts, Quasi - contracts

Specific Contracts- Contract of Indemnity and Guarantee, Contract of Bailment, Contract of Agency

Unit - II

THE SALE OF GOODS ACT, 1930 - Contract of sale, meaning and difference between sale and agreement to sell. Conditions and warranties, Transfer of ownership in goods including sale by a non-owner, Performance of contract of sale. Uunpaid seller – meaning, rights of an unpaid seller against the goods and the buyer.

Unit - III

THE INFORMATION TECHNOLOGY ACT, 2000 :- Definitions, Digital signature, Electronic governance, Attribution, acknowledgement and dispatch of electronic records, Digital Signatures Certificates, Duties of Subscribers, Penalties and adjudication, Appellate Tribunal, Offences

UNIT - IV

THE NEGOTIABLE INSTRUMENTS ACT 1881 - Meaning, Characteristics, and Types of Negotiable Instruments - Promissory Note, Bill of Exchange, Cheque, Holder and Holder in Due Course, Privileges of Holder in Due Course. Negotiation: Types of Endorsements, Crossing of Cheque, Bouncing of Cheque

Suggested Readings:

1. M.C. Kuchhal, and Vivek Kuchhal, Business Law, Vikas Publishing House, New Delhi.
2. Avtar Singh, Business Law, Eastern Book Company, Lucknow.
3. SN Maheshwari and SK Maheshwari, Business Law, National Publishing House, New Delhi.
4. Aggarwal S K, Business Law, Galgotia Publishers Company, New Delhi.
5. Sushma Arora, Business Laws, Taxmann Pulications.
6. P C Tulsian and Bharat Tulsian, Business Law, McGraw Hill Education
7. Sharma, J.P. and Sunaina Kanojia, Business Laws, Ane Books Pvt. Ltd., New Delhi.
8. Information Technology Rules 2000 with Information Technology Act 2000, Taxmann Publications Pvt. Ltd., New Delhi.

Note: Latest edition of text books may be used.

Paper - III

Course Name – Core Java

Course Code – 4T3

UNIT – I

Java History and Introduction - Java history, Java features, How java differ from C and C++, Java and internet, Java and world wide web, Java environment. Simple Java programs, Java program structure, Java tokens, Java virtual machine, Command line arguments. **Variables, Data Types and Simple I/O –**Variables, Data Types, Scope of variables, Symbolic constants, Type casting, Standards default values, Getting Simple User Input. **Operators in java**-Introduction, Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment and decrement operators, Conditional operators, Bitwise operators, Special operators, Mathematical functions. **Decision Making and Branching** –If…Else statement, Nesting of If...Else statement, the switch statement, The? : Operators.

UNIT-II

Decision Making and Looping – Introduction, The while statement, the do statement, for statement, Jumps in loops, Labeled loops. **Arrays, Strings** – One Dimensional Array, Two Dimensional Array, Strings. **Classes, Objects and Methods** – Introduction, Defining a class, Methods declaration, Creating objects, Accessing class members, Constructors, Method overloading, Static members, **Inheritance**: Extending a class, Overriding methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes, Visibility Controls. **Interfaces:**– Introduction, Defining interfaces, Implementing interfaces, Accessing interface variables.

UNIT - III

Packages:– Introduction, Java API Packages, Using system packages, Naming conventions, Creating packages, Accessing a package, Using a package. **Introduction to Thread** - Creating threads, Life cycle of thread. **Managing Errors and Exceptions** – Introduction, Types of errors, Exceptions, Syntax of exceptions handling code, catch statements, using finally statements, throwing our own exceptions. **Graphics Programming** – Introduction, The graphics class, Lines and rectangles, Circles and ellipses, Drawing arcs, Drawing polygons.

UNIT-IV

Applet Programming – Introduction, How applet differ from application, Preparing to write applet, Building applet code, Applet life cycle, Creating an executable applet, Designing a web page, Applet tag, Adding applet to HTML file, Running the applet, Passing parameters to applet, Displaying numerical values, Getting input from the user.

Managing Input / Output Files in JAVA – Introduction, Concepts of streams, Streams classes,

Bytes streams classes, Character streams classes, Using the file classes, Input / Output exception, Creation of files, Reading/Writing character, Reading/Writing bytes.

Text Book:

1. E. Balagurusamy, Programming with Java, McGraw-Hill.

Reference Books

2. Java Programming for the absolute beginner, PHI, Joseph P. Russel
3. Schildt,The Complete Reference Java 2, McGraw-Hill.
4. Rashmi Kanta Das, Core Java for Beginners, Vikas Publishing.
5. Joel Murach, Murach‘s Java Programming, Shroff Pubishers.
6. Mike Mcgrath, Java in Easy Steps, McGraw-Hill

Paper - IV

Course Name – PHP & MySQL

Course Code – 4T4

UNIT- I

Getting Started With PHP- Basic HTML Syntax, Basic PHP Syntax, Using FTP, Testing Your Scripts, Sending Text To The Browser, Adding Comment To The Script, Basic Debugging Steps. **Variables-** What Are Variables?, Variable Syntax, Types Of Variables, Variable Values, Understanding, Quotation Marks. **HTML Forms And PHP-** Creating A Simple Forms, Choosing A Form Data In PHP, Displaying Errors, Error Reporting. **Using Numbers-**, Performing Arithmetic, Formatting Numbers, Understanding Precedence, Incrementing And Decrementing A Number, Creating Random Numbers.

UNIT- II

Using Strings- Creating The HTML Forms, Concatenating Strings, Handling Newlines, HTML And PHP, Finding Substrings, Replacing Parts Of A String. **Control Structures-**The if Conditional, Validation Functions, Using Else, More Operators, Using else if, The Switch Conditional, The For Loop. **Using Arrays-** What Is An Array, Creating An Array, Adding Items To An Array, Accessing An Array From A Form.

UNIT- III

Creating Web Applications- Creating Templates, Using Constants, Working With The Date And Time, Handling HTML Forms With PHP, Sending Email. **Cookies And Sessions-** What Are Cookies?, Creating Cookies, Reading From Cookies, Adding Parameters To Cookies, Deleting A Cookie, What Are Sessions?, Creating Session,

Accessing Session Variables, Deleting Session. **Creating Functions-** Creating And Using Simple Functions, Creating And Calling Functions That Take Arguments, Setting Default Arguments Values, Creating And Using Functions That Return A Value, Understanding Variable Scope.

UNIT- IV

Files And Directories- File Permissions, Writing To Files, Locking To Files, Reading From Files, **Introduction To Database-** Introduction To SQL, Connecting To MYSQL, MYSQL Error Handling, Creating And Selecting A Database, Creating A Database, Inserting Data Into A Database, Securing Query Data, Retrieving Data From A Database, Deleting Data In A Database, Updating Data In A Database. **Putting It All Together-** Getting Started, Connecting To The Database, Writing The User-Defined Function, Creating The Template, Adding Quotes, Listing Quotes, Editing Quotes, Deleting Quotes.

Text Book

1. Larry Ullman, PHP for Web, Pearson.

Reference Books

1. Holznr, The Complete Reference – PHP, McGraw-Hill.
2. Mike Mcgrath, PHP & MySQL in Easy Steps, McGraw-Hill.
3. Steve Suehring, Tim Converse & Joyce Park, PHP and MySQL, Wiely.
4. Joel Murach & Ray Harris, murach‘s PHP and MySQL, Shroff Publishers.
5. Jason Gilmore, Beginning PHP and MySQL.

BCCA – Part - III

Semester – V

Paper - I

Course Name – Computerized Accounting using Tally

Course code - 5T1

UNIT I

Introduction to Tally.ERP 9- Basics of Accounting-Types of accounts-Golden rules of accounting –Accounting principles –Features of Tally- Opening Tally.ERP 9, Components of the Tally.ERP 9 Window, Creating a Company. Accounting masters in Tally –F11: Features –F12 Configurations –Setting up of Account Heads.

UNIT II

Groups, Ledgers, Vouchers and Orders- Introducing Groups, Introducing Ledgers, Introducing Vouchers, Introducing Purchase Orders, Introducing a Sales Order, Introducing Invoices.. **Stock and Godown in Tally-** Stock Groups, Stock Categories, Stock Items, Units of Measure, Godowns.

UNIT III

Stock and Godown in Tally-Cost Centers and Cost Categories–Bank Reconciliation –Interest Calculations. **Reports in Tally.ERP 9-** Working with Balance Sheet, Working with Profit & Loss A/c Report, Working with Stock Summary Report, Understanding Ratio Analysis, Working with Trial Balance Report, Working with Day Book Report.

UNIT IV

Taxation – Indian Tax Structure, Tax deducted at source in tally.ERP 9, Create a Tax Ledger, TDS Vouchers, Printing a TDS Challan, Tax collected at source in Tally.ERP 9, TCS reports in Tally.ERP 9, Calculating GST in Tally.ERP 9, GST Classification, GST Vouchers, GST Reports in Tally.ERP 9. Taking Backup in Tally.ERP 9, Restoring Data inTally. ERP 9,

Text Book:

1. DT Editorial Services, Tally.ERP 9 in Simple Steps, Dreamtech Press.

Reference Books:

1. Computerized Accounting using Tally ERP 9, Sahaj Enterprise, Tally Education Private Ltd (TEPL).
2. Vikas Gupta, Business Accounting with MS Excel and Tally.ERP 9 Course Kit, Dreamtech Press.
3. Vishnu Priya Singh, Tally 9.
4. K. K. Nadhani, Accounting with Tally, BPB Publication.
5. K. K. Nadhani and A.K. Nadhani, Tally Tutorial, BPB Publication.
6. Mr. Ravindra Parmar, Tally ERP 9 with GST – Paperback

Paper - II

Course Name – VB.Net

Course code -5T2

UNIT- I

Welcome to Visual Basic.NET – Windows Versus DOS Programming, Installing Visual Basic.NET, The Visual Basic.NET IDE, Creating a Simple Application, Using the Help System. **The Microsoft.NET Framework** – Microsoft's Reliance on Windows, Writing Software for Windows, Common Language Runtime, The Common Type System and Common Language Specification. **Writing Software –** Information and Data, **Variables**, Comments and Whitespaces, Data Types, Sorting Variables, Methods. **Controlling the Flow** – Making Decisions, The if Statement, Select Case, Loops.

UNIT- II

Working with Data Structure – Understanding Array, Understanding Constants, Structures, Working with Collection and Lists, Advanced Array Manipulation. **Building Windows Application** – Responding to Events, Building a Simple Application, Creating Complex Applications, Using Multiple Forms. **Displaying Dialog Boxes** – The MessageBox Dialog box, The OpenDialog Control, The SaveDialog Control, The FontDialog Control, The ColorDialog Control, The PrintDialog Control.

UNIT- III

Creating Menu – Understanding Menu Features, Creating Menu, Context Menu. **Debugging and Error Handling –** Major Error Types, Debugging, Error Handling. **Building Objects** – Understanding Objects, Reusability, Our First Object, Constructor, Inheritance, The Framework Classes.

UNIT- IV

Accessing Database – What is Database, SQL Select Statement, Queries in Access, Data Access Components, Data Binding. **Database Programming with SQL Server and ADO.NET** –ADO.NET, The ADO.NET Classes in Action, Data Binding. **Deploying Your Application** – What is Deployment?, Creating a Visual Studio .NET Setup Application, Assemblies as Installers, The Core of Deployment, Deploying Different Solution.

Text Book

1. Jonathan, Richard Blair, Beginning VB.MET 2003, WILEY, Thearon Willis.

Reference Books

1. Thearon Willis, Jonathan Crossland, Richard Blair, Beginning CB.Net 2003, Dreamtech Press, Wiley.

2. Jeffry R. Shapiro, The Complete Reference, Visual Basic .NET, McGraw- Hill.

3. Francesco Balena, Programming Microsoft Visual Basic.net, Microsoft Press.

4. Jeffrey Kent, Visual basic.Net – A Beginner‘s Guide, McGraw- Hill.

SEC – I – Skill Enhancement Course

Elective - I

Paper - III

Course Name – Management Information System

Course code -5T3

UNIT- I

Management Information Systems: An Overview - Introduction, Need for Management Information Systems, Management Information Systems: A Concept, MIS: A definition, Management Information System and Information Technology, Nature and Scope of MIS, MIS Characteristics, Structure of MIS, Types of MIS, Role of MIS in Global Business, Challenges of Managing Information Systems. **Information, System and Organization Concepts -** Introduction: A definition, Types of Information, Information Quality, Dimensions of Information, System: A definition, Kinds of Systems, System -related Concepts, Elements of a System, Information System, Organization : A Concept, Impact of Information System on Organization.

UNIT- II

IT Infrastructure and Emerging Technology - Data Resource Management - Introduction, Database Concepts, Files : The Traditional Approach, The Database Management Approach: The Modern Approach, Database Management System, Data Models, Data Warehousing and Data Mining, Application of DBMS using MS-Access. **Telecommunication and Computer Networks -** Introduction, Telecommunications, Types of Signals, Communication Channels, Characteristics of

Communication Channels, Communication Hardware, Communication Networks, Computer Networks in India, Internet.

UNIT- III

E-Commerce, e-Business and e-Governance - Introduction, e-Commerce, e-Commerce Sales Life Cycle, e-Commerce Infrastructure, e-Commerce Applications , e-Commerce Challenges and Opportunities, E-Business, e-Governance. **Enterprise Systems -** Introduction, Enterprise Systems, Enterprise Resource Planning (ERP) System, Customer Relationship Management(CRM) System, Supply Chain Management(SCM) System. **Decision Support Systems -** Introduction, Decision-Making :A Concept, Simon‘s Model of Decision Making ,Types of Decisions, Methods for Decision-Making, Decision Support Techniques ,Decision Making and Role of MIS, Decision Support Systems (DSSs),Business Intelligence ,Knowledge Management Systems.

UNIT- IV

Information Requirements Analysis & Systems Design - Introduction, Systems Analysis, Requirements Determination, Strategies for Requirements Determination, Structured Analysis Tools, System Design. **Evolution and Maintenance of IS -** Introduction Evaluation Approaches, Evaluation Classes, Product-Based MIS Evaluation, Cost/benefit –Based Evaluation, Models Used in Evaluation, Process-based Evaluation, System Maintenance.

Text Book

1. D. P. Goyal, Management Information System, Vikas Publishing House Pvt Ltd.

Reference Books

1. Waman S. Jawadekar, Management Information Systems, McGraw-Hill.
2. D. P. Nagpal, Management Information Systems, S. Chand.
3. Dr. SushilaMaden, Management Fundamental and Information System, Taxmann.
4. S. Sadagopan, Management Information Systems, PHI.
5. A. K. Gupta, Management Information Systems, S. Chand.
6. Mahesh Halale, Management Information Systems, Himalaya publishing house.

SEC – I – Skill Enhancement Course

Elective - II

Paper - III

Course Name – System Analysis & Design

Course code - 5T3

UNIT- I

System Concept And The Information Systems Environment- Introduction, The Systems Concept, Characteristics Of A System, Elements Of A System, Types Of A System. **The System Development Life Cycle** - Introduction, System Development Life Cycle, Considerations for the Candidate System, Prototyping. **The Role Of System Analyst**- Introduction, Definition, Historical Perspective, The Multifaceted Role Of The Analyst, The Place Of The Analyst In The MIS Organization, Rising Positions In System Development, Conclusions.

UNIT- II

System Analysis- System Planning And The Initial Investigation- Introduction, Bases For Planning In System Analysis, Initial Investigation. **Information Gathering-** Introduction, What Kinds Of Information Do We Need?, Where Does Information Originate?, Information Gathering Tools. **The Tools Of Structured Analysis-** Introduction, What Is Structured Analysis?, The Tools Of Structured Analysis. **Feasibility Study-** Introduction, System Performance Definition, Feasibility Study.

UNIT- III

System Design- The Process And Stages Of System Design- Introduction, The Process Of Design, Design Methodologies, Major Development Activities, Audit Consideration. **Input/output And Forms Design-** Introduction, Input Design, Output Design, Forms Design. **File Organization And Data Base Design-** Introduction, File Structure, File Organization, Data Base Design, The Role Of The Data Base Administrator.

UNIT- IV

System Implementation- System Testing And Quality Assurance- Introduction, Why System Testing?, What Do We Test For?, The Test Plan, Quality Assurance,

Trends In Testing, Role Of Data Processing Auditor. **Implementation And Software Maintenance-** Introduction, Conversion, Combating Resistance To Change, Post-Implementation Review, Software Maintenance. **Hardware/ Software Selection -** Introduction, The Computer Industry, The Software Industry, A Procedure For Hardware/ Software Selection, Financial Considerations In Selection, The Used Computer, The Computer Contract.

Text Book

1. Elias Awad, System Analysis and Design, Galgotia.

2.C.S.V.Murthy Management Information System , Himalaya Publication .

DSE – I – Discipline Specific Elective (DSE) Course
Elective - I
Paper - IV
Course Name – Cost and Management Accounting
Course code -5T4

Unite-I :- Cost Accounting

Meaning, Scope, Objective, Importance, Features of cost accounting, Function of Cost Accounting, Advantage, Element of cost, Cost-Absorption, Allocation of overheads and Methods of costing, Type of Costing, Difference between cost Accounting and Financial Accounting. Problems on Cost Sheet, Tender and Quotations. (Theory and Numerical)

Unit-II :- Process Cost Accounting

Definition, Features of Process costing, Advantages of Process costing, Limitations of process costing, Wastage and By-products, Normal Loss, Abnormal Loss/Gain, Joint Products, Difference between Process cost and Job cost. Problems on Process costing

Unit-III :- Management Accounting

Meaning, Definitions, Characteristics and Nature of Management Accounting, Objective, Importance, Functions of Management Accounting, Advantage and Limitations of Management Accounting, Difference between management Accounting and Cost Accounting, Difference between Financial Accounting and Management Account. Break-Even Point Analysis (Theory and Numerical)

Unit-IV :- Ratio Analysis

Meaning, Importance, Limitations of Ratio Analysis, Use and Significance of Ratio Analysis, Classification of Ratio, Computation of Profitability Ratio, Financial Ratio with special reference to Current Ratio, Liquid Ratio, Inventory turnover Ratio, Debtors and Creditors turnover Ratio, Fixed Assets turnover Ratio, Debt-Equity Ratio, Working Capital Ratio, earnings per share Ratio, Gross Profit Ratio, Net Profit Ratio, expenses Ratio, Operating Ratio. (Theory and Numerical)

Reference Books:

1. Lal, Jawahar and Seema Srivastava , Cost Accounting. Tata McGraw Hill Publishing Co., New Delhi.

2. Nigam, B.M. Lall and I.C. Jain. Cost Accounting: Principles and Practice. Prentice Hall of India, New Delhi.
3. Mittal, D.K. and Luv Mittal. Cost Accounting. Galgotia Publishing Co., New Delhi.
4. Arora, M.N. Cost Accounting – Principles and Practice. Vikas Publishing House, New Delhi.
5. Shukla, M.C., T.S. Grewal and M.P. Gupta. Cost Accounting: Text and Problems. S.Chand & Co. Ltd., New Delhi.
6. Maheshwari, S.N. and S.N. Mittal. Cost Accounting: Theory and Problems. Shri Mahabir Book Depot, New Delhi.
7. Jain, S.P. and K.L. Narang. Cost Accounting: Principles and Methods. Kalyani Publishers, Jalandhar.
8. Horngreen, Charles T., George Foster and Srikant M. Dattar. Cost Accounting: A Managerial Emphasis. Prentice Hall of India Ltd., New Delhi.
9. H.V. Jhamb ,Fundamentals of Management Accounting, Ane Publishing.
10. Drury, Colin. Management and Cost Accounting. Thomson Learning.
11. Lal, Jawahar. Advanced Management Accounting- Text and Cases. S. Chand & Co.,New Delhi.
12. Khan, M.Y. and P.K. Jain. Management Accounting. Tata McGraw Hill, Publishing
13. Dr. Vijay Bagde, Dr. Pramod Fating, Dr. Sarang Javkhedkar, Dr. Milind Gulhane – Cost and Management Accounting - Sir Sahitya Kendra, Nagpur
Note: Latest edition of text books may be used.

DSE – I – Discipline Specific Elective (DSE) Course
Elective – II
Paper - IV
Course Name – Corporate Accounting
Course code -5T4

Unit-I :- Company Account- Issue of Share Capital and Capital Structure

Meaning of a company, Characteristics, Kinds of companies, Formation of company, difference between partnership and company , Difference between Private Limited company and Public Limited company, Type of Share, Kinds of Share Capital, Accounting for issue and forfeiture of shares, re-issue of forfeited shares, meaning and need of De-mating of shares. (Theory and Numerical)

Unit-II :- Final Accounts of Companies

Preparation of Final Accounts of Joint Stock companies with reference to Companies Act 2013. (Theory and Numerical)

Unit-III : Amalgamation and Absorption

Meaning and Definitions of Amalgamation and Absorption, Types of Amalgamation, characteristics, Difference between amalgamation and absorption, Purchase Consideration. (Theory and Numerical)

Unit-IV : Valuation of Share

Meaning, Need for valuation of shares, factors influencing valuation of shares, Kinds of value of shares, Methods of valuation of shares. : (Theory and Numerical)

(i) Net Assets Method (ii)Yield Method (iii) Fair value method

Text Book

1. Corporate Accounting,V. Rajasekaran, R. Lalitha, Pearson.

Reference Books

1. Corporate Accounting, V. K. Goyal, RuchiGoyal, PHI.

2. Corporate Accounting, S N Maheshwari&Suneel K Maheshwari, Vikas Publishing House Pvt. Ltd..
3. Corporate Financial Accounting, Dr. S.K. Singh, SBPD.
4. Dr. Vijay Bagde, Dr. Pramod Fating, Dr. Sarang Javkhedkar, Dr. Milind Gulhane – Corporate Accounting - Sir Sahitya Kendra, Nagpur

Semester – VI

Paper - I

Course Name – C#.Net

Course code - 6T1

UNIT – I

Introducing C# - What is C#?**,**Evaluation of C#**,** Characteristics of C#**,** Application of C#**,** How does C# Differ from C++?**,** How does C# Differ from Java?. **Understanding.NET: The C# Environment –**The.NET Framework, The Common Langue Runtime, Framework Base Class,.NET Languages, Benefits of the .NET Approach, C# and .NET. **Overview of C#** - Introduction, A Simple C# Program, Namespaces, Adding Comments, Using Aliases for Namespaces Classes, Passing String Objects to WriteLine Method, Command Line Argument, Main with Class, Providing Interactive Input, Multiple Main Methods, Compile Time Error. **Literals, Variables and Data Types** –Introduction, Literals, Variables, Data Types, Value Types, Reference Type, Declaration Types, Initialization of Variables, Default Value, Constant Variable, Scope of Variables, Boxing and Unboxing. **Operators and Expressions** – Introduction, Operator Precedence and Associativity, Type Conversion,

UNIT - II

Decision Making and Branching –Introduction, Decision Making with if Statement, Simple if Statement, The if…else Statement, The else if Ladder, The Switch Statement, The ? : Operator, Decision Making and Looping – Introduction, The while

Statement, The do Statement, for Statement, The for each Statement. **Methods in C#** - Introduction, Declaring Methods, The Main Method, Invoking Methods, Nesting of Methods, Method Parameters, Pass by Value, Pass by Reference, The Output Parameters, Variables Argument List, Methods Overloading. **Handling Arrays** – Introduction, One-Dimensional Array, Creating an Array, Two-Dimensional Array, Variable-Size Arrays,. Manipulating Strings – Introduction, Creating String, String Methods, Inserting String, Comparing String, Finding String, Mutable String Arrays of String,

UNIT - III

Structures and Enumerations –Introduction, Structures, Structs with Methods, Difference between Classes and Structs, Enumerations, Enumerator type Conversion. **Classes and Objects** - Introduction, Basic Principle of OOP, Defining a Class, Adding Variables, Adding Methods, Member Access Modifiers, Creating Objects, Accessing Class Members, Constructors, Overloaded Constructors, Static Members, Static Constructors, Private Constructors, Copy Constructors, Destructors, Member Initialization, The This Reference, Nesting of Members, Constant Members, Read-only Members, Properties, Indexers. **Inheritance and Polymorphism** – Introduction, Classical Inheritance, Defining a Subclass, Visibility Control, Defining Subclass Constructors, Multilevel Inheritance, Hierarchical Inheritance, Overriding Methods, Abstract method, Sealed Class: Preventing Inheritance, Sealed Methods, Polymorphism.

UNIT - IV

Interface: Multiple Inheritance–Introduction, Defining an Interface, Extending Interface, Implementing Interface, Interface and Inheritance, Explicit Interface Implementation, Abstract Class and Interface. **Operator Overloading** – Introduction, Overloadable Operators, Need for Operator Overloading, Defining Operator Overloading, Overloading Unary Operator, Overloading Binary Operator, Overloading Comparison Operator. **Managing Errors and Exceptions** – Introduction, What is Debugging?, Types of Errors, Exceptions, Syntax of Exception Handling Code, Multiple Catch Statements, The Exception Hierarchy, General Catch Handler, Using Finally Statement, Nested Try Blocks, Throwing Our Own Exceptions, Checked and Unchecked Operators, Using Exceptions for Debugging.

Text Book:

1. E. Balagurusamy, Programming in C#, McGraw-Hill.

Reference Books:

1. Rod Stephens, C# 5.0 – Programmer‘s Reference, Wrox A Wiley Brand.
2. Rod Stephens, C# - 24 –Hour Trainer, Wrox A Wiley Brand.
3. Herbert Schildt, The Complete Reference C# 4.0, McGraw-Hill.

SEC – I – Skill Enhancement Course

Elective - I

Paper - II

Course Name – Python

Course code - 6T2

UNIT - I

Getting Started -Introducing python, Installing python on windows, Installing python on Linux, Meeting the interpreter, Writing your first program, Employing variables, Obtaining user input, Correcting Errors. **Performing operations-**Doing arithmetic, Assigning values, Comparing Values, Assessing logic. , Examining Conditions, Setting precedence, casting data types, Manipulating bits. **Making statements -** Writing lists, Manipulating lists, Restricting lists, associating list elements, Branching with if, Looping while true, Looping over items, Breaking out of loops.

UNIT - II

Defining Functions-Understanding scopes, Supplying arguments, Returning Values, Using callbacks, Adding placeholders, producing generators, Handling exceptions, Debugging assertions. **Importing Modules -** ,Storing functions, Owning function names, Interrogating the system, Performing mathematics, Calculating decimals, Telling the time, Running a timer, Matching patterns.

UNIT - III

Managing strings -Manipulating strings, Formatting strings, Modifying strings, Accessing files, Reading and writing files, Updating file strings, Pickling data **Programming objects**, Encapsulating data, Creating instance objects, Addressing

class attributes, Examining built-in attributes, Collecting garbage, Inheriting features, Overriding base methods, Harnessing polymorphism.

UNIT - IV

Processing requests-Sending responses, Handling values, Submitting forms, Providing text areas, Checking boxes, Choosing radio buttons, Selecting options, Uploading files **Building interfaces-**Launching a window, Responding to buttons, Displaying messages, Gathering entries, Listing options, Polling radio buttons, Checking boxes, Adding images **Developing applications-** Generating random numbers, Planning the problem, Designing the interface, Assigning static properties, Initializing dynamic properties, Adding runtime functionality, Testing the program, Freezing the program, Deploying the application.

Text Book:

1. Mike McGrath, Python in easy steps, McGraw-Hill.

Reference Books:

1. Charles Dierbach, Introduction to Computer Science using Python, Wiley.
2. Laura Cassell& Alan Gauld, Python Projects, Wrox A Wiley Brand.
3. Allen B. Downey, Think Python, Shroff Publishers, O'Reilly.
4. Paul Greis, Jennifer Campbell, Jason Montojo, Practical Programming – An Introduction to Computer Science using Python, Shroff Publishers.

SEC – I – Skill Enhancement Course

Elective – I

Paper - II

Course Name – Ruby on Rail

Course code - 6T2

UNIT - I

Introduction - A Tour of Ruby, Try Ruby, A Sudoku Solver in Ruby. **The Structure and Execution of Ruby Programs -** Lexical Structure, Syntactic Structure, File Structure, Program Encoding, Program Execution. **Data types and Objects -** Numbers, Text, Arrays, Hashes, Ranges, Symbols, True, False, and Nil, Objects.

UNIT - II

Expressions and Operators - Literals and Keyword Literals, Variable References, Constant References, Method Invocations, Assignments, Operators. **Statements and Control Structures -**Conditionals, Loops, Iterators and Enumerable Objects, Blocks, Altering Control Flow, Exceptions and Exception Handling, BEGIN and END, Threads, Fibers, and Continuations. Methods, Procs, **Lambdas, and Closures -** Defining Simple Methods, Method Names, Methods and Parentheses, Method Arguments, Procs and Lambdas, Closures, Method Objects, Functional Programming.

UNIT - III

Classes and Modules - Defining a Simple Class, Method Visibility: Public, Protected, Private, Subclassing and Inheritance, Object Creation and Initialization, Modules, Loading and Requiring Modules, Singleton Methods and the Eigenclass, Method Lookup, Constant Lookup. **Reflection and Meta programming -** Types, Classes, and Modules, Evaluating Strings and Blocks, Variables and Constants, Methods, Hooks, Tracing, Object Space and GC, Custom Control Structure, Missing Methods and Missing Constants, Dynamically Creating Methods, Alias Chaining, Domain-Specific Languages.

UNIT - IV

The Ruby Platform – Strings, Regular Expressions, Numbers and Math, Dates and Times, Collections, Files and Directories, Input/Output, Networking, Threads and Concurrency. **The Ruby Environment -** Invoking the Ruby Interpreter, The Top-Level Environment, Practical Extraction and Reporting Shortcuts, Calling the OS, Security.

Text Book:

1. David Flanagan, Yukihiro Matsumoto, The Ruby Programming language, O‘Reilly.

Reference Books:

1. Noel Rappin, Professional Ruby on Rails, Wrox.
2. Michael Fitzgerald, Ruby – Pocket Reference, O‘Reilly.
3. Timothy Fisher, Ruby on Rails – Bible, Wrox.
4. Daniel Kehoe, Learn Ruby on Rails, Book One.
5. MichaelHartl, Ruby on Rail Tutorial,

DSE – I – Discipline Specific Elective (DSE) Course

Elective – I

Paper - III

Course Name – Entrepreneurship Development

Course code - 6T3

UNIT – I

Entrepreneur: Introduction, Evolution of the concept of Entrepreneur, Characteristics of successful Entrepreneurs, The charms of becoming Entrepreneur, The Entrepreneurial decision process, Functions of Entrepreneur, Need of Entrepreneur, Types of Entrepreneurs, Distinction between an Entrepreneur and a Manager, Intrapreneur, social Entrepreneur. **Entrepreneurship:** Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of Entrepreneurship in economic development. Types of Entrepreneurship, Family Business

UNIT - II

Agri-Preneurship: Introduction, Need for developing Agri-Preneurship in India, Opportunities for developing Agri-Preneurship, Challenges involved in developing Agri-Preneurship. **Factors affecting Entrepreneurship growth:** Factors affecting Entrepreneurship, Government Actions. **Entrepreneurial Motivation:** Meaning of Entrepreneurial Motivation, Motivational Cycle or Process, and Theories of Entrepreneurial Motivation. **Entrepreneurial Competencies:** Meaning of Entrepreneurial Competency, Major Entrepreneurial Competencies, Developing Entrepreneurial Competencies.

UNIT - III

Entrepreneurship Development Programmes (EDPs): Meaning of EDP, Need of EDPs, Objectives of EDPs, Entrepreneurship Development Programmes in India: A Historical Perspective, Course contents and curriculum of EDPs, Phase of EDP, Evaluation of EDPs, and Problems of EDPs. **Micro and small enterprises:** Small enterprise: Meaning & Definition, Essentials, features & Characteristics, Relationship between Micro and Macro enterprises, Rationale behind Micro & small enterprises, Role of Micro enterprise in economic development, Package for promotion of Micro and Small-scale enterprise. **Formulation of Business Plans:** Meaning of business

plan, Contents of business plan, Significance, Formulation of business plan, Network Analysis, Common Errors in business plan formulation.

UNIT - IV

Project Appraisal: Concept of Project Appraisal, Methods of Project Appraisal, and Environmental clearance of SMEs. **Financing of Enterprise:** Meaning and need for financial planning, Source of Finance, Capital Structure, Capitalization, Term Loans, Sources of short-term Finance, Venture Capital, Export Finance. **Forms of business Ownership:** Sole Proprietorship, Partnership, Company, Cooperative, And Selection of an appropriate form of ownership structure, **Institutional Finance of entrepreneurs:** Need for institutional finance, Institutional Finance. **Institutional Support to Entrepreneurs:** Need for institutional support, Institutional Support to small Entrepreneurs.

Text Book- Dr. S. S. Khanka, Entrepreneurial Development, S. Chand.(Reprint 2016)

Reference Books

1. Robert D. Hisrich, Mathew J. Manimala, Michael P. Peters, Dean A. Shepherd, Enterpreneurship, McGraw-Hill.
2. CA Dr. AbhaMathur, Business Entrepreneurship and Management, Taxmann.
3. Charles E. Bamford, Garry D. Bruton, Enterpreneurship – A Small Business Approach, McGraw-Hill.

DSE – I – Discipline Specific Elective (DSE) Course

Elective – I

Paper - III

Course Name – Company Law and Secretarial Practice

Course code - 6T3

Unit - I

Company and its Nature and Scope - Meaning, Definition and characteristics of company. Historical background of company law in India, Companies Act 2013, landmark provisions of the Act, Classification of companies, Lifting the corporate veil.

Unit - II

Procedure for Incorporation of companies - Role of promoters, Legal Position of Promoter, functions and liabilities of a promoter, Registration and incorporation of a company, Merits and Demerits of Incorporation of company - Memorandum of Association - Meaning, Purpose, Contents, clauses Ultra vires and Doctrine of Ultravires. Articles of Association - Meaning Purpose, Content. Alteration, Doctrine of Constructive Notice. Distinction between the Memorandum and Articles, Doctrine of Indoor management. Meaning - Formalities of issue Prospectus - Misrepresentation of Prospectus - Golden Rule **Amalgamation and winding up -** Merger and Demerger of Company, Amalgamation, Winding up of a Company, Payment of Liabilities in the event of winding up, Role of Official Liquidator, Court and National Company Law Tribunal.

Unit - III

Shares, Debentures and Company Meetings - Shares - Meaning, Types of Shares and Transfer of shares, price of issue of shares. Share Capital, Meaning, Kinds, Alteration, Reduction and Voting Rights, Global Depository receipts, Sweat Equity shares, bonus shares, buyback of shares. Share Certificate. Debenture - Meaning, Types, Charge-Fixed and Floating, Crystallization of Floating charge. **Company Meetings:-** Annual General Meetings, Extraordinary General Meetings, Persons Entitled To Call EGM, Notice,

Unit - IV

Secretary :- Definition, need and importance, Appointment and dismissal, Work, duties, rights and liabilities, Memorandum of association and secretary, Articles of association and secretary, Prospectus and secretary. **Directors Position, Appointment And Removal: -** Definition Of Directors, Position Of Director In A Company, Composition Of Board Of Directors, Methods and Provisions As To Directors Appointment, Appointment/Reappointment Of Rotational Directors, Director Identification Number, Disqualifications For Director, Vacation Of Office Of Director, Resignation Of Director, Removal Of Directors

Book Recommended:

1. C.A.Kamal Garg, Bharat's Corporate and Allied Laws, 2013

2. Institute of Company Secretaries of India, Companies Act 2013, CCH Wolter Kluver Business, 2013

3. Lexis Nexis, Corporate Laws 2013 (Palmtop Edition)
4. Avtar Singh : Company Law
5. Dutta on Company Law
6. N.D.Kapoor on Company Law, Charles Wild and Stuart Weinstein Smith and Keenan, Company Law, Pearson Longman, 2009
7. The Companies Acts from 1956 to 2014 as amended up to the date.
8. The New Company Law, Dr. N.V. Paranjape, Central Law Agency.

RASHTRASANT TUKDOJI MAHARAJ

NAGPUR UNIVERSITY, NAGPUR.

Semester System Syllabus of Economics

For

B.A. (Part III) – Semester – Vth & VIth

Faculty of Humanities

(WITH EFFECT FROM Session 2018-19)

Economics Vth Semester

Indian Economy-I

Unit I - Nature of Indian Economy

Meaning, Nature and types of economy- Capitalist-, Socialist, Mixed , Basic features and Changing structure of Indian Economy, Population, Urbanization and Migration .National Income of India - Trends and Structure, Basic features of Maharashtra's Economy.

Unit II - Agriculture

Importance of Indian Agriculture, Problems related to Indian Agriculture Production and Productivity , Cropping pattern in India, .Agrarian reforms, Irrigation and types of irrigation, Green revolution, Agriculture price policy, Agriculture credit, Agricultral marketing, Policies for Sustainable Agriculture, Contract Farming, Community Farming, Crop Insurance And Livestock Insurance, Problems Of Agricultural Labour , Agricultural Crisis In India

Unit III - Industry

Need, Importance and Role of Industries in Economic Development. , Cottage, Small And Large Scale Industries, Role of Public And Private Sector In Indian Economy. Concept of Disinvestment, Public-Private Partnership(PPT), Industrial Policies of India. Privatization, Liberalisation And Globalization,

Unit IV - Employment and Poverty

Employment : Extent of employment- organized ,unorganized sector, Meaning, Types, causes and problems of unemployment, Labour problem in India, problems of child labour and exploitation of labour.

Concept of poverty, methods to measure poverty in India (Different Committee Reports), Estimates of poverty and inequality, Inequality of income, Vicious circle of poverty

Poverty alleviation programmes: Programmes for Rural areas, Programmes for Urban areas, Objectives and Strategy and Outline of Wage employment programmes, Self-employment programmes, Food security programmes ,Social security programmes , DRDA Administration programmes , Urban poverty alleviation programmes

Books Recommended :-

Economic Survey of Govt. of India Every year current issue available on website finmin.nic.in/indiabudget

.Dutt and K.P.M. Sundaram 2018 : Indian Economics, S. Chand & Company Ltd., Nerw Delhi.

. Dhingra, I.C. 2018, The Indian Economics : Environment and Poliy, Sultan Chand & Sons, New Delhi.

. Datt, R.C., (1950), The Economic History of Indian Under Early British Rule, Low Pricer Publications, Delhi.

. Kumar D. (ed.) (1982), The Cambridge Economics History of India Volume II, 1757-1770, Orient Longman Ltd., Hyderabad.

. Misra, S.K. and V.K. Puri (2018), Indian Economy – Its Development Experience, Himalaya, Publishing House, Mumbai.

. Gadgil, D.R. (1971), The Industrial Evolution in India in Recent Times, 1860-1939, Oxford University Press, Bombay.

. Government of India, Economic Survey (Annual), Economic Division, Ministry of Finance, New Delhi.

. Naoroji, D. (1962), Poverty and Un-British Rule in India, Low. Price Publications, Delhi.

. Planning Commission Government of India, New Delhi.

.Singh, V.B. (Ed.) (1965) Economic History of India, 1857-1956, Allied Publishers Private Ltd. Bombay.

. Ahluwalia, L.J. and I.M.D. Little (Eds.) (1999), India's Economic reforms and f Development (Essays in honour of Manmohan Singh), Oxford University, Press, New Delhi.

. Jalan B. (1992), The Indiazn Economy : Problem and Prospectus, Viking, New Delhi.

. Jalan B. (1996), Indian's Economic Policy – Preparing for the Twenty first Century, Viking, New Delhi.

. Parikh, K.S.(1996), India Development Report- 1999-2000, Oxford University Press, New Delhi.

. Datt, R.(Ed.) (2018), Second Generation Economic Reforms in India, Deep & Deep Publications, New Delhi.

. Thirlwal, A.P. 2018, (6th Edition), Growth and Developments, Macmillian, London.

. Arestis, P. (Ed.)(1993), Employment Economic Growth and the Tyranny of the Market Edward Elgar, Aldershol..

. Bhagwati, J land P. Desai (1970), India : Planning for Industrialization, Oxford University Press, London.

. Brahmananda, P.R. and C.N. Vakli (1956), Planning for an Expending Economy Vora and Co., Bombay.

. Chakravarty, S. (1987), Development Planning : The Indian Experiencve, Clerendor Press., Oxford.

. Ucchatar Arthik Siddhant by H.L. Ahuja (In Hindi) ()Mucrieconomics Analysis) S. Chand.

. Uchatar Sanashti Arthshastra by H.L. Ahuja (In Hindi) S. Chand.

B.A.- III

. श्री. आ. देशपांडे, भारताचे नियोजन आणि आर्थिक विकास, विद्या प्रकाशन.

. केवल कृष्णा डयुएट, भारतीय अर्थशास्त्र

. प्रा. नारायण जाजूख प्रा.प्रभाकर देश्यमुख, प्रा. बलराम वनमाळी, भारतीय ग्रामीण अर्थशास्त्र
. प्रा.प्रभाकर देश्यमुख, प्रा. बलराम वनमाळी, भारतीय औद्योगिक अर्थव्यवस्था
. कर्वे, डॉ. भेंडे – भारताच्या आर्थिक समस्या
. देसाई, जोशी – भारताचा आर्थिक विकास
. देसाई, जोशी – भारतीय अर्थव्यवस्था – भाग १ व २.
. रा. म. दिवलकर – भारतीय नियोजन (महाराष्ट्र विद्यापीठ ग्रंथ निर्मिती मंडळ)
. गो. स. कामत – सहकारख त्त्व, व्यवहार आणि व्यवस्थापन (महाराष्ट्र विद्यापीठ ग्रंथ निर्मिती मंडळ)
. वासेकर, एस. पी. काकडे जे. एम. भारतीय अर्थव्यवस्था, विकास व पर्यावरणात्मक अर्ळाशास्त्र, पायल प्रकाशन, नागपूर.
. प्रा. बापट, प्रा. अभ्यंकर – भारतीय आर्थिक विकास(महाराष्ट्र विद्यापीठ ग्रंथ निर्मिती मंडळ)
. डॉ. पालीवाल – भारतीय आर्थिक विकास आणि नियोजन (मंगेश प्रकाशन, नागपूर.)
. प्रा. शास्त्री, फुके, प्रा. डोंकरे – भारतीय आर्थिक समस्या, नियोजन आणि विकास (संगम प्रकाशन)
प्रा. ल. ग. बापट, अभ्यंकर – भारतीय आर्थिक विकास व समस्या (महाराष्ट्र विद्यापीठ ग्रंथ निर्मिती मंडळ)

Economics VIth Semester

Indian Economy - II

Unit I- Economic Development and Growth

Meaning Of Economic Development And Factors Affecting Economic Development, Indicators And Measurement Of Economic Development, Concept Of Sustainable Development,- Definition, Background, Issues , Objectives and Goals , Human Development Index and its components, Gender Development Index, Multidimensional Poverty Index Concept Of Inclusive Growth- need ,elements of inclusive growth, Impact and Challenges of Inclusive growth in Indian Economy..

Unit II- Planning and Policy

Meaning and Definition, Objectives, Broad achievement and failures of five year plans ,NITI (National Institution for Transforming India)Aayog - Objectives, Structure. Regional planning , Features of Current Economic Survey of India. ,Special Economic Zone (SEZ) - Definition, Objectives and its impact on Indian Economy. Concept of Economic Reforms in India.

Unit III- Public Finance

Meaning, Nature, Scope and Importance of Public Finance, Source of Public Revenue, Indian Tax Structure, Classification of Taxes, Shifting And Incidence of Taxes., Features of Indian Tax System. ,,Goods and Services Tax (GST),

Meaning And Types of Public Debt, Problems of Public Debt,

Meaning of Budget,. Concept of Deficit: Revenue, Fiscal And Primary Deficit. . ,

Gender Budgeting, .Features of Current Year Budget ,

Latest Finance Commission – Centre-State Conflicts.

Unit IV- International Trade

India's Foreign Trade, Trends in Export And Imports, Composition And Direction of Indian Foreign Trade,

Multilateral and Bilateral trade of India, India's Free Trade and Preferential Trade Agreements and its impact on Indian Economy,

BRICS and its impact on Indian Economy. India and World Trade Organization,

Balance of Payments, Export Promotion, Export- Import Policy ,Foreign Direct Investment. ,Foreign Portfolio Investment, Multinational Corporations

Books Recommended :-

. Dutt and K.P.M. Sundaram 2018 : Indian Economics, S. Chand & Company Ltd., Nerw Delhi.

. Dhingra, I.C. 2018, The Indian Economics : Environment and Poliy, Sultan Chand & Sons, New Delhi.

. Datt, R.C., (1950), The Economic History of Indian Under Early British Rule, Low Pricer Publications, Delhi.

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B.A.- III

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. कर्वे, डॉ. भेंडे – भारताच्या आर्थिक समस्या

. देसाई, जोशी – भारताचा आर्थिक विकास
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प्रा. ल. ग. बापट, अभ्यंकर – भारतीय आर्थिक विकास व समस्या (महाराष्ट्र विद्यापीठ ग्रंथ निर्मिती मंडळ)

Rashtrasant Tukadoji Maharaj Nagpur Univeristy

Economics Syllabus for B.A (Part - I) Semester – I Examination

Micro Economics Theory - I

Time : Three Hours Max. Marks : 80

Course Outline :-

Unit – I : **Introduction to Economics**

Nature, Definition and Scope of Economics, Dimensions of Economics : Positive and Normative Economics, Tools of Economics Analysis, Inductive and deductive methods, Meaning of Micro and Macro Economics, Importance of Micro and Macro economics, Economic Laws, Economic Problem, Significance of the study of economics, Limitation of Economics.

Unit – II: **Law of Demand and Law of Supply**

Demand: Definition and Features of Demand, Market demand, Determinants of demand, Law of Demand, Demand Schedule Demand Curve, Giffen goods and Giffen's Paradox

Elasticity of Demand: Definition, Types of Elasticity - Price Elasticity, Income Elasticity and Cross Elasticity, Methods of Measuring price elasticity of demand, Factor's influencing elasticity of Demand, Importance of price elasticity of demand (Theory and applicable simple problem on elasticity of demand)

Supply: Definition, Market Supply, Determinates of supply, Law of Supply, Supply Schedule, Supply curve

Unit – III: **Consumer Behavior**

Utility Analysis: Meaning of Utility, Measure of Utility, Law of Diminishing Marginal Utility, Law of equip-Marginal Utility

Indifference Curve Analysis: Definition, Assumption, Schedule, Characteristics, Price or budget line, Consumers Equilibrium with help of Indifference Curve, Significance of Indifference curve analysis

Consumer Surplus: Concept and Measurement of Consumer Surplus, Importance of Consumer Surplus, Engel's Law.

Unit – IV: **Production Function**

Production Function: Meaning and concepts of Production, Factor's of production, Return to Scale, Law of Variable Proportion, Iso-quant Curve, Economies of scale.

Reference Books:

1. *Jhingan M.L, Micro Economic Theory, Vrinda Publication (P) Ltd., Delhi*
2. *Seth M.L, Micro Economics, Lakshmi Narain Agrwal Educational Publishers, Agra*
3. *Appannaiah, Reddy, Shanthi, Economics for Business, Himalalya Publishing House, Mumbai*
4. *डॉ. गजानन पाटील, सूक्ष्म अर्थशास्त्र, कस्तूरी प्रकाशन, नागपूर*
5. *डॉ. एच.पी.सिंह, बी.पी.मित्तल, व्यष्टि आर्थिक सिद्धान्त, संजीव प्रकाशन मेरठ, मेरठ*
6. *Sunil Bhaduri, Micro Economic Theory, New Central Book Agency (P) Ltd, Kolkata*
7. *Dr. Deepashree, Micro Economic Theory, Sultan Chand & Son, New Delhi*

Rashtrasant Tukadoji Maharaj Nagpur Univeristy

Economics Syllabus for B.A (Part - I) Semester – II Examination

Micro Economics Theory – II

Time : Three Hours Max. Marks : 80

Course Outline :-

Unit – I: **Cost and Revenue Analysis**

Cost of Production: Meaning, Costs, Different concept of production - Monetary cost, Implicit and Explicit cost, Opportunity cost, Inter-relationship between average and marginal cost, Causes to increase in marginal and average cost according to line period (short-long term)

Revenue Analysis: Concept of Total, Average, Marginal revenue, Relationship between average revenue and marginal revenue, concept of profit - Gross, Net, Normal and Abnormal, Break-Even point, Equilibrium of the Firm, Expansion path.

Unit – II: **Market Structure and Perfect Competition Market**

Market Structure: Meaning and definitions, Classifications of the Markets.

Perfect Competition Market: Features of Perfect competition, Meaning of Firm and Industry, Price determination under perfect competition, Equilibrium (Short-long run) of Industry and firm

Unit – III: **Monopoly and Imperfect Competition Market**

Monopoly: Definition, Characteristics, Types, Price determination under monopoly, Price discrimination under monopoly, Monopoly Control, Monopoly and anti-trust policy

Monopolistic Competition: Definition, Characteristics, Price determination under Monopolistic competition, Product Differentiation

Oligopoly: Definition, Characteristics, Price Leadership

Unit – IV: **Factors Pricing and Statistics for Economics**

Factors Pricing: Factors of production – Land, Labour, Capital and organization; Theories of Distribution: Marginal Productivity and Modern Theory of Distribution; Theories of Rent: Ricardo and Modern Theory of Rent; Theories of Wages: Modern Theory of wages, Wages determination under imperfect competition; Theories of Interest: Lonable fund and Keynes liquidity Preference theory of Interest; Theories of Profit: Uncertainty theory of Profit, Dynamic theory of profit, Innovation theory of profit (only principle applicable)

Statistics: Nature and scope of Statistics, Relationship of Economics to statistics, Statistical Averages: Mean, Median, Mode, Geometric and Harmonic mean, their merits and demerits (Theory and applicable simple problem)

Reference Books:

1. *Jhingan M.L, Micro Economic Theory, Vrinda Publication (P) Ltd., Delhi*
2. *Seth M.L, Micro Economics, Lakshmi Narain Agrwal Educational Publishers, Agra*
3. *Appannaiah, Reddy, Shanthi, Economics for Business, Himalalya Publishing House, Mumbai*
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6. *Gajanan Patil, Fundamental Statistics, Kasturi Publications, Nagpur*
7. *Sunil Bhaduri, Micro Economic Theory, New Central Book Agency (P) Ltd, Kolkata*
8. *Dr. Deepashree, Micro Economic Theory, Sultan Chand &Son, New Delhi*

Rashtrasant Tukadoji Maharaj Nagpur Univeristy

Economics Syllabus for B.A (Part - II) Semester – III Examination

Macro Economics Theory – I

Time : Three Hours Max. Marks: 80

Course Outline :-

Unit – I: **Introduction to Macro Economics**

Nature and Scope of Macro Economics, Importance of Macro economics, Limitations of macro economics, Transition from Micro economics to macro economics, Difference between micro and macro economics, Basic concepts of circular flow of economic activity – two, three and four sector model.

Unit –II : **National Income**

Concepts of National income, Some basic concepts- Consumption goods, Capital goods, Final goods, Intermediate goods, Gross investment and depreciation, GNP, NNP, GDP, NDP, Per Capita Income, Personal and disposal Income, Methods and difficulties in Measurement of National income, Importance of National income analysis.

Unit –III : **Money and Value of Money**

Money: Meaning, Definitions, Types of Money, Functions of Money,

Theories of Value of Money - Fishers Quantity Theory of Money and Cambridge Quantity Theory of Money

Inflation, Deflation, Dis-inflation and Reflection: Meaning, Definition, Features, Causes, Types and Effect

Monetary and Fiscal Policy: Meaning, Objectives and Importance, Measures of monetary policy, Instrument of Fiscal policy, Importance of Deficit Budget, Limitations of Fiscal policy.

Unit –IV : **Output and Employment**

Say's Law of Market: Concept of Say's of Market Law, Keynesian objection, Principle of Effective Demand: Aggregate demand and aggregate supply functions.

Consumption Function: Average and Marginal Propensity to Consume, Factors influencing consumption function, Importance of propensity to consume.

Investment Multiplier: Definition of investment multiplier, Limitations, Criticism, Importance of Multiplier

Investment Function: Meaning of investment, Types of investment- Autonomous and Induced investment, Marginal Efficiency of Capital

Reference Books:

1. *Jhingan M.L, Macro Economic Theory, Vrinda Publication (P) Ltd., Delhi*
2. *Seth M.L, Lakshmi Narain Agrwal Educational Publishers, Agra*
3. *डॉ. गजानन पाटील, स्थूल अर्थशास्त्र, कस्तूरी प्रकाशन, नागपूर*
4. *डॉ. एच.पी.सिंह, वी.पी.मित्तल, व्यष्टि आर्थिक सिद्धान्त, संजीव प्रकाशन मेरठ, मेरठ*

Rashtrasant Tukadoji Maharaj Nagpur Univeristy

Macro Economic Theory – II

Economics Syllabus for B.A (Part - II) Semester – VI Examination

Time : Three Hours Max. Marks : 80

Course Outline :-

Unit –I : **Commercial and Central Bank**

Commercial Banks: Evolution, Meaning, Functions, Critical appraisal of the commercial bank in India after nationalization, Principle of Sound Commercial Bank, Credit creation of commercial Banks, Process of Credit Creation, Cash Reserve Ratio of Commercial Bank, Limitation of credit creation, Management of Balance Sheet, Reforms in banking sector in India

Central Bank and Credit Control: Meaning, Definition, Characteristics, Importance, Functions, Credit Control of Central Bank

Unit –II: **RBI and Innovation in Banking**

Reserve Bank of India: Meaning, Objects and Functions,

Monetary policy of RBI- Objectives, Limitation and Credit control- Quantitative and Qualitative methods

Modern Banking System: Non-performing Assets, Electronic Banking, CORE Banking, Innovation in Banking Sector- ATM, Debit and Credit Card, Plastic Card, Smart Card, Cheque Card, Electronic Purse, Laser Card, Bankers Clearing House – Automated Clearing House, Online Banking, Advanced Ledger posting machine, MICR Technology, Cheque Clearing, Electronic fund transfer, Internet Banking, Electronic Cheque, Electronic Clearing Service, DEMAT Account, Private sector Banks in India

Unit -III: **Financial Market**

Money Market: Meaning, Definition, Features, Objectives, Components of Money Market, Function, Importance and need, Indian Money Market- Meaning and Types, Features and Demerits

Financial Markets: Financial institutions, Markets Instruments and financial innovations, Role of Financial Markets and institutions, Equilibrium of Financial markets, financial crises

Capital Market: Stock Exchange - Meaning, Features; Functions and Size of capital market, Relationship of Debt Market, Indian capital Market - Structure, Factors responsible to develop capital market in India

Unit –IV: **Health Economics and Statistics for Economics**

Health Economics: Meaning, Areas of Health Economics, Causes of Health Problems in India, Sources of health finance.

Dispersion: Definition, Objects, Nature, Properties of good measures of Dispersion, Standard Deviation, Coefficient of Variation (Theory and applicable problem on simple and discrete series)

Reference Books:

1. *Jhingan M.L, Macro Economic Theory, Vrinda Publication (P) Ltd., Delhi*

2. *Seth M.L, Lakshmi Narain Agrwal Educational Publishers, Agra*
3. *डॉ. गजानन पाटील, स्थूल अर्थशास्त्र, कस्तूरी प्रकाशन, नागपूर*
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5. *Gajanan Patil, Fundamental Statistics, Kasturi Publications, Nagpur*
6. *Harish Basavaiah, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi*

Rashtrasant Tukadoji Maharaj Nagpur Univeristy

B.A (Part – I, II and III) All semester Examination

Syllabus under the Board of Studies Economics and Faculty of Social Science

Paper pattern for B.A – I,II and III year semester examination for Economics

Time: Three Hours] [Maximum Marks: 80

N.B : *1) Attempt ALL questions.*
2) All questions carry equal marks.
3) Draw neat diagrams wherever necessary.

Question No. 1: a) Long Questions (16 Marks) — 16 Marks

OR

b) Long Questions (8 Marks)
c) Long Questions (8 Marks)

Question No. 2: a) Long Questions (16 Marks) — 16 Marks

OR

b) Long Questions (8 Marks)
c) Long Questions (8 Marks)

Question No. 3: Short Questions (Solved **ANY FOUR** of the following) — 16 Marks

a) Short Questions (4 Marks)
b) Short Questions (4 Marks)
c) Short Questions (4 Marks)
d) Short Questions (4 Marks)
e) Short Questions (4 Marks)
f) Short Questions (4 Marks)

Question No. 4: Short Questions (Solved **ANY FOUR** of the following) — 16 Marks

a) Short Questions (4 Marks)
b) Short Questions (4 Marks)
c) Short Questions (4 Marks)
d) Short Questions (4 Marks)
e) Short Questions (4 Marks)
f) Short Questions (4 Marks)

Question No. 5: Multiple Choice Questions (Solved **ALL** of the following) — 16 Marks

a) Short Questions (2 Marks)
b) Short Questions (2 Marks)
c) Short Questions (2 Marks)
d) Short Questions (2 Marks)

[TWO from each Unit – I, II, III, IV]

e) Short Questions (2 Marks)
f) Short Questions (2 Marks)
g) Short Questions (2 Marks)
h) Short Questions (2 Marks)

Rashtrasant Tukadoji Maharaj Nagpur Univeristy

B.A (Part – I, II and III) All semester Examination

For Economics

Under the Board of Studies Economics and Faculty of Social Science

Internal Assessment : 20 Marks

	Evaluation Type	Marks
1.	Class Attendance	05
2.	One Periodical Class Test and Two Assignments	10
3.	Active participation in routine class instructional deliveries (Seminars/presentation)	03
4.	Overall conduct as a responsible student, mannerism and articulation and exhibit of leadership qualities in organizing related academic actives	02
	Total	20

Guidelines about conduct of Assignment:

The assignment should be based on any of the sub-topic suggested for the course/syllabus.

PROGRAMME OUTCOMES – B.A.

1. Integrate student's learning across all facets of their lives.
2. Analyse critically and imaginatively. Develop skills of crtical analyse and interpretation.
3. Communicate effectively
4. Understand the ethical implications of ideas, communications and actions
5. Appear in competitive examinations.

PROGRAMME SPECIFIC

1. Understand background of our historic past, religion, customs, institutions, administration and so on.
2. Understand Social, Political, Religious and Economic conditions of the people.
3. Understand the history of world with comparative approach.
4. Analyse relationship between the past and the present times and bringing its contemporary relevance.
5. Emphasis on developing crtical thinking in historical writing, discussion and interpretation among students.
6. Prepare students for various competitive examinations.

B.A. First Year

Semester I

Paper 1T1 **History of India from Earliest Times to 1525**

Outcomes:-

1. Study the ancient Indian civilization such as Harappa and Vedic and understand social, political and religious changes during the period.
2. Develop the ability to understand the origin and tents of Jainism and Buddhism.
3. Acquire knowledge about ancient Indian dynasties – Maurya, Gupta and Vakataka.
4. Introduction to prominent Sultanate dynasties and their administrative systems in medieval India.
5. Acquire knowledge on religious, culture and art history in medieval India.

Time : Three Hours **Full Marks : 80**

Unit – 1

a. The Harappan Civilization – Extent, Town Planning, Social, Religious Condition.
b. Rig Vedic, Later Vedic Age – Polity, Society, Religious Condition
c. Jainism, Buddhism – Origin, Tenets

Unit – 2

a. Chandragupat Maurya – Administration, Ashoka – His Conquests, Dhamma.
b. The Gupta Dynasty – Chandra Gupta-I, Samudragupta, Chandragupta Vikramaditya
c. Vakataka – Prabhavati Gupta, Pravarsen-I, Harisen, Cultural condition

Unit – 3

a. Iltutmish – Founder of Slave Dynasty, Balban – Blood and Iron Policy
b. Alauddin Khilji – Administrative Policy
c. Mohammad – bin – Tuglaq – His Experiments, Firoz Tuglaq – Administration

Unit – 4

a. Sufi cult – Tenets, Moinuddin chisti
b. Bhakti Movement – Main features, Kabir, Nanak
c. Architecture of Sultanate period.

Books Recommended:-

English:-

1. The Wonder that was India – A. L. Basham
2. History & Culture of the Indian people Vols II, III, IV & V (Bharatiya Vidya Bhavan Series) – R. C. Majumdar et al.
3. Ancient India – R. C. Majumdar
4. Ancient India – V.D. Mahajan
5. Ancient Indian History & Culture - S.R. Sharma
6. Medieval India, from Sultante to the Mughals – Satish Chandra.
7. Delhi Sultanate – A.L. Shrivastava
8. Mughal Empire – A.L. Shrivastava
9. New History of the Marathas Vol. I – G.S. Sardesai.

हिन्दी :–

10. प्राचीन भारत का इतिहास – डी. एन. झा और के. एम. श्रीमाली
11. प्राचीन भारत का इतिहास – दिनानाथ वर्मा
12. भारत का बृहत इतिहास भाग १, २ – श्री. नेत्र पांण्डे
13. दिल्ली सल्तनत – ए. एल. श्रीवास्तव
14. मुगल साम्राज्य – ए. एल. श्रीवास्तव
15. मराठों का नवीन इतिहास, खंड १ – गो. स. सरदेसाई

मराठी :–

16. प्राचीन भारत – अ. वि. विश्वरूपे
17. भारताचा इतिहास (प्राचीन काळ ते १६०५) – श. गो. कोलारकर
18. भारताचा प्राचीन व मध्ययुगीन इतिहास – च. श. फडनाईक
19. भारताचा इतिहास (प्रारंभापासून इ.स. १७६०) – नी. सी. दीक्षित
20. मध्य कालीन भारत – ढवळे, बारगळ
21. मराठी सत्तेचा विकास व ऱ्हास – प्रा. ल. सासवडकर
22. प्राचीन भारताचा सांस्कृतिक व राजकीय इतिहास – आचार्य केशट्टीवार
23. मध्ययुगीन भारत – आचार्य केशट्टीवार
24. भारताचा इतिहास प्रारंभापासून १७६० पर्यंत – डॉ. धनंजय आचार्य

बी.ए. भाग – १

सत्र – प्रथम

पेपर 1T1 **भारताचा इतिहास प्रारंभापासून ते १५२५ पर्यंत**

वेळ : तीन तास **एकूण गुण : ८०**

घटक – १

अ) हडप्पा संस्कृती – विस्तार, नगर रचना, सामाजिक, धार्मिक स्थिती

ब) ऋग्वेदिक व उत्तरवैदिक काळ – राजकीय, सामाजिक, धार्मिक स्थिती

क) जैन धर्म, बौध्द धर्म – उदय, सिध्दान्त

घटक – २

अ) चंद्रगुप्त मौर्य – प्रशासन, अशोक – कामगिरी व धम्म

ब) गुप्त राजवंश – चंद्रगुप्त प्रथम, समुद्रगुप्त, चंद्रगुप्त विक्रमादित्य

क) वाकाटक – प्रभावती गुप्ता, प्रवरसेन–I, हरीसेन, सांस्कृतिक स्थिती

घटक – ३

अ) अल्तमश – गुलाम राजवंशाचा संस्थापक, बल्बन – रक्त आणि लोह धोरण

ब) अल्लाउद्दीन खिलजी – प्रशासकिय धोरण

क) महम्मद–बिन–तुघलक – त्याचे प्रयोग, फिरोज तुघलक – प्रशासन

घटक – ४

अ) सुफीपंथ – सिध्दांत, मोईनुद्दीन चिश्ती

ब) भक्ती चळवळ, प्रमुख वैशिष्टये, कबीर, नानक

क) सल्तनतकालीन स्थापत्यकला

बी.ए. भाग – १

सत्र – प्रथम

विषय – इतिहास

पेपर 1T1 **भारत का इतिहास आरंभ से १५२५ तक**

समय : तीन घंटे **कुल अंक : ८०**

इकाई : १

अ) हडप्पा सभ्यता – विस्तार, नगर नियोजन, सामाजिक एवं धार्मिक स्थिती

ब) ऋग्वैदिक एवं उत्तर वैदिक काल – राजकीय, सामाजिक, धार्मिक स्थिती

क) जैनधर्म, बौध्दधर्म – उदय एवं सिध्दांत

इकाई : २

अ) चंद्रगुप्त मौर्य – प्रशासन, अशोक विजय अभियान, धम्म

ब) गुप्त वंश – चंद्रगुप्त प्रथम, समुद्रगुप्त, चंद्रगुप्त विक्रमादित्य

क) वाकाटक – प्रभावती गुप्ता, प्रवरसेन प्रथम, हरीसेन, सांस्कृतिक स्थिती

इकाई : ३

अ) इल्तुतमिश – गुलाम वंश का संस्थापक, बलबन – रक्त एवं लौह नीति

ब) अल्लाउद्दीन खिलजी – प्रशासनिक नीति

क) मुहम्मद – बिन – तुगलक – प्रयोग, फिरोज तुगलक का प्रशासन

इकाई :४

अ) सुफी पंथ – सिध्दांत; मोईनुद्दीन चिश्ती

ब) भक्ती आंदोलन – प्रमुख विशेषताएँ; कबीर, नानक

क) सल्तनतकालीन स्थापत्यकला

B.A. First Year

Semester II

Paper 2T1 **History of India from 1526 to 1761**

Outcomes:-

1. To understand rise and establishment of Mughal dynasty in India.
2. Know about the war of succession or Shahjahan and understand the Deccan Policy of Aurangzeb.
3. Introduction to history of Marathas; understand significance of coronation and administrative system of Chhatrapati Shivaji.
4. Analyse the Maratha War of Independence and study third battle of Panipat in Peshwa period.
5. Understanding foundation of East India Company's rule in India.

Time : Three Hours **Full Marks : 80**

Unit – 1

a. Establishment of Mughal Power – Babur
b. Sher Shah Suri – His Administrative Reforms
c. Akbar – Religious Policy, Territorial Expansion

Unit – 2

a. Shah Jahan – War of Succession
b. Aurangzeb – Deccan Policy
c. Art and Architecture

Unit – 3

a. Shivaji – Relations with Deccan Powers and the Mughals
b. Shivaji's Coronation and Administration
c. Chhatrapati Sambhaji – His relations with Mughals

Unit – 4

a. Maratha War of Independence, Accession of Shahu
b. Third battle of Panipat – Causes and Consequences
c. Establishment of East India Company's rule in India

Books Recommended :-

English:-

1. The Wonder that was India – A. L. Basham
2. History & Culture of the Indian people Vols II, III, IV & V (Bharatiya Vidya Bhavan Series) – R. C. Majumdar et al.
3. Ancient India – R.C. Majumdar
4. Ancient India – V. D. Mahajan
5. Ancient Indian History & Culture - S. R. Sharma
6. Medieval India, from Sultante to the Mughals – Satish Chandra.
7. Delhi Sultanate – A. L. Shrivastava
8. Mughal Empire – A. L. Shrivastava
9. New History of the Marathas Vol. I - G.S. Sardesai.

हिन्दी :–

१०. प्राचीन भारत का इतिहास – डी. एन. झा और के. एम. श्रीमाली

११. प्राचीन भारत का इतिहास – दिनानाथ वर्मा

१२. भारत का बृहत इतिहास भाग १, २ – श्री. नेत्र पांण्डे

१३. दिल्ली सल्तनत – ए. एल. श्रीवास्तव

१४. मुगल साम्राज्य – ए. एल. श्रीवास्तव

१५. मराठों का नवीन इतिहास, खंड १ – गो. स. सरदेसाई

मराठी :–

१६. प्राचीन भारत – अ. वि. विश्वरूपे.

१७. भारताचा इतिहास (प्राचीन काळ ते १६०५) – श. गो. कोलारकर

१८. भारताचा प्राचीन व मध्ययुगीन इतिहास – च. श. फडनाईक

१९. भारताचा इतिहास (प्रारंभापासून इ.स. १७६०) – नी. सी. दीक्षित

२०. मध्यकालीन भारत – ढवळे, बारगळ

२१. मराठी सत्तेचा विकास व ऱ्हास – प्रा. ल. सासवडकर

२२. प्राचीन भारताचा सांस्कृतिक व राजकीय इतिहास – आचार्य केशट्टीवार

२३. मध्ययुगीन भारत – आचार्य केशट्टीवार

२४. भारताचा इतिहास प्रारंभापासून १७६० पर्यंत – डॉ. धनंजय आचार्य

बी.ए. भाग – १

सत्र – द्वितीय

पेपर 2T1 **भारताचा इतिहास १५२६ ते १७६१ पर्यंत**

वेळ : तीन तास **एकूण गुण : ८०**

घटक – १

अ) मुघल सत्तेची स्थापना – बाबर

ब) शेरशाह सुरी – त्याची प्रशासकीय सुधारणा

क) अकबर – धार्मिक धोरण, साम्राज्य विस्तार

घटक – २

अ) शहाजहान – वारसा युध्द

ब) औरंगजेब – दक्षिण धोरण

क) कला आणि स्थापत्यकला

घटक – ३

अ) शिवाजी – दख्खनी सत्ता आणि मुघलांसोबत संबंध

ब) शिवाजीचा राज्याभिषेक आणि प्रशासन

क) छत्रपती संभाजी–मुघल संबंध

घटक – ४

अ) मराठा स्वातंत्र्य संग्राम, शाहूचे राज्यारोहण

ब) पानिपतची तिसरी लढाई – कारणे आणि परिणाम

क) भारतात ईस्ट इंडिया कंपनीच्या सत्तेची स्थापना

बी.ए. भाग – १

सत्र – दोन

पेपर 2T1 भारत का इतिहास १५२६ से १७६१ तक

समय : ३ घंटे **कुल अंक : ८०**

इकाई : १

अ) मुगल सत्ता की स्थापना–बाबर

ब) शेरशाह सूरी – प्रशासनिक सुधार

क) अकबर – धार्मिक नीति एवं साम्राज्य विस्तार

इकाई : २

अ) शारजहाँ – उत्तराधिकार युध्द

ब) औरंगजेब – दख्खन नीति

क) कला एवं स्थापत्य

इकाई : ३

अ) शिवाजी – दख्खन के राज्य एवं मुगलों के साथ संबंध

ब) शिवाजी का राज्यभिषेक एवं प्रशासन

क) छत्रपती संभाजी–मुगल संबंध

इकाई :४

अ) मराठा स्वतंत्रता युध्द, शाहू का पदारोहण

ब) पानीपत की तीसरी लड़ाई – कारण और परिणाम

क) भारत में ईस्ट इंडिया कंपनी के शासन की स्थापना

B.A. Second Year

Semester III

Paper 3T1 History of India : 1764 to 1885

Outcomes:-

1. Understand the rise of British Power in India and analyse their agrarian poicy and land revenue system.
2. Analyse policies of Governor-Generals in India under East India Company's rule.
3. Study socio-religious movements of modern India.
4. Understand the administrative reforms introduced by Viceroys during establishment of British rule in India.
5. Analyse the causes of rise of Indian nationalism and emergence of local organisations.

Time : Three Hours **Full Marks : 80**

Unit : 1

a. Battle of Buxar – Treaty of Allahabad, Dual Government of Lord Clive
b. Permanent Settlement, Ryotwari, Mahalwari System of Agriculture
c. Comercialization of Agriculture

Unit : 2

a. Subsidiary Alliance of Lord Wellesley
b. Internal Reforms of Lord William Bentinck
c. Doctrine of Lapse of Lord Dalhousie

Unit: 3

a. Revolt of 1857 – Causes, Effects
b. Brahmo Samaj, Prarthna Samaj, Arya Samaj
c. Satya Shodhak Samaj, Depressed Class Movement

Unit : 4

a. Lord Lytton's Administration
b. Lord Ripon's Internal Reforms
c. Rise of Indian Nationalism, Foundation of Local organizations

Books Recommended

English:-

1. The New look at Modern Indian History – B.L. Grover and Alka Mehta
2. An Advanced History of India – Majumdar, Ray Choudhary, Datta
3. A History of Modern India – Ishwari Prasad, Subhedar
4. An Advanced Study in the History of Modern India, Vol. I, II, III – G.S. Chabra
5. History of Freedom Movement in India – Four Volumes – Tarachand
6. India's Struggle for Independence – Bipan Chandra
7. History of Modern India – A.L. Shrivastava.

हिन्दी :–

8. आधुनिक भारत – दीनानाथ वर्मा
9. आधुनिक भारत का इतिहास – ग्रोवर एवंम् यशपाल
10. आधुनिक भारत का इतिहास – आर. एल. शुक्ला
11. भारत का स्वतंत्रता संघर्ष – बिपन चंद्र
12. भारतीय स्वतंत्रता आन्दोलन का इतिहास, चार खण्ड – ताराचंद
13. आधुनिक भारत – बिपन चंद्र
14. आधुनिक भारत का इतिहास, दो खण्ड – धनपति पाण्डे

मराठी :–

15. अर्वाचीन भारत – के. मु. केशट्टीवार
16. आधुनिक भातर – ढवळे, बारगळ
17. भारताचा इतिहास (१७०७ ते १९५०) – श. गो. कोलारकर
18. आधुनिक भारताचा इतिहास (१७५७ ते १८५८) – डॉ. सुमन वैद्य, डॉ. शांता कोठेकर
19. आधुनिक भारताचा इतिहास (१८५८ ते १९२०) – डॉ. सुमन वैद्य, डॉ. शांता कोठेकर
20. आधुनिक भारताचा इतिहास (१९२० ते १९४७) – डॉ. सुमन वैद्य, डॉ. शांता कोठेकर
21. आधुनिक भारताचा इतिहास (१९४७ ते १९८६) – डॉ. शांता कोठेकर
22. आधुनिक भारताचा इतिहास – व्ही. के. जाधव

बी.ए. भाग – २

सत्र – तृतीय पेपर 3T1 **भारताचा इतिहास : १७६४ ते १८८५**

वेळ : तीन तास **एकूण गुण : ८०**

घटक – १

अ) बक्सारची लढाई – अलाहाबादचा तह, लार्ड क्लाईव्हची दुहेरी शासनव्यवस्था

ब) कृषी व्यवस्थेतील कायमधारा पध्दती, रयतवारी, महालवारी

क) कृषीचे व्यापारीकरण

घटक – २

अ) लॉर्ड वेलस्लीची तैनाती फौज पध्दत

ब) लॉर्ड विल्यम बेंटिकच्या अंतर्गत सुधारणा

क) लॉर्ड डलहौसीचा खालसा सिध्दान्त

घटक – ३

अ) १८५७ चा उठाव – कारणे, परिणाम

ब) ब्राम्हो समाज, प्रार्थना समाज, आर्य समाज

क) सत्यशोधक समाज, वंचित वर्गाची चळवळ

घटक – ४

अ) लॉर्ड लिटनचे प्रशासन

ब) लॉर्ड रिपनच्या अंतर्गत सुधारणा

क) भारतीय राष्ट्रवादाचा उदय, स्थानिक संघटनाची स्थापना

बी.ए. भाग – २

सत्र – तृतीय

पेपर 3T1 **भारत का इतिहास : १७६४ से १८८५**

समय : तीन घंटे **कुल अंक : ८०**

इकाई : १

अ) बक्सर की लड़ाई – इलाहाबाद की संधि, लॉर्ड क्लाईव की द्वैध शासन प्रणाली

ब) कृषि व्यवस्था में स्थायी बंदोबस्त, रयतवारी एवं महलवारी

क) कृषि का व्यापारीकरण

इकाई : २

अ) लॉर्ड वेलस्ली की सहायक संधि

ब) लॉर्ड विलियम बेंटिक के आंतरिक सुधार

क) लॉर्ड डलहौजी की हड़प नीति

इकाई : ३

अ) १८५७ का विद्रोह–कारण एवं परिणाम

ब) ब्रम्हो समाज, प्रार्थना समाज, आर्य समाज

क) सत्यशोधक समाज, वंचित वर्ग का आंदोलन

इकाई :४

अ) लॉर्ड लिटन का प्रशासन

ब) लॉर्ड रिपन के आंतरिक सुधार

क) भारतीय राष्ट्रवाद का उदय, स्थानिय संघटनाओं की स्थापना

B.A. Second Year

Semester IV

Paper 4T1 History of India : 1885 - 1947

Outcomes:-

1. Understand the origin and establishment Indian National Congress. Understand the nature of moderates and extremists ideology.
2. Understand the phases of Indian National Movement and its impact under the leadership of Mahatma Gandhi.
3. Study various missions proposed by British government.
4. Examine role of Subhash Chandra Bose and his formed INA in struggle of Indian Independence.
5. Evaluate Mountbatten plan and Indian Independence Act of 1947.

Time : Three Hours **Full Marks : 80**

Unit : 1

a. Establishment of Indian National Congress
b. Nature of Moderate Politics – 1885-1905
c. Rise and Growth of Extremism – 1905-1920

Unit : 2

a. Non Co-operation Movement
b. Civil Disobedience Movement
c. Quit India Movement

Unit : 3

a. Rashtriya Swaysevak Sangh (R.S.S.) Role in Nation building
b. Cripps Mission
c. Cabinet Mission Plan

Unit : 4

a. Subhash Chandra Bose, I.N.A.
b. Mountbatten Plan
c. Indian Indepedence Act

Books Recommended

English:-

1. A New Look at Modern Indian History – B.L. Grover and Alka Mehta
2. An Advanced History of India – Majumdar, Ray Choudhary, Datta
3. A History of Modern India – Ishwari Prasad, Subhedar
4. An Advanced Study in the History of Modern India, Vol. I, II, III – G.S. Chabra
5. History of Freedom Movement in India – Four Volumes - Tarachand
6. India's Struggle for Independence – Bipan Chandra
7. History of Modern India – A.L. Shrivastava.

हिन्दी :–

8. आधुनिक भारत – दीनानाथ वर्मा
9. आधुनिक भारत का इतिहास – ग्रोवर एवंम् यशपाल
10. आधुनिक भारत का इतिहास – आर. एल. शुक्ला
11. भारत का स्वतंत्रता संघर्ष – बिपन चंद्र
12. भारतीय स्वतंत्रता आन्दोलन का इतिहास, चार खण्ड – ताराचंद
13. आधुनिक भारत – बिपन चंद्र
14. आधुनिक भारत का इतिहास, दो खण्ड – धनपति पाण्डे

मराठी :–

15. अर्वाचीन भारत – के. मु. केशट्टीवार
16. आधुनिक भातर – ढवळे, बारगळ
17. भारताचा इतिहास (१७०७ ते १९५०) – श. गो. कोलारकर
18. आधुनिक भारताचा इतिहास (१७५७ ते १८५८) – डॉ. सुमन वैद्य, डॉ. शांता कोठेकर
19. आधुनिक भारताचा इतिहास (१८५८ ते १९२०) – डॉ. सुमन वैद्य, डॉ. शांता कोठेकर
20. आधुनिक भारताचा इतिहास (१९२० ते १९४७) – डॉ. सुमन वैद्य, डॉ. शांता कोठेकर
21. आधुनिक भारताचा इतिहास (१९४७ ते १९८६) – डॉ. शांता कोठेकर
22. आधुनिक भारताचा इतिहास – व्ही. के. जाधव

बी.ए. भाग – २

सत्र – चतुर्थ

पेपर 4T1 **भारताचा इतिहास : १८८५ – १९४७**

वेळ : तीन तास **एकूण गुण : ८०**

घटक – १

अ) भारतीय राष्ट्रीय काँग्रेस ची स्थापना

ब) मवाळ राजकारणाचे स्वरूप – १८८५–१९०५

क) जहालवादाचा उदय आणि विकास – १९०५–१९२०

घटक – २

अ) असहकार चळवळ

ब) सविनय कायदेभंग चळवळ

क) 'चले जाव' चळवळ

घटक – ३

अ) राष्ट्रीय स्वयंसेवक संघ (R.S.S.) राष्ट्रनिर्माणातील भूमिका

ब) क्रिप्स मिशन

क) कॅबिनेट मिशन योजना

घटक – ४

अ) सुभाषचन्द्र बोस, आय.एन.ए.

ब) माऊंटबॅटन योजना

क) स्वतंत्र भारताचा कायदा

बी.ए. भाग – २

सत्र – चतुर्थ

पेपर 4T1 **भारत का इतिहास : १८८५ – १९४७**

समय : तीन घंटे **कुल अंक : ८०**

इकाई : १

अ) भारतीय राष्ट्रीय काँग्रेस की स्थापना

ब) नरमपंथी राजनीति का स्वरूप – १८८५–१९०५

क) उग्र राष्ट्रवाद का उदय एवं विकास : १९००–१९२०

इकाई : २

अ) असहयोग आंदोलन

ब) सविनय अवज्ञा आंदोलन

क) भारत छोड़ो आंदोलन

इकाई : ३

अ) राष्ट्रीय स्वयंसेवक संघ (R.S.S.) राष्ट्रनिर्माण में भूमिका

ब) क्रिप्स मिशन

क) कॅबिनेट मिशन योजना

इकाई :४

अ) सुभाषचंद्र बोस, आजाद हिंद फौज

ब) माऊंटबैटन योजना

क) भारतीय स्वतंत्रता अधिनियम

B.A. III or Final Year

Semester V

Paper 5T1 **Modern World – 1789-1920**

Outcomes:-

1. Introduction to landmark events in World history.
2. Understand policy of imperialism and changes in world political order.
3. Emergence of State of Germany and its diplomatic policy.
4. Critically analyse background of First World War and international peace making attempts that followed.

Time : Three Hours **Full Marks : 80**

Unit : 1

a. French Revolution
b. European Colonialism of Asia and Africa
c. Causes and consequences of Imperialism

Unit : 2

a. Sino-Japanese War of 1894-1895
b. Russo – Japanese War of 1904-1905
c. Chinese Revolution of 1911

Unit : 3

a. Foreign Policy of Bismark and Kaiser Willium - II
b. Causes of the First World War
c. Treaty of Versailles

Unit : 4

a. League of Nations - Structure
b. League of nations – Achievements and failures
c. Russian Revolution of 1917

Books Recommended

English:-

1. A History of Modern Europe Since 1789 (S. Chand & Comp.) V.D. Mahajan
2. Europe and the World (S. Chand & Comp.) – Sailendra Nath Sen.
3. Europe in 19th and 20th Century - Lipson
4. Modern Europe up to 1945 - Hazen
5. The World Since 1919-Langsam
6. Twentieth Century World – L.P. Mathur
7. Modern World – B.V. Rao
8. A History of the far East in Modern Times – H.M. Vinacke
9. The far East – Clyde and Beers
10. Modern World – S.P. Nanda
11. History of far East – Majumdar and Shrivastava

हिन्दी :–

12. आधुनिक युरोप का इतिहास – व्ही. डी. महाजन
13. आधुनिक युरोप का इतिहास – सत्यकेतु विद्यालंकार
14. अन्तर्राष्ट्रीय संबंध – हरिदत्त वेदालंकार
15. आधुनिक विश्व का इतिहास – दीनानाथ वर्मा
16. बीसवीं सदी का विश्व – डॉ. संजिव जैन
17. एशिया का इतिहास – डॉ. अंबिका प्रसाद शर्मा

मराठी :–

18. आधुनिक युरोप भाग २ – ब. म. मेहता
19. आंतरराष्ट्रीय संबंध भाग १, २ – म. गो. शुक्ला
20. आधुनिक भारताचा इतिहास (एस.चांद) – विद्याधर महाजन
21. आधुनिक जग – डॉ. कोलारकर, मंगेश प्रकाशन, नागपूर
22. युरोपचा इतिहास – डॉ. नी. सी. दीक्षित, पिंपळापुरे पब्लिकेशन, नागपूर
23. अर्वाचीन युरोप – डॉ. के. मु. केशट्टीवार
24. विसाव्या शतकातील जग नांदेड २००३ – डॉ. सुहास जोशी
25. आधुनिक जग भाग – १ (१८७० ते १९४५) – डॉ. सुमन वैद्य आणि डॉ. शांता कोठेकर
26. आधुनिक जग भाग – २ (१९४५ ते १९८०) – डॉ. सुमन वैद्य आणि डॉ. शांता कोठेकर
27. आधुनिक चीन – जपानचा इतिहास – तानाजीराव निकम
28. चीन व जापान : राजकिय इतिहास – डॉ. यादव गुजर
29. आधुनिक जग – धनंजय आचार्य

बी.ए. भाग – ३

सत्र – पाचवे

पेपर 5T1 **आधुनिक जग – १७८९–१९२०**

वेळ : तीन तास **एकूण गुण : ८०**

घटक – १

अ) फ्रेंच राज्यक्रांती

ब) आशिया व आफ्रिकेतील युरोपचा वसाहतवाद

क) साम्राज्यवादाचे कारणे व परिणाम

घटक – २

अ) चीन–जपान युध्द – १८९४–१८९५

ब) रशिया–जपान युध्द – १९०४–१९०५

क) १९११ ची चीन मधील क्रांती

घटक – ३

अ) बिस्मार्क व कैसर विलियम द्वितियचे परराष्ट्र धोरण

ब) प्रथम महायुध्दाची कारणे

क) व्हर्सायचा तह

घटक – ४

अ) राष्ट्रसंघ – रचना

ब) राष्ट्रसंघ – यशापयश

क) १९१७ ची रशियन राज्यक्रांती

बी.ए. भाग – ३

सत्र – पाँच

पेपर 5T1 **आधुनिक विश्व – १७८९–१९२०**

समय : तीन घंटे **कुल अंक : ८०**

इकाई : १

अ) फ्रेंच क्रांति

ब) एशिया एवं आफ्रिका में यूरोप का उपनिवेशवाद

क) साम्राज्यवाद के कारण एवं परिणाम

इकाई : २

अ) चीन – जापान युध्द – १८९४–१८९५

ब) रूस–जापान युध्द – १९०४–१९०५

क) १९११ – चीन की क्रांती

इकाई : ३

अ) बिस्मार्क, कैसर विलियम द्वितीय की विदेश नीति

ब) प्रथम विश्वयुध्द के कारण

क) वर्साय की संधि

इकाई :४

अ) राष्ट्रसंघ की संरचना

ब) राष्ट्रसंघ की उपलब्धियाँ एवं असफलताएँ

क) रूसी क्रांती – १९१७

B.A. III or Final Year

Semester VI

Paper 6T1 **Modern World : 1920-1960**

Outcomes:-

1. Analyse causes for the rise of dictatorship in Europe.
2. Understand international crisis; inter world war period politics and events leading to Second World War and its aftermath.
3. Understand world politics after World War and attempts to restore World peace.
4. Introduction to political shifts in West Asia.

Time : Three Hours **Full Marks : 80**

Unit : 1

a. Soviet Russia – Five Year Plans
b. Hitler – Foreign Policy
c. Mussolini – Foreign Policy

Unit : 2

a. Sino-Japanese War of 1937-39
b. Causes of the Second World War
c. U.N.O. – Structure, Achievements

Unit : 3

a. Cold War
b. NATO, SEATO, Warsaw Pact
c. Decolonisation of Asia

Unit : 4

a. Establishment of Israel
b. Non Alignment
c. Suez Crisis

Books Recommended

English:-

1. A History of Modern Europe Since 1789 (S. Chand & Comp.) V.D. Mahajan
2. Europe and the World (S. Chand & Comp.) – Sailendra Nath Sen.
3. Europe in 19th and 20th Century - Lipson
4. Modern Europe up to 1945 - Hazen
5. The World Since 1919-Langsam
6. Twentieth Century World – L.P. Mathur
7. Modern World – B.V. Rao
8. A History of the far East in Modern Times – H.M. Vinacke
9. The far East – Clyde and Beers
10. Modern World – S.P. Nanda
11. History of far East – Majumdar and Shrivastava
12. A Short History of the Middle East – Somendra Lal Ray
13. Studies in World History – Satish Kumar

हिन्दी :–

14. आधुनिक युरोप का इतिहास – व्ही. डी. महाजन
15. आधुनिक युरोप का इतिहास – सत्यकेतु विद्यालंकार
16. अन्तर्राष्ट्रीय संबंध – हरिदत्त वेदालंकार
17. आधुनिक विश्व का इतिहास – दीनानाथ वर्मा
18. बीसवीं सदी का विश्व – डॉ. संजिव जैन
19. एशिया का इतिहास – डॉ. अंबिका प्रसाद शर्मा

मराठी :–

20. आधुनिक युरोप भाग २ – ब. म. मेहता
21. आंतरराष्ट्रीय संबंध भाग १, २ – म. गो. शुक्ला
22. आधुनिक भारताचा इतिहास (एस.चांद) – विद्याधर महाजन
23. आधुनिक जग – डॉ. कोलारकर, मंगेश प्रकाशन, नागपूर
24. युरोपचा इतिहास – डॉ. नी. सी. दीक्षित, पिंपळापुरे पब्लिकेशन, नागपूर
25. अर्वाचीन युरोप – डॉ. के. मु. केशट्टीवार
26. विसाव्या शतकातील जग नांदेड २००३ – डॉ. सुहास जोशी
27. आधुनिक जग भाग – १ (१८७० ते १९४५) – डॉ. सुमन वैद्य आणि डॉ. शांता कोठेकर
28. आधुनिक जग भाग – २ (१९४५ ते १९८०) – डॉ. सुमन वैद्य आणि डॉ. शांता कोठेकर
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बी.ए. भाग – ३

सत्र – सहावे

पेपर 6T1 **आधुनिक जग : १९२०–१९६०**

वेळ : तीन तास **एकूण गुण : ८०**

घटक – १

अ) सोवियत रशिया – पंचवार्षिक योजना

ब) हिटलर – पराराष्ट्र धोरण

क) मुसोलिनी – पराराष्ट्र धोरण

घटक – २

अ) चीन–जपान युध्द – १९३७–३९

ब) द्वितीय महायुध्दाची कारणे

क) संयुक्त राष्ट्रसंघ – रचना, उपलब्धी

घटक – ३

अ) शीत युध्द

ब) नाटो (NATO), सिटो (SEATO), वार्सा करार (Warsaw Pact)

क) आशियाचे निर्वसाहतीकरण

घटक – ४

अ) इस्त्रायलची स्थापना

ब) असंलग्नता

क) सुवेझ प्रश्न

बी.ए. भाग – ३

सत्र – छह

पेपर 6T1 **आधुनिक विश्व : १९२० – १९६०**

समय : ३ घंटे **कुल अंक : ८०**

इकाई : १

अ) रूस की पंचवर्षीय योजना

ब) हिटलर की विदेश नीति

क) मुसोलिनी की विदेश नीति

इकाई : २

अ) चीन – जापान युध्द – (१९३७–३९)

ब) द्वितीय विश्वयुध्द के कारण

क) संयुक्त राष्ट्रसंघ की संरचना एवं उपलब्धियाँ

इकाई : ३

अ) शीत युध्द

ब) नाटो (NATO), सिटो (SEATO), वार्सा समझौता (Warsaw Pact)

क) एशिया का वि–उपनिवेशीकरण

इकाई :४

अ) इजराईल की स्थापना

ब) गुट–निरपेक्षता

क) सुवेज समस्या

RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR
SYLLABUS
B. A. (C.B.S)
SUBJECT : PHILOSOPHY (U.G.)

	PAPERS	
B. A. I	**1 T 1** **(ETHICS : INDIAN)**	**2 T 1** **(ETHICS : WESTERN)**
B. A. II	**3 T 1** **(LOGIC : INDIAN)**	**4 T 1** **(LOGIC : WESTERN)**
B. A. III	**5 T 1** **(EPISTEMOLOGY & METAPHYSICS : INDIAN)**	**6 T 1** **(EPISTEMOLOGY & METAPHYSICS : WESTERN)**

R.T.M. NAGPUR UNIVERSITY NAGPUR

PHILOSOPHY B. A. I

Semester I

Paper : 1 T 1

ETHICS (INDIAN)

Unit I: Indian Ethics

- Definition, nature & Scope of Indian Ethics.
- Four stages of development. Characteristics of Indian Ethics
- Philosophical & Religious Postulates.
- Importance of Indian Ethics

Unit II: Dharma: Introduction

- Definition, kinds of Dharma- Sadharan Dharma, Swadharma (Ashram & Varna vyavastha) Importance of Dharma.
- Buddha Ethics: Introduction, Four noble truths, eight fold path.

Unit III: Karma & Yoga

- Theory of Karma (Karmasidhanta)
- Nishkam karmayoga
- Yoga Ethics: Definition, i) Chittabhumi 2) Chitta Vrutti 3) Panchaklesh 4) Ashtangmarga.

Unit IV: Purushartha : Definition, kinds, Importance of Purushartha.

- Jaina Ethics
- Assignment for 20 Marks based on whole syllabus.

Books recommended:

- डॉ. रामनाथ केदारनाथ शर्मा : नीतिशास्त्र की रूपरेखा
- श्रीनिवास हरी दीक्षित : नीतिमीमासां
- श्रीनिवास हरी दीक्षित : भारतीय नीतिशास्त्र
- यदुनाथ सिन्हा : नीतिशास्त्र
- रत्ना देव : नीतिशास्त्र की रूपरेखा
- दिवाकर पाठक : भारतीय नीतिशास्त्र
- भारतीय नीतिषास्त्रा : डॉ.वृशाली कुलकर्णी
- Ethical Philosophies of India by I. C. Sharma
- The Ethics of the Hindus By S. K. Maitra
- Bhartiya Darshan By Datta &Chatterjee

R.T.M. NAGPUR UNIVERSITY NAGPUR

PHILOSOPHY B. A. I

Semester II

Paper : 2 T 1

ETHICS (WESTERN)

Unit I:

- Introduction, Definition, nature &Scope of western Ethics.
- Moral concepts: Good, Right, Duty and Obligation.
- Kinds of Action: Voluntary actions, Non-voluntary actions, In- Voluntary actions.
- Object of Moral judgments: Motive & Intention (हेतू आणि उद्देश्य) Means & ends (साधन, साध्य)

Unit II:

- Hedonism: Introduction, Definition, Kinds, Psychological Hedonism, Ethical Hedonism, Egoistic Hedonism.
- Altruistic Hedonism.
- Utilitarianism: Bentham and J.S. Mill.

Unit III:

- Rationalism: Introduction, Definition
- Difference between Hedonism & Rationalism, Kant's Rationalism.
- Meta ethics: Subjectivism, Objectivism, descriptivism, Prescriptivism, Emotivism.

Unit IV:

Theories of Punishment: Introduction, Types & Importance

Applied Ethics: Introduction, Definition, nature & Scope

Assignment for 20 Marks based on whole syllabus.

Books recommended:

1. सु. वा. बखले : नीतिशास्त्राची रूपरेशा
2. पी. डी. चौधरी : सबुोध नीतिशास्त्रा
3. डॉ. रामनाथ केदारनाथ शर्मा : नीतिशास्त्रा की रूपरेखा
4. श्रीनिवास हरी दीक्षित : नीतिमीमांसा
5. यदुनाथ सिन्हा : नीतिशास्त्रा
6. सरेुन्द्र गायधनेः मुल्यनिवेदन : एक अतिनीतिशास्त्रीय चिकित्सा
7. दि. य. देशपांडे : नीतिशास्त्राचे प्रष्न
8. Ethics by Mcenzee

9- An Introduction to Ethics by William Lillie

10- A Manual of Ethics by Dr. J. N. Sinha

R.T.M. NAGPUR UNIVERSITY NAGPUR

PHILOSOPHY B. A. II

Semester III

Paper : 3 T 1

LOGIC (INDIAN)

UNIT –I

Theories of inference in Nyaya: Definition, Constituents, Process and Types; Pakshata.

UNIT-II

Paramarsa, Lingaparamarsa, Vyaptigrahopaya, Hetvabhasa.

UNIT -III

Theories of inference in Buddhism: Definition, Constituents, Process and Types; Paksata, Paramarsa, Lingaparamarsa, Vyaptigrahopaya, Hetvabhasa.

UNIT-IV

Theories of inference in Jainism: Definition, Constituents, Process and Types; Paksata, Paramarsa, Lingaparamarsa, Vyaptigrahopaya, Hetvabhasa.

SUGGESTED READINGS:

1. Annambhatta: Tarkasangraha
2. C. Bhattacharyya: Elements of Indian Logic and Epistemology
3. S.S. Barlingay: A Modern Introduction to Indian logic
4. S. Chatterjee: Nyaya Theory of Knowledge.
5- श्रीनिवास हरी दिक्षित : भारतीय तत्त्वज्ञान
6- डॉ. वृशाली कुलकर्णी : भारतीय तर्कशास्त्र
7. डॉ. वृशाली कुलकर्णी : भारतीय तर्कशास्त्रा में अनुमान
8. दत्त एवं चटर्जीः भारतीय दर्शन
9- शांतीप्रसाद अत्रोय : भारतीय तर्कशास्त्रा
10. डॉ. राजबीर सिंह शेखावत : न्याय दर्शन में व्याप्ती की अवधारणा
11. बलीराम शुक्लः अनुमान प्रमाण
12- ब्रजनारायण शर्माः भारतीय दर्शन में अनुमान

R.T.M. NAGPUR UNIVERSITY NAGPUR

PHILOSOPHY B. A. II

Semester IV

Paper : 4 T 1

LOGIC (WESTERN)

(Traditional Logic)

UNIT-I

1. Nature of logic- definition of logic, importance and scope.
2. Introductory topics: Sentence, Propositions, Argument: Truth, Validity,
3. Difference between deductive and inductive inference.
4. Term and classification of terms: connotation, denotation.
5. Difference between Proposition and sentence, classification of proposition.

UNIT-II

1. Aristotelian classification of propositions.
2. Immediate inference: Square of opposition, conversion, obversion.
3. Categorical syllogism: Figure, Mood, Rules of validity,(8 rules) and its related fallacies.

(Symbolic logic)

UNIT-III

1. Symbolic Logic: use of symbols
2. Truth functions: Negation, Conjunction, Disjunction, Implication, and Equivalence.

UNIT-IV

1. Tautology, Contradiction, Contingency
2. Decision procedure: Truth table
3. Veen diagram
4. Soundness

SUGGESTED READINGS:

1. K. T. Basantani : Introduction to symbolic logic
2. I. M. Copy: Symbolic logic
3. डॉ. सनुीता इंगळे व प्रा. वंदना घुशेः तर्कशास्त्र
4. दि. य. देशपांडेः सांकेतिक तर्कशास्त्रा आणि उद्‌गमन

R.T.M. NAGPUR UNIVERSITY NAGPUR

PHILOSOPHY B. A. III

Semester V

Paper : 5 T 1

EPISTEMOLOGY & METAPHYSICS (INDIAN)

EPISTEMOLOGY (INDIAN)

UNIT -I

- Knowledge: Nature and scope.
- Prama and Aprama: definition and kinds.

UNIT -II

- Pramana, definition and kinds,
- Pramanyavada definition and kinds,

METAPHYSICS (INDIAN)

UNIT –III

- Vaiseshika (Padartha), Concept of Soul, Liberation and ultimate reality according to Carvaka, Vaiseshika.

UNIT –IV

- Concept of Soul, Liberation and ultimate reality according to Sankhya and Vedanta (Shankaracharya).

SUGGESTED READINGS:

1. C. Bhattacharyya: Elements of Indian Logic and Epistemology
2. S. Chatterjee: Nyaya Theory of Knowledge.
3. Frank Thilly: A History of Philosophy
4. Dr. J. N. Sinha: Outlines of Indian Philosophy
5. M. Hiriyanna: Outlines of Indian Philosophy
6. Dr. J. N. Sinha: Outlines of Western Philosophy
7. श्रीनिवास हरी दिक्षित : भारतीय तत्त्वज्ञान
8. डॉ. वृशाली कुलकर्णीः भारतीय व पाश्चात्य तत्त्वज्ञानातील समस्या
9. दत्त एवं चटर्जीः भारतीय दर्शन
10. डॉ. रामनाथ शर्माः भारतीय दर्शन के मूलतत्व

R.T.M. NAGPUR UNIVERSITY NAGPUR

PHILOSOPHY B. A. III

Semester VI

Paper : 5 T 1

EPISTEMOLOGY & METAPHYSICS (WESTERN)

EPISTEMOLOGY (WESTERN)

UNIT-I

- Knowledge: Nature and kinds of knowledge.
- Russell Theory of Knowledge: Knowledge by acquaintance and Knowledge by description.

UNIT-II

- Sources of Knowedge: Empiricism and Rationalism, Kant's theory.
- Hume's Scepticism: Definition of Scepticism.

METAPHYSICS (WESTERN)

UNIT- III

- Concept of Substance. (Special reference to Descartes, Spinoza and Leibnitz)

UNIT-IV

- Theory of causation –Hume, Mill and Aristotle.
- God: Nature and proofs for the existence of God.

SUGGESTED READINGS:

1. C. Bhattacharyya: Elements of Indian Logic and Epistemology
2. S. Chatterjee: Nyaya Theory of Knowledge.
3. Frank Thilly: A History of Philosophy
4. Dr. J. N. Sinha: Outlines of Indian Philosophy
5. M. Hiriyanna: Outlines of Indian Philosophy
6. Dr. J. N. Sinha: Outlines of Western Philosophy
7. श्रीनिवास हरी दिक्षित : भारतीय तत्त्वज्ञान
8. डॉ. वृशाली कुलकर्णी : भारतीय व पाश्चात्य तत्त्वज्ञानातील समस्या
9. दत्त एवं चटर्जीः भारतीय दर्षन
10. डॉ. रामनाथ शर्माः भारतीय दर्शन के मूलतत्व
11. डॉ. विनोदकुमार कटारे एवं प्रदीपकुमार खरेः आधुनिक पाश्चात्य दर्शन
12. पा. दा. चौधरी : पाश्चात्य दर्शन

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY NAGPUR

STRUCTURE OF SYLLABUS- SEMESTER PATTERN

BACHELLOR OF ARTS

in

POLITICAL SCIENCE

2016-17

Semester system for B.A. Programme in Political Science is being introduced from ensuing academic year 2016-17. B.A. Programme will of three academic years and will consist of Six Semesters. Each academic year will consist of two semesters- one odd and one even. The theory paper will be of 80 marks the examination of which will be taken by the university at the end of the semester. There shall be internal evaluation of each student for each paper consisting of 20 marks. Each student is required to obtain at least 32 out of 80 marks for passing the theory paper and 08 marks out of 20 in the internal assessment test conducted by the college/department.

Following is the scheme under Semester Pattern for B.A. Political Science Course

B.A. I

SEMESTER I

PAPER- I : POLITICAL THEORY

SEMESTER II

PAPER-II : WESTERN POLITICAL THOUGHT

B.A. II

SEMESTER III

PAPER-III : INDIAN GOVERNMENT AND POLITICS

SEMESTER IV

PAPER-IV: STATE GOVERNMENT AND POLITICS

B.A. III

SEMESTER V

PAPER-V : COMPARATIVE GOVERNMENT AND POLITICS

(With Reference to UK and USA)

SEMESTER VI

PAPER-VI : INTERNATIONAL RELATIONS

INTERNAL ASSESSMENT SCHEME OF B.A. SEMESTER

The students is required to appear and qualify the internal examination separately. He/She must secure minimum 08 marks out of 20 for passing. No second chance will be given for internal assessment.

1. If the student remains absent during the internal assessment examinations he/she can be allowed for re-examination on the permission of the Principal on the recommendation of the Head of Department of the subject concerned.
2. If the student fails in the internal examination he/she will have to apply in the prescribed Application form and pay the prescribed fee as per rules laid down by the university.

(University must design a Application form for A.T.K.T. of the internal examination)

1) Attendance and class room participation : 05 Marks
2) Project Assignment : 05 Marks
   (On topics of syllabus, including research paper, Survey report, book review etc.)
3) Classroom Seminar Presentation : 05 Marks
   (On topics of syllabus)
4) Viva- Voce : 05 Marks
   (Questions on entire syllabus of the paper taught giving emphasis on conceptual clarity)

B.A.FIRST YEAR: SEMESTER - I

POLITICAL THEORY

PAPER-I **MARKS: 80**

COURSE RATIONALE:

This is an introductory paper to the concepts, ideas and theories in political theory. It seeks to explain the evolution and usage of these concepts, ideas and theories with reference to individual thinkers both historically and analytically. The different ideological standpoints with regard to various concepts and theories are to be critically explained with the purpose of highlighting the difference in their perspectives and in order to understand their continuity and change. Furthermore there is a need to emphasize the continuing relevance of these concepts today and explain how in idea and theory of yester years gains prominence in contemporary political theory. All units to be taught with Liberal and Marxist approaches.

COURSE CONTENT:

UNIT - I: POLITICAL THEORY AND STATE

(1) POLITICAL THEORY: Meaning, Nature (Normative and Empirical), Scope and Significance

(2) STATE: Meaning, Basic Elements, Approaches (Liberal and Marxist)

UNIT- II: POWER AND AUTHORITY

(3) POWER: Meaning, Nature, Significance and Types

(4) AUTHORITY: Meaning, Nature, Significance and Types.

UNIT- III: LIBERTY AND EQUALITY

(5) LIBERTY: Meaning, Nature, Significance and Types.

(6) EQUALITY: Meaning, Nature and Significance and Types.

UNIT- IV: RIGHTS AND JUSTICE

(7) RIGHTS: Meaning, Nature, Types, Theory of Natural Rights, Legal Theories of Rights.

(8) JUSTICE: Meaning, Nature, Types, Distributive Justice, Feminist Perspective.

Books Recommended:

1. Amaj Ray & Mohit Bhattacharya: Political theory and Institutions

2. Gauba O.P.: An Introduction to Political Theory, 2014
3. Sushila Ramaswami: Political Theory: Ideas and Concepts, 2010.
4. Sushila Ramaswami: Political Theory and Thought, 2010.
5. Sushila Ramaswami: Key Concepts in Political Theory, 2014.
6. ओमप्रकाश गोबाः राजनीति–सिद्धांत एवं चिंतन, राजनीति–सिंद्धांत के विवेच्य विषय
7. गवई जोगेन्द्र, हाशम शेखः राजकीय सिद्धांत, विश्व प्रकाशन, नागपूर, 2013.
8. देशमुख अलकाः राजकीय सिद्धांत, साईनाथ प्रकाशन नागपूर, 2014.
9. काळे अशोकः राजकीय सिद्धांत, विद्या प्रकाशन, नागपूर, 2007.

B. A. I Semester – II

Western Political Thought

Paper – II Marks: 80

Course Rationale

The paper on western political thought introduces the students to the classical ideas generated in the western world representation the ancient to the modern. The paper intends to introduce the thinkers broadly representing the individual and communitarian ideas. Four thinkers have been selected including Plato, Aristotle, J.S. Mill and Karl Marx who represent this spectrum. The paper deals with details the various aspects of the ideas of all these political thinkers.

Unit – I **Plato**

1. Ideal State
2. Philosopher King
3. Theory of Justice
4. Theory of Communism

Unit – II **Aristotle**

1. Theory of State
2. Classification of state
3. Thoughts on revolution
4. Slavery

Unit – III **J. S. Mill**

1. Concept of Liberty
2. Concept of Democracy
3. Property
4. Government

Unit – IV **Karl Marx**

1. Dialectical Materialism
2. Class War
3. Thoughts on State
4. Theory of surplus value

Books Recommended:

1) Francis W. Coker - Recent Political Thought, The world Press Pvt. Ltd.
2) George H. Sabine - A History of Political theory, George G. Harrap&comoany Ltd. London.
3) C.L. Wayper - Political thought, S.T Pauls, Honce Warwick lane London, Ec. 4
4) V.D. Mahajan& R.R. Seth,Recent Political Thought, Premier Publishing Co, Delhi.
5) William Ebenstiein,Great Political Thinkers – PlatoTo the present Modern Political thought, The great Issues, IInd Edition, Oxford & IBH Publishing company.
6) Radhey Sham Chourasia, History of western Political thought – Volume I & II
7) Suda J.P., History of Political Thought

८ प्रा. भा.ल. भोळे – भारतीय आणि पाश्चिमात्य राजकीय विचार, पिंपळापुरे अॅन्ड कं. पब्लीशर्स, नागपूर

९ प्रा. वा.भा. पाटील –पाश्चिमात्य राजकीय विचारक, मंगेश प्रकाशन, नागपूर

१० प्रा. वि.सी. जोशी –प्लेटोआणिॲरिस्टॉटल यांचे राजकीय तत्वज्ञान,नाथ मुद्रणालय, औरंगाबाद

११ प्रा. प.सी. काणे –काहीप्रमुख राज्यशास्त्रज्ञ, विद्याप्रकाशन, नागपूर

१२ डॉ. ना.य.डोळे, राजकीय विचारांचाइतिहास, कॉन्टिनेन्टलप्रकाशन, पुणे

१३ प्रा. सुधाकरकुलकर्णी, निवडकराजकीय विचारवंत, विद्याभारतीप्रकाशन, लातूर

B.A.SECOND YEAR: SEMESTER - III

INDIAN GOVERNMENT AND POLITICS

PAPER-III **MARKS: 80**

COURSE RATIONALE:

This paper focuses in detail on the political processes and the actual functioning of the political system. It simultaneously studies in detail the political structure both Constitutional and Administrative. It emphasizes on local influences that derive from social stratification of Castes and Jatis, from language, religious ethnic and economic determinants and critically assesses its impact on the political processes. The major contradictions of the Indian Political Process are to be critically analysed along with an assessment of its relative success and failure in a comparative perspective with other developing countries and in particular those belonging to the South Asian region.

COURSE CONTENT:

UNIT - I: INDIAN CONSTITUTION

(1) Preamble: Nature, Objectives of Constitution of India.
(2) Features of Indian Constitution.

UNIT- II: FUNDAMENTAL RIGHTS, DIRECTIVE PRINCIPLES OF STATE POLICY

(3) Fundamental Rights: Meaning, Kinds, Restrictions.

(4) Directive Principles of State Policy: Nature and Significance.

UNIT- III: PRESIDENT, PARLIAMENT AND PRIME MINISTER

(5) President: Powers and Functions.

(6) Parliament: Composition, Powers and Functions.

(7) Prime Minister: Powers and Functions.

UNIT- IV: SUPREME COURT AND MAJOR ISSUES IN INDIAN POLITICS

(8) Supreme Court: Composition, Powers and Jurisdiction (Original, Appellate, Advisory and Judicial Review).

(10) Major Issues in Indian Politics: Caste, Religion, Terrorism.

Books Recommended:

1. Austin Granville: The Indian Constitution: Cornerstone of a Nation, 1999, Working in a Democratic Constitution: A History of the Indian Experience, 2013.
2. Morris Jones, Indian Government and Politics,

3. Fadia B.L. & Fadia Kuldeep: Indian Government and Politics, 2016.
4. Jain M.P.: Indian Constitutional Law, 2014.
5. Johari J.C.: Select World Constitutions
6. Kashyap Subhash: Our Constitution-2015, Our Parliament-2015, Our Political System-2013
7. Khan A.R.: The Constitution of India
8. Narang A.S.: Indian Political System, Process and Development
9. Rajeev Bhargave: Politics and Ethics of the Indian Constituion, 2009.
10. फाडिया बी.एल.ः भारत का संविधान, 2015.
11. जैन पुखराज व फाडिया बी.एल.ः भारतीय शासन एवं राजनीति, 2015.
12. डॉ. भोळे भा.ल.ः भारतीय राज्यव्यवस्था, पिंपळापुरे प्रकाशन, नागपूर, 1990.
13. डॉ. गवई जोगेन्द्र, शेख हाशमः भारतीय शासन आणि राजनीती, विश्व प्रकाशन, नागपूर, 2014.
14. देशमुख अलकाः भारतीय शासन आणि राजकारण, साईनाथ प्रकाशन, नागपूर, 2013.
15. लोटे रा.ज.ः भारतीय शासन आणि राजकारण, पिंपळापुरे प्रकाशन, नागपूर, 2013.
16. डॉ. काळे अशोकः भारतीय शासन आणि राजकारण, अनुराधा प्रकाशन, नागपूर, 2013.

B.A.SECOND YEAR: SEMESTER - IV

STATE GOVERNMENT AND POLITICS

PAPER-IV **MARKS: 80**

COURSE RATIONALE:

This paper focuses in detail on the political processes and the actual functioning of the political system. It simultaneously studies in detail the political structure both Constitutional and Administrative. It emphasizes on local influences that derive from social stratification of Castes and Jatis, from language, religious ethnic and economic determinants and critically assesses its impact on the political processes. The major contradictions of the Indian Political Process are to be critically analysed along with an assessment of its relative success and failure in a comparative perspective with other developing countries and in particular those belonging to the South Asian region.

COURSE CONTENT:

UNIT - I: CENTRE-STATE RELATIONS AND GOVERNOR

(1) Centre-State Relations: Legislative, Administrative and Financial.

(2) Governor: Powers and Functions and Role.

UNIT- II: STATE LEGISLATURE

(3) Legislative Assembly: Composition, Powers and Functions.

(4) Legislative Council: Composition, Powers and Functions.

UNIT- III: CHIEF MINISTER AND HIGH COURT

(5) Chief Minister: Powers and Functions and Role.

(6) High Court: Composition, Powers and Functions.

UNIT- IV: PANCHAYAT RAJ AND RIGHT TO INFORMATION

(7) 73rd and 74th Constitutional Amendment, Women Reservation and Panchayat Raj

(8) Right to Information: Nature, Importance and Role.

Books Recommended:

1. Austin Granville: The Indian Constitution: Cornerstone of a Nation, 1999, Working in a Democratic Constitution: A History of the Indian Experience, 2013.
2. Fadia B.L. & Fadia Kuldeep: Indian Government and Politics, 2016.
3. Jain M.P.: Indian Constitutional Law, 2014.
4. Johari J.C.: Selec World Constituions

5. Kashyap Subhash: Our Constitution-2015, Our Parliament-2015, Our Political System-2013
6. Khan A.R.: The Constitution of India
7. Narang A.S.: Indian Political System, Process and Development
8. Rajeev Bhargave: Politics and Ethics of the Indian Constituion, 2009.
9. फाडिया बी.एल.: भारत का संविधान, 2015.
10. जैन पुखराज व फाडिया बी.एल.: भारतीय शासन एवं राजनीति, 2015.
11. डॉ. भोळे भा.ल.: भारतीय राज्यव्यवस्था, पिंपळापुरे प्रकाशन, नागपूर, 1990.
12. डॉ. गवई जोगेन्द्र, शेख हाशमः भारतीय शासन आणि राजनीती, विश्व प्रकाशन, नागपूर, 2014.
13. देशमुख अलकाः भारतीय शासन आणि राजकारण, साईनाथ प्रकाशन, नागपूर, 2013.
14. लोटे रा.ज.: भारतीय शासन आणि राजकारण, पिंपळापुरे प्रकाशन, नागपूर, 2013.
15. डॉ. काळे अशोकः भारतीय शासन आणि राजकारण, अनुराधा प्रकाशन, नागपूर, 2013.
16. देशमुख अलकाः स्थानिक स्वशासन, साईनाथ, प्रकाशन, नागपूर, 2013.

B.A.III YEAR: SEMESTER-V

COMPARATIVE GOVERNMENT AND POLITICS
(GOVERNMENT & POLITICS OF U.K. and U.S.A.)

PAPER-V **MARKS: 80**

COURSE RATIONALE

This paper studies two major systems of the world by adopting a comparative approach. The contributional, legal provisions, the ideological basis, the institutional arrangements and their social & economical background are to be explained, analyzed and evaluated critically. The comparative perspective enables the student to understand the differences & similarities between various constitutional arrangements. Furthermore , the political institutions are to be studies in light of the political process to gain an understanding of the dynamics of actual politics and policy making.

COURSE CONTENT :

Unit I :- Comparative Politics & Constitutions

A) Comparative Politics :- Meaning, Nature, Approaches (Legal/institutional & Behavioural) and Significance.

B) Features of Constitution : - Salient features of U.K., U.S.A. constitution

Unit II :- Political Culture & Executive

A) Political Culture :- Meaning, Nature, Types and significance in U.K. & U.S.A.

B) Executive : - Composition, Power & functions of the executive in U.K.& USA

Unit III :- Political Parties & Legislature

A) Political Parties :- Nature, function and role of political parties in U.K. & U.S.A.

B) Legislative : - Composition, power and function of the legislature in U.K.& USA

Unit IV :- Pressure Group & Judiciary

A) Pressure Group :- Meaning, Nature, Types, Techniques & role adopted by pressure group in U.K. & U.S.A.

B) Judiciary : - Nature. Power and function of Judiciary in U.K. & U.S.A.

Books Recommended:

1.Harry Eckstein & David E Apter - Comparative Politics, A Reader (New York, The Free press, 1968)
2. J Blondel – An Introduction to Comparative Government, London, 1969.
Herman Finer - The Theory and Practice of Modern Government, Met
huen and Company, London, 1969
3. S.R. Maheshwari - Comparative Govt. and Politics Laxmi Narayan Agra
wal, Agra,1983.
4. V.N.khanna– Major Political Systems , Chand and Company, Delhi.
5. J.C.Johari– Comparative Politics, Sterling, Delhi.
6. Vidya Bhushan- Comparative Politics, Atlantic Publication and D
istributors.
7. J.Denis Derbyshire , Ian Derbyshire - Political System of the world, Allied Publishers Ltd.
8. D.Deol– Comparative Government and Politics, sterling Publishers pvt.Ltd.
9.D.Mahajan- Select Modern Governments, S. Chand & Co Ltd, New Delhi.

१. चिं.ग. घांगरेकर – तुलनात्मक राजकीय विष्लेशण , कॉन्टिनेन्टल प्रकाशन, पुणे.
२.म. द...देशपांडे – शासनसंस्था– राज्यपद्धती तौलानिक विचार, महाराश्ट्र विद्यापीठ, ग्रंथनिर्मिती मंडळासाठी दि कोल्हापूर रायटर्स को–ऑप. सोसायटी लि. कोल्हापूर.
३ प्रा. हाशम डॉ. गवई जोगेंद्र– तुलनात्मक शासन आणि राजकारण, विश्व पब्लिकेशन नागपूर.
४.लोटे रा.ज.– तुलनात्मक शासन आणि राजकारण, पिंपळापुरे पब्लिकेशन नागपूर.
५. देवगावकर रा.गो. – आधुनिक राजकीय व्यवस्था, साईनाथ प्रकाशन, नागपूर.
८. प्रा. ए.सुबोधकुमार ए कांकबे–शासनसंस्था तुलनात्मक अभ्यास, राविल पब्लिकेशन्स, सातारा.

B.A.III YEAR: SEMESTER-VI

INTERNATIONAL RELATIONS

PAPER-VI **MARKS: 80**

Course Rationale:

This paper deals with concepts and dimensions of international relations and makes an analysis of different theories highlighting the major debates and differences within the different theoretical paradigms. The dominant theories of power and the question of equity and justice, the different aspects of balance of power leading to the present situation of a unipolare world are included. It highlights various aspects of conflict and conflict resolution on through collective security and the role of UN.

Course Content:

UNIT-I

- **A- International Relations:-**Meaning, Nature, Scope and significance.
- **B- Theories of International Relations:-** i) Realist Theory and ii) Game theory.

UNIT-II

- **A- National Power:-**Meaning, Nature and Elements.
- **B- Foreign Policy:-**Meaning, Objectives and Determinants.

UNIT-III

- **B- Balance of Power:-**Meaning, Types and Techniques.
- **C- Collective Security:-**Meaning, Nature and Basic Principles.

UNIT-IV

- **A- Global Terrorism:-**Meaning, Causes and Techniques.
- **B- Human Rights:-**Meaning, Nature and Importance.

References:

1.Vinay Kumar Malhotra - International Relation (New Delhi: Anmol Publication 1999)
2. Joshna Goldstein - International Relation (NewYork: Longman, 2003)

3. Hans Morgenthau - Politics Among Nation (New York: Alfred Knopf, 1985)
4. Parmer and Perkins- International Relations,
5. Raghunandan Wharadkar, Antarrashtriya Sambandh,
4. देवळाणकर ष्षैलेंद्र–अंतरराष्ट्रीय संबंध–औरंगाबाद, विद्याप्रकाषन, 2005.
5. रायपूरकर वसंत–आंतरराष्ट्रीय संबंध–नागपूर, मंगेश प्रकाशन,2006
6.पेंडसे अरूणा–सहस्त्रबुध्दे उत्तरा–आंतरराष्ट्रीय संबंध –शीतयुध्दोत्तर व जागतीकीकरणाचे राजकारण, हैद्राबाद–ओरिएंटब्लॅकस्वानप्रा. लि. 2011.
7. फडिया बी. एल.–आंतर्राष्ट्रीय राजनीति, आगरा–साहित्य भवन पब्लिकेषन, 2004
8. जोषी टी. ए. –आंतरराष्ट्रीय संबंधाची ओळख, प्रकाषक–अंकिता कंप्युटर्स नांदेड 1994
9. लोटे रा. ज. – आंतरराष्ट्रीय संबंध. पिंपळापूरे ॲंड कं. पब्लिषर्स नागपुर, 1995
10. जोरगुलवार भुषण–आंतरराष्ट्रीय संबंध, प्रकाषक, सौ. सुनिता कुलकर्णी, अहमदपूर 1998
11. कुलकर्णी सुधाकर–आंतरराष्ट्रीय संबंधः सिध्दांत आणि राजकारण, अरूणा प्रकाषन,2005

NEED FOR THE SEMESTER SYSTEM

Under the so-called conventional system of higher education governed by the old and unchanged University Act, largely shaped by the state Government keeping in view the convenience and state of mind of the majority of the mediocre learners, the undergraduate colleges entrusted with the task of catering to the needs of higher education in society, have been constrained to operate freely towards achieving their goal of both quantity and quality in higher education. Any kind of innovative change in the form of introduction of the new papers having potentials for job market or ensuring skills for the jobs in demand seems to be almost impossible owing to their lack of academic autonomy. Perhaps due to the same reason the colleges are unable to initiate some reforms in the examination and evaluation patterns largely warranted in the interest of the students' community as well as the institution. In the present crisis in higher education the semester-oriented syllabi and the corresponding examination system would be just a boon to the undergraduate colleges affiliated to Rashtrasant Tukadoji Maharaj Nagpur University by ensuring the teaching faculties as much academic autonomy as required for the change and reform in the curriculum, internal and external examination patterns and evaluation of the students from time to time.

With the commencement and implementation of semester pattern U.G. Syllabi there can be higher academic autonomy resulting into more creativity and thoughtful engagement of the teachers for academic pursuit. The colleges can hopefully bring about some meaningful changes in terms of more quantity of students admitted as well as the quality in the academic performance.

OBJECTIVES OF SEMESTER SYSTEM IN SOCIOLOGY

Sociology as one of the most dynamic disciplines is primarily involved in the study of society and the social structure characterizing society. Conventionally the interest of sociology has been on knowing the intricacies of the older institutions such as family, marriage, kinship, religion and many other aspects such as group, culture, norms, values, education, stratification, etc., gaining momentum in the process of building up of a society. The focus in sociology has always been on understanding the web of social relationship and interaction which go into making the society a stronger social fabric. The theories claiming an overriding influence in sociology till the recent past have been mainly of structural-functional and conflict perspective and said to characterize the mainstream society. The structural-functional and conflict theories as a part of the mainstream society operate as the two extremes opposing each other on the basis of their respective laws of operation which mostly remain fixed or unchanged in their own right. But sociology today does not seem to remain confined to the fixed boundaries determined by the laws of structural-functionalism and social conflict. The subject has now acquired enormous flexibility and thus entered into the realms of other social sciences. It has in general assumed an interdisciplinary character. Some of the early areas of interest now either have started losing their importance or giving way to the new thrust areas of study. The prevailing scenario at the global level makes the subject oblivious of one dominant culture, order, system of values, ideas and thought. Sociology at present engages itself in focusing more on the emerging trends of multiculturalism, post-structuralism, post-modernism, hyper-modernity and globalization. The theory at present emerges to be increasingly characterized as synthetic or integrative rather than deterministic. The trend now accommodates more of a soft approach and avoids as much of a hard core approach as it can. The proposed semester pattern syllabus in sociology at the undergraduate level has been planned keeping in mind the growing acceptance for the new trends, facts of life and orientations within the domain of sociology as a science of society. The learners of

sociology, the students and teachers, now will have ample scope to know and understand the subject in a broad perspective. The U.G. course under semester pattern syllabi will aim at the following objectives in general:-

1. To make students understand the nature of sociology and its nexus with other disciplines.
2. To make students understand the recent concepts surfacing in the studies of sociologists and social scientists.
3. To make students know the current issues, problems and the measures to address them in right perspective.
4. To sustain the interest of the students in terms of making them capable of fitting into the job market.
5. To develop a multi-disciplinary interest and a broad perspective among the students to understand the intricacies of the concepts, issues and problems brought by the papers.

YEAR OF COMMENCEMENT OF THE SEMESTER PATTERN SYLLABI

The semester pattern syllabi shall come into force from the academic year 2016-2017 for the students seeking enrollment in B.A. Semester I and Semester II. For B.A. Semesters III & IV, and V & VI, the admissions shall be given in the academic years 2017-2018 and 2018-2019, respectively. This suggests for successive implementation of the U.G. semester pattern syllabi for all three years.

STRUCTURE OF THE SEMESTER PATTERN SYLLABI

1. The semester pattern syllabi shall give sufficient opportunity for continuous internal evaluation of the students (CIE).
2. The whole course shall be of full-time course of three years duration equally divided among six semesters.
3. Each semester shall have only one paper having four units. The students, on the whole, in order to complete B.A. degree, shall have to give examinations for 600 marks in the subject of sociology.
4. The system shall be based on continuous external evaluation based on a descriptive written examination of 80 marks (External) and internal evaluation of 20 marks in each paper of a semester.

CODE/SCHEME OF EXAMINATION

Students shall undergo the following process of examination:

Written Examination:

1. There shall be a written examination of descriptive type in each paper at the end of every semester.
2. Each paper shall be of 80 marks of 3 hours duration.
3. The question paper shall contain in all total 4 questions among which only first question shall be in the long form with an internal choice, carrying 20 marks. The second, third and fourth questions shall be of short forms wherein second and third questions shall have four questions each (A, B, C and D) with an internal choice (E, F, G and H), carrying 20 marks each at the rate of 5 marks for each short question.

4. The question number four shall also consist of four questions with 5 marks each but without an internal choice.
5. Each paper shall be of 80 full marks in which each question, whether in long form or short form, shall carry an equal value of 20 marks.

Nature of Internal Evaluation:

i. There shall be an internal evaluation of each student in each paper at the end of every semester.
ii. Out of 20 internal marks in each theory paper 10 marks shall be for home assignment and another 10 marks for viva-voce test of the students based on the course content. The viva-voce test shall be conducted by a committee of two persons consisting of the teacher teaching the subject and the Principal of the college.
III. The teacher of the concerned subject shall give the questions to the students from any portion of the syllabus already covered by him/her for home assignment. The viva-voce test of the students shall be conducted at the end of the completion of teaching. Both home assignments and viva-voce tests shall be in place before the commencement of university examination.

PASSING MARKS

1. The students shall be required to score a minimum of 32 marks out of 80 in order to pass in the external examination in each paper.
2. The minimum passing marks in the internal evaluation shall be 8 out of 20 in each paper.
3. This means the passing marks both in the written (external) examination and internal evaluation shall be considered separately.

ABSORPTION OF FAILURE CANDIDATES

1. The failure students of all B.A. I, II & III of old and annual pattern syllabi shall be given two consecutive terms such as one in winter and another in summer to clear their papers.

Semester I
Sociology: An Introduction

Objectives of the Paper:

1. This paper intends to induct the students to sociology as the beginner of the subject.
2. The paper thus aims to expose the students to the basic concepts in sociology.

1. Understanding Sociology:

A. Sociology: Its meaning, definition and characteristics as a science.

B. Relationship of sociology with other social sciences: Anthropology, History, Political Science and Economics.

2. Basic Concepts in Sociology:

A. Groups, reference groups, association, institution, community and society.

B. Development of human societies: **Pre-modern societies** (hunting and gathering societies, pastoral and agrarian societies.) **Modern industrial Society:** Its characteristics-industrialism, capitalism, urbanism, liberal democracy.

C. Society and Individual: A mutual relationship.

3. Socialization:

A. Meaning, processes and importance of socialization.

B. Agencies of socialization: Family, education, religion, peer group and mass media.

C. Mead's concepts of 'I', 'Me' and Socialization.

4. Social structure:

A. Elements of social structure.

B. Functions and dysfunctions of social Structure.

C. Socio-cultural processes: Cooperation, conflict, accommodation, assimilation and competition.

Suggested Readings

1. Bottomore, T.B., Sociology: A guide to problems and literature, George Allen and Unwin (India), Bombay, 1972.
2. Harlambos Michael, Martin Holborn and Robin Heald, 2000, Sociology: Themes and Perspectives, Collins.
3. Inkeles, Alex, What is Sociology? Prentice-Hall of India, New Delhi, 1987.
4. Jayaram, N., Introductory Sociology, Macmillan India, Madras, 1988.
5. Johnson, Harry M., Sociology: A Systematic Introduction, Allied Publishers, New Delhi, 1995.
6. Schaefer, Richard T. and Robert P. Lamm, Sociology, Tata-McGraw Hill,New Delhi, 1999.
7. Ghode R.N., and BhauDaydar, Sociology: Basic concepts, S. Spectrum Publication, Nagpur.
8. Melvin M. Tumin, Social Stratification, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
9. Vivek, P.S., Sociological Perspectives and Indian Sociology, Himalaya Publishing House, Mumbai, 2002.
10. Vaidya, N. S., Samajshastra, VidyaPrakashan,RuikarMarg, Nagpur.
11. दुधे, मेश्राम, बोरकर आणि सोनटक्के, समाजशास्त्र - विषय आणि संकल्पना, जी.सी. पब्लिशर्स, नागपूर
12. आगलावे, प्रदीप, समाजशास्त्र - विषय आणि संकल्पना, श्री साईनाथ प्रकाशन, नागपूर

Semester II

Sociology: Themes and Perspectives

Objectives of the Paper:

1. This paper intends to orient the students to certain basic perspectives in sociology.
2. The paper also intends to make students know in details about culture, stratification and mobility and the deviant patterns and social control in society.

1. Culture and Society:

A. Meaning, definition and characteristics of culture.
B. Elements of culture: Cognitive elements, beliefs, values and norms, and signs.
C. Culture and ways of individual behavior and personality.

2. Social Deviation and Social Control:

A. Social deviance and conformity: Meaning and definition, causes of and measures to check deviant behavior. Factors promoting conformity.
B. Anomie and social deviation, social structure and social deviation.
C. Social Control: Meaning, definition and means – formal and informal means.

3. Social Stratification and Social Mobility:

A. Social differentiation and social stratification.
B. Meaning, definition and forms of social stratification.
C. Functions and dysfunctions of social stratification.
D. Social mobility: Meaning, definition and types of social mobility.

4. Major Perspectives in Sociology:

A. Structural-functional perspective
B. Conflict perspective
C. Feminist perspective

Suggested Readings

1. Bottomore, T.B., Sociology: A guide to problems and literature, George Allen and Unwin (India), Bombay, 1972.
2. Harlambos Michael, Martin Holborn and Robin Heald, 2000, Sociology: Themes and Perspectives, Collins.
3. Inkeles, Alex., What is Sociology? Prentice-Hall of India, New Delhi, 1987.
4. Jayaram, N., Introductory Sociology, Macmillan India, Madras, 1988.
5. Johnson, Harry M., Sociology: A Systematic Introduction, Allied Publishers, New Delhi, 1995.
6. Schaefer, Richard T. and Robert P. Lamm, Sociology, Tata-McGraw Hill,New Delhi, 1999.
7. Ghode R.N., and BhauDaydar, Sociology: Basic concepts, S. Spectrum Publication, Nagpur.
8. Melvin M. Tumin, Social Stratification, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
9. Ronald S. Edari, Social Change, WM. C. Brown Company Publishers, 1976.
10. Vivek, P.S., Sociological Perspectives and Indian Sociology, Himalaya Publishing House, Mumbai, 2002.
11. Vaidya, N. S., Samajshastra, VidyaPrakashan,RuikarMarg, Nagpur.
12. दुधे, मेश्राम, बोरकर आणि सोनटक्के, समाजशास्त्र - विषय आणि संकल्पना, जी.सी. पब्लिशर्स, नागपूर
13. आगलावे, प्रदीप, समाजशास्त्र - विषय आणि संकल्पना, श्री साईनाथ प्रकाशन, नागपूर

Semester III
Foundations of Sociological Thought

Objectives of the Paper:

1. The paper aims at orienting the students to the basic sociological thoughts of the great masters of sociology.
2. The paper also intends to help the students to shape their thoughts and ideas and also addressing many current sociological issues and problems.

1. Emergence of Sociology as a Discipline:

A. The intellectual and social forces.
B. The social, economic and political forces.

2. Founders of Sociology: I

A. August Comte: Views on positivism and law of three stages of society.
B. Herbert Spencer: Organic analogy, theory of social evolution, military and industrial society.

3. Founders of Sociology: II

A. Charles Horton Cooley: Looking-Glass Self, primary group - its characteristics and importance
B. Emile Durkheim: Types of suicide, religion and its functions.

4. Founders of Sociological Thought: III

A. Karl Marx: Capitalism and its criticism, class and class struggle
B. Max Weber: Types of social action, types of authority and bureaucracy.

Suggested Readings:

1. George Ritzer, 1996, Sociological Theory, TheMcGRAW-HILLInternational Editions.
2. Parsons Talcott, The Structure of Social Action, Vol. I & II, McGraw Hill, New York.
3. Nisbet, 1966, The Sociological Tradition, Heinmann Educational Books Ltd, London.
4. Zetlin Irving, 1981, Ideology and the Development of SociologicalTheory, Prentice Hall.
5. Dahrendorf Ralph, 1959, Class and Class Conflict in Industrial Society.
6. BendizRinehard, 1960, Max Weber, An Intellectual Portrait.
7. Popper Karl, 1945, Open Society and its Enemies, Routledge, London.
8. Aron Raymond, Main Currents in Sociological Thought, Vol. I & II, Penguin.
9. Coser L.A., 1977, Masters of Sociological Thought, New York.
10. Giddens Anthony, 1997, Capitalism and Modern Social Theory.
11. Writings of Marx, Durkheim and Weber, Cambridge University Press.
12. R.N. Mukherjee and ArunansuGhoshal, Social Thought, VivekPrakashan, Delhi.
13. Francis Abraham and John Henry Morgan, Sociological Thought.
14. Michael Haralambos, Martin Holborn and Robin Heald, 2000, Sociology: Themes and Perspectives, Harper Collins, London.
15. H.E. Barnes, Introduction to Sociology.
16. N.S. Vaidya, SamajikVicharbant.
17. आगलावे, प्रदीप, मुलभूत समाजशास्त्रीय विचार, श्री साईनाथ प्रकाशन, नागपूर

Semester IV
Indian Sociological Tradition

Objectives of the Paper:

1. The paper intends to make the students understand the seminal ideas and thoughts reflected in the works of Indian Sociologists.
2. The paper also aims to help the students in understanding at the theoretical level the sociological issues concerning Indian society.

1. **Theoretical Roots of Caste in India:**
   - **A. B.R. Ambedkar:** Origin of caste and its criticism.
   - **B. G. S. Ghurye:** Characteristics of caste and the emergence of sub-castes.
2. **Social Change from Indian Perspective:**
   - **A. M.N. Shriniwas:** Dominant caste –Meaning and implication. Sanskritization–as a factor of social change, mobility and development.
   - **B. D.P. Mukherjee:** Historical Dialecticism, Indian tradition and social change.
3. **Indian Society and Contemporary Change:**
   - **A. R.K. Mukherjee :**Values, symbols, personality and change.
   - **B. S.C. Dubey**: Values in modernity; modernity, Indian society and social change.
4. **Gender and Society in India:**
   - **A. Tarabai Shinde:** Women and patriarchy in Indian society.
   - **B. Jyotibha Phule and Savitribai Phule:** Women's education and women's rights.

Suggested Readings:

1. George Ritzer, 1996, Sociological Theory, TheMcGRAW-HILLInternational Editions.
2. Parsons Talcott, The Structure of Social Action, Vol. I & II, McGraw Hill, New York.
3. Nisbet, 1966, The Sociological Tradition, Heinmann Educational Books Ltd, London.
4. Zetlin Irving, 1981, Ideology and the Development of SociologicalTheory, Prentice Hall.
5. Dahrendorf Ralph, 1959, Class and Class Conflict in Industrial Society.
6. BendizRinehard, 1960, Max Weber, An Intellectual Portrait.
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8. Aron Raymond, Main Currents in Sociological Thought, Vol. I & II, Penguin.
9. Coser L.A., 1977, Masters of Sociological Thought, New York.
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11. Writings of Marx, Durkheim and Weber, Cambridge University Press.
12. R.N. Mukherjee and ArunansuGhoshal, Social Thought, VivekPrakashan, Delhi.
13. Francis Abraham and John Henry Morgan, Sociological Thought.
14. Michael Haralambos, Martin Holborn and Robin Heald, 2000, Sociology: Themes and Perspectives, Harper Collins, London.
15. H.E. Barnes, Introduction to Sociology.
16. N.S. Vaidya, SamajikVicharbant.
17. आगलावे, प्रदीप, मुलभूत समाजशास्त्रीय विचार, श्री साईनाथ प्रकाशन, नागपूर
18. आगलावे सरोज, जोतीराव फुले यांचे सामाजिक विचार, सुगावा प्रकाशन, पुणे

Semester V
Indian Society: The Structural Issues

Objectives of the Paper:

1. The paper aims at acquainting the students with Indian society in terms making them know the issues and problems confronting the institutions of caste and family.
2. The paper also aims to bring into fore the issues and problems concerning the tribes and rural communities in India.

1. **Indian Society, Structure and Inequality**
   - A. Caste as a structure of inequality and discrimination.
   - B. Problems of Scheduled Castes and Other Backward Castes.
   - C. Constitutional Provisions for Scheduled Castes.
   - D. Mandal Commission for Other Backward Castes.
2. **Family in Contemporary India:**
   - A. Intra and inter generational conflict: Meaning, causes and measures to check them.
   - B. Dowry, divorce and domestic violence.
   - C. Problems of elderly people.
3. **Tribal Issues and Problems in India:**
   - A. Tribal problems: Education, development and agrarian problem.
   - B. Social mobility and change: Hinduization.
   - C. Reservation among the tribals, Provision of Schedule V, PESA & Forest Act.
4. **Rural Community in India:**
   - A. Migration: causes and consequences
   - B. Unemployment: causes and consequences
   - C. Farmers' suicide & its impact on family

Suggested Readings:

1. Beteille, Andre., Social Inequality, OUP, New Delhi, 1974.
2. Beteille, Andre., Backward Classes in Contemporary India, OUP, New Delhi, 1992.
3. Berreman, G.D., Caste and Other Inequalities : Essays in Inequality, Folklore Institute, Meerut, 1979.
4. Dube, Leela., Women and Kinship : Comparative Perspectives on Gender in South and Southeast Asia, Sage Publications, New Delhi, 1997.
5. Gadgil, Madhav and Guha, Ramchandra., Ecology and Equity : The use and Abuse of Nature in Contemporary India, OUP, New Delhi, 1996.
6. Kothari Rajani, (ed.) Caste in Indian Politics, 1973.
7. Mehta, S.R., (ed.), Population, Poverty, and Sustainable Development, Rawat Publications, Jaipur, 1997.
8. Dube, S.C., Society in India.
9. Ahuja Ram, social Problems in India, Rawat Publications.
10. Finkle, Jason L and C. Alison Mclntosh (eds.) The New Policies of Population, The Population Council, New York, 1994.
11. Bose Ashish, Demographic Diversity of India, B.R. Publishing Corporation, Delhi, 1991.
12. Premi, M.K. et al, An Introduction to Social Demography, Vikas Publishing House, Delhi, 1983.
13. Rajendra Sharma, Demography and Population Problems, Atlantic Publishers, New Delhi, 1997.
14. Srivastava, O.S., Demography and Population Studies, Vikas Publishing House, New Delhi, 1994.
15. Chandrasekhar, S., (ed.) Infant Mortality, Population Growth and Family planning in India, George Allen &Unwin Ltd., London, 1974.
16. आगलावे, प्रदीप, प्रश्न आणि समस्या, श्री साईनाथ प्रकाशन, नागपूर

Semester VI
Current Social Problems in India

Objectives of the Paper:

1. The paper is based on the problems the society in India is facing at present.
2. The paper thus intends to make the students know the nature, causes and consequences of those problems as well as the measures to put a check on them.

1. Education in contemporary India:

A. Educational status among different communities in India.
B. Gender bias in education in India: Obstacles to women's education.
C. Problems of education among SCs, STs and Other Backward Castes and the measures to resolve it.

2. Displacement and Rehabilitation:

A. Displacement: Meaning, causes and consequences.
B. Rehabilitation: Concept, problems and plans.

3. Intolerance, Riot and Crime:

A. Caste, religious and cultural intolerance.
B. Communal riots, caste and ethnic conflict.
C. Violence and crime against women and the marginalized.
D. Measures to check intolerance, riots and crime.

4. Corruption:

A. Meaning, definition and types of corruption.
B. Factors inducing corruption.
C. Measures to check corruption.

Suggested Readings:

1. Beteille, Andre., Social Inequality, OUP, New Delhi, 1974.
2. Beteille, Andre., Backward Classes in Contemporary India, OUP, New Delhi, 1992.
3. Berreman, G.D., Caste and Other Inequalities : Essays in Inequality, Folklore Institute, Meerut, 1979.
4. Dube, Leela., Women and Kinship : Comparative Perspectives on Gender in South and Southeast Asia, Sage Publications, New Delhi, 1997.
5. Gadgil, Madhav and Guha, Ramchandra., Ecology and Equity : The use and Abuse of Nature in Contemporary India, OUP, New Delhi, 1996.
6. Kothari Rajani, (ed.) Caste in Indian Politics, 1973.
7. Mehta, S.R., (ed.), Population, Poverty, and Sustainable Development, Rawat Publications, Jaipur, 1997.
8. Dube, S.C., Society in India.
9. Ahuja Ram, social Problems in India, Rawat Publications.
10. Finkle, Jason L and C. Alison Mclntosh (eds.) The New Policies of Population, The Population Council, New York, 1994.
11. Bose Ashish, Demographic Diversity of India, B.R. Publishing Corporation, Delhi, 1991.
12. Premi, M.K. et al, An Introduction to Social Demography, Vikas Publishing House, Delhi, 1983.
13. Rajendra Sharma, Demography and Population Problems, Atlantic Publishers, New Delhi, 1997.
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15. Chandrasekhar, S., (ed.) Infant Mortality, Population Growth and Family planning in India, George Allen &Unwin Ltd., London, 1974.
16. आगलावे, प्रदीप, प्रश्न आणि समस्या, श्री साईनाथ प्रकाशन, नागपूर