SYLLABUS

CHEMISTRY

(Under SAP & FAC)

Under Choice Based Credit System (CBCS)

M.Sc. (PREVIOUS) EXAMINATION, 2015-16

M.Sc. (FINAL) EXAMINATION, 2016-17

JAI NARAIN VYAS UNIVERSITY

JODHPUR

INTRODUCTION

Jai Narain Vyas University, Jodhpur, established in July 1962, is a residential University and operates within the limits of Jodhpur City only, The Department of Chemistry is situated in the New Campus of the University, near the Bhagat-ki Kothi Railway Station, along Pali Road.

The Department imparts post-graduate education in the field of chemistry and has made impressive progress in research activities. More than 700 candidates have been awarded the Ph.D. degree and three have been awarded D.Sc. degree. About 1700 research papers from faculty and research workers have been published in International and National Scientific Journals. The Department has received research projects from different agencies like U.G.C., C.S.I.R., D.S.T., D.B.T., I.C.A.R., DRDO, DAE etc.. In 1983, U.G.C. has formulated a programme under which certain departments, selected on the basis of their achievement in the field of teaching and research, are provided with infrastructure for raising the standard of their post-graduate education and research to international level. The programme has been formulated by the Committee on Strengthening of Infrastructure of Science and Technology (COSIST) of U.G.C. The Department is amongst the few Chemistry department of the country, which were selected for this programme. The M.Sc. course under this new scheme was in operation between July 1985-2003. Now in the lines COSIST, University Department of Chemistry has identified by U.G. C. under Special Assistance Program (SAP) of Departmental Research Support under which autonomy has been assigned to the PG course in the Department of Chemistry since year 2010. Further, the Department of Chemistry has also been awarded second level FIST programme by DST, New Delhi in year 2010.

Awards

Apart from the university gold medal for securing highest marks in M.Sc., following awards have been instituted in the Department of Chemistry for the meritorious students:

1. Professor R.C. Kapoor Gold Medal for securing highest marks in M.Sc. (Chemistry)
2. Professor J.P. Saxena Award for excellence in Organic Chemistry
3. Sushila Bhandari Ugam Kanwar Bhandari Memorial Abhay-II Award for excellence in Physical Chemistry
4. Dr. Kamla Tandon Memorial Award for excellence in Inorganic Chemistry.

Academic and Research Programme

Under Special Assistance Program (SAP), Department of Chemistry offers a two year (4 semesters) integrated programme leading to the Master's degree in Chemistry in two sections of 40 students each. Syllabus is designed to cover all four branches of chemistry viz. Inorganic Chemistry, Organic Chemistry, Physical Chemistry and Analytical Chemistry. Fourth semester offers a choice of sixteen electives to strengthen diverse field of interdisciplinary nature.

Department of Chemistry has advanced facilities for research in major areas of Chemistry leading to Ph.D.. The major research interests of the faculty members includes: Nanotechnology, Biosensors; Electrochemistry & Electroanalytical Chemistry, Chemical Dynamics & Reaction Mechanism; Mineral Beneficiation; Oil & Fats; Natural Products; Synthetic Heterocyclics; Chemical Spectroscopy; Synthetic & Structural Organo & Organometallic Chemistry; Effluent Treatment; Environmental Chemistry; Synthetic Organic Chemistry; Photochemistry; Solar Energy Conversion & Storage; Co-ordination Chemistry; Green Chemistry and Applied Chemistry.

ADDMISSION

The minimum qualification for admission to M.Sc. course is B.Sc. (10+2+3) degree with Chemistry as a major subject. The details of the eligibility conditions and admission procedures are given in the admission forms. The admission would be done on the basis of merit as per university rules. Reservation for SC, ST and OBC would also be done as per J.N.V. University, Jodhpur rules. Candidates are required to attend minimum 75% of the classes in theory and practicals both.

FACILITIES

The Department of Chemistry possesses several sophisticated, advanced and modern equipments required for teaching and research. The specialized instruments includes Electrochemical Analysers, Surface plasmon Resonance Spectrometer, Fluorescence Spectrophotometer, FTIR, UV-VIS spectrophotometers, Stoped-flow spectrophotometers, HPLC, Low temperature thermostats, Flame photometers, Ion meters, Centrifuge and computers for networking. In

addition, certain facilities related to equipments are also available with USIC in the Faculty of Science.

FACULTY MEMBERS

PROFESSOR & HEAD

Dr. P.K. Sharma (B)	Electro-chemistry, Chemical Kinetics &
Ph.D.	Correction Analysis.

PROFESSOR

Prof. P.K. Sharma(M)	Analytical Electrochemistry
Ph.D.	Environmental Chemistry
Prof. (Mrs.) Sunita Kumbhat	Biosensors, Electrochemistry & Electro analytical
Ph.D.	Chemistry Environmental Chemistry
Dr. R.S. Sindal Ph.D.	Electrochemistry, Physicochemical ,Studies of coordination compounds of transition and inner-transition elements, Photochemistry Chemical Kinetics
Dr. (Miss) Seema Kothari	Reactions Kinetics, Correlation Analysis
Ph.D.	
Dr. (Mrs.) Seema Acharya	Fluorescence Studies
Ph.D.	
Dr. (Mrs.) Pramila Sah	Natural Products and Medicinal Chemistry
Ph.D.	

Dr. Kailash Daga	Co- ordination Chemistry
Ph.D.	
Dr. (Mrs.) Vinita Sharma	Organic Chemistry Reaction Mechanism
Ph.D.	
Dr. (Mrs.) S. Loonker	Polymers, Environmental and applied Chemistry
Ph.D.	

ASSOCIATE PROFESSORS

Dr. (Miss) S. Sharma	Co-ordination Chemistry ,
Ph.D.	Environmental Chemistry
Dr. (Mrs.) V. Choudhary	Co-ordination Chemistry ,
Ph.D.	Environmental Chemistry
Dr. (Mrs.) S. Gaur	Co-ordination Chemistry
Ph.D.	
Dr. J.S. Rathore	Analytical Chemistry,
Ph.D	Environmental Chemistry
Dr. V. Gupta	Applied Chemistry;
Ph.D.	Effluent Treatment Studies
Dr. A.V. Singh	Physical Chemistry, Mineral beneficiation and
Ph.D.	Environmental Chemistry

Dr. (Mrs.) P. Mishra	Organic Reaction Mechanism
Ph.D.	
Dr. K.R. Genwa	Solar energy conversion technologies
Ph.D.	
Dr. R.C. Meena	Photochemistry (Solar energy
Ph.D.	Conversion technologies)
Dr. A. Arora	Natural products, Oils and fats
Ph.D.	
Dr. Rajendra Mathur	Polymer Science
Ph.D.	

ASSISTANT PROFESSORS

Dr. P. Koli	Organic Chemistry and Solar Energy Conversion
Ph.D.	and storage
Dr. Jaishree Rathore	Organic Chemistry
Ph.D.	
Ms. Meenakshi Jonwal	Inorganic Chemistry
M.Sc.	
Ms. Anita Meena	Physical Chemistry
M.Sc.	

Dr. S.L. Meena Ph.D.	Electrochemistry, Corrosion & its prevention
Dr. Priyanka Purohit Ph.D.	Chemical Kinetics
Dr. Rajni Bais Ph.D.	Analytical Electrochemistry
Dr. Sangeeta Parihar Ph.D.	Environmental Chemistry
Dr. Om Prakash Ph.D.	Chemical Kinetics
Sh. R.L. Saini M.Sc.	Organic Chemistry
Dr. Anurag Choudhary Ph.D.	Chemical Kinetics
Dr. Seema Parveen Ph.D.	Organic and Phytochemistry
Dr. Amita Dhariwal Ph.D.	Analytical Chemistry

GUIDELINES FOR CHOICE BASED CREDIT SYSTEM:

Definitions of Key Words:

1. **Academic Year**: Two consecutive (one odd + one even) semesters constitute one academic year.
2. **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed elective and skill courses. A student need to select **two elective papers** offered by the Department in which he/she is doing core course this shall be part of core programme during third and fourth semester. Each student has to complete **four skill courses**: two within the Department and two from other Department within JNV University or the Universities approved by JNV University
3. **Course**: Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ project work/ self-study etc. or a combination of some of these.
4. **Credit Based Semester System (CBSS)**: Under the CBSS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.
5. **Credit Point**: It is the product of grade point and number of credits for a course.
6. **Credit**: 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 period of teaching (lecture or tutorial) or two periods of practical work/field work per week.
7. **Cumulative Grade Point Average (CGPA)**: It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
8. **Grade Point**: It is a numerical weight allotted to each letter grade on a 10-point scale.

9. **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
10. **Programme**: An educational programme leading to award of the Postgraduate Degree in the Core subject in which he/she is admitted.
11. **Semester Grade Point Average (SGPA)**: It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.
12. **Semester**: Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to November/ December and even semester from December/January to May. **Odd semester University examination shall be during second/third week of December and even semester University examination shall be during second/third week of May. The Department shall conduct the Practical examinations of odd and even semesters as per the Panel of Examiners approved by the University. Each Board of examiners shall consist of one external Examiner from other University/Institute and another from the Department.**

13. **Transcript or Grade Card or Certificate:** Based on the grades earned, a statement of grades obtained shall be issued to all the registered students after every semester. This statement will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester

Fairness in Assessment

Assessment is an integral part of system of education as it is instrumental in identifying and certifying the academic standards accomplished by a student and projecting them far and wide as an objective and impartial indicator of a student's performance. Accordingly the Faculty of Science resolves the following:

a. All internal assessments shall be open assessment system only and that are based on Quizzes, term test, seminar
b. Attendance shall carry the prescribed marks in all papers and Practical examination internal assessment
c. In each semester three out of four theoretical component University examination shall be undertaken by external examiners from outside the university conducting examination, who may be appointed by the competent authority

Grievances and Redressal Mechanism

a) The students will have the right to make an appeal against any component of evaluation. Such appeal has to be made to the Head/Principal of the College or the Chairperson of the University Department concerned as the case may be clearly stating in writing the reason(s) for the complaint / appeal.

b) The appeal will be assessed by the Chairman and he/she shall place before the **Grievance Redressal Committee (GRC),** Chaired by the Dean, Faculty of Science comprising all HODs of the Faculty and if need be Course Teacher(s) be called for suitable explanation; GRC shall meet at least once in a semester and prior to CCA finalization.

c) The Committee will consider the case and may give a personal hearing to the appellant before deciding the case. The decision of the Committee will be final.

Table 1: Grades and Grade Points

S.No.	Letter Grade	Meaning	Grade Point
1	'O'	Outstanding	10
2	'A+'	Excellent	9
3	'A'	Very Good	8
4	'B+'	Good	7
5	'B'	Above Average	6
6	'C'	Average	5
7	'P'	Pass	4
8	'F'	Fail	0
9	'Ab'	Absent	0

i. A student obtaining Grade F in a paper shall be considered failed and will be required to reappear in the University End Semester examination.

ii. For noncredit courses (Skill Courses) 'Satisfactory' or "Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

Grade Point assignment

= and > 95 % marks Grade Point 10.0
90 to less than 95 % marks Grade Point 9.5
85 to less than 90 % marks Grade Point 9.0
80 to less than 85 % marks Grade Point 8.5
75 to less than 80 % marks Grade Point 8.0
70 to less than 75 % marks Grade Point 7.5
65 to less than 70 % marks Grade Point 7.0
60 to less than 65 % marks Grade Point 6.5
55 to less than 60 % marks Grade Point 6.0
50 to less than 55 % marks Grade Point 5.5
45to less than 50 % marks Grade Point 5.0
40 to less than 45 % marks Grade Point 4.5
35 to less than 40 % marks Grade Point 4.0

Computation of SGPA and 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

$$\textbf{SGPA}\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci$$

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.

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 programme,
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.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for SGPA

S.No.	**Course**	**Credit**	**Grade letter**	**Grade point**	**Credit Point** (Credit x Grade)
1	Course 1	**4**	**B**	**6**	**4 x 6 =24**
2	Course 2	**4**	**B+**	**7**	**4 X 7 =28**
3	Course 3	**4**	**B**	**6**	**4X 6 = 24**
4	Course 4	**4**	**O**	**10**	**4 X 10 =40**
5	Course 5- Practical I	**4**	**C**	**5**	**4 X 5 =20**
6	Course 6 – Practical II	**4**	**B**	**6**	**4 X 6 = 24**
	Total	**24**			**24+28+24+40+20+24 =160**

Thus, **SGPA =160/24 =6.67**

***Illustration* for CGPA**

	Semester- I	**Semester-II**	**Semester-III**	**Semester-IV**
Credit	**24**	**24**	**24**	**24**
SGPA	**6.67**	**7.25**	**7**	**6.25**

CGPA = (24X6.67+ 24X 7.25 + 24X7 + 24 X 6.25)/ 96

652.08/96 = 6.79

Semester-wise Theory Papers/Practical / Skill component

Type of course	Course code	Title of the Course	Lecture-Tutorial-Practical/ Week	No. of credits	Continuous Comprehensive Assessment (CCA)	End-Semester Examination (ESE) [University Examination]	Total
Semester I							
Core course 1	Bot 101	Cell and Molecular Biology	4-0-0	4	30	70	100
Core course 2	Bot 102	Cytology and Genetics	4-0-0	4	30	70	100
Core course 3	Bot 103	Biology and Diversity of Microbes, Algae and Fungi	4-0-0	4	30	70	100

Core course 4	Bot 104	Biology and Diversity of Archaegoniate	4-0-0	4	30	70	100
Core course practical 1	Bot 105	Board I consisting of first two theory papers	0-0-8	4	30	70	100
Core course practical 2	Bot 106	Board II consisting of next two theory papers	0-0-8	4	30	70	100
Skill Course I	As per the list		2-0-2				
Total				24	180	420	600
Semester II							
Core course 5	Bot 201	Taxonomy and Diversity of Seed Plants	4-0-0	4	30	70	100
Core course 6	Bot 202	Plant Development and Reproductive Biology	4-0-0	4	30	70	100
Core course 7	Bot 203	Plant Resource Utilization	4-0-0	4	30	70	100
Core course 8	Bot 204	Plant physiology	4-0-0	4	30	70	100
Core course practical 3	Bot 205	Board I consisting of	0-0-8	4	30	70	100

		first two theory papers					
Core course practical 4	Bot 206	Board II consisting of next two theory papers	0-0-8	4	30	70	100
Skill course II	As per the list		2-0-2				
Total				24	180	420	600
Semester III							
Core course 9	Bot 301	Plant Ecology	4-0-0	4	30	70	100
Core course 10	Bot 302	Plant Metabolism	4-0-0	4	30	70	100
Discipline Specific Elective 1	One paper from the list of Group I		4-0-0	4	30	70	100
Discipline Specific Elective 2	One paper from the list of Group II		4-0-0	4	30	70	100
Core course practical 5	Bot 305	Board I consisting of first two theory papers	0-0-8	4	30	70	100
Discipline Specific Elective practical 1	Bot 306	Board II consisting of next two theory papers	0-0-8	4	30	70	100
Skill course III	As per the list		2-0-2				
Total				24	180	420	600

Semester IV							
Core course 11	Bot 401	Applied Ecology	4-0-0	4	30	70	100
Core course 12	Bot 402	Biotechnology and Genetic Engineering of Plants	4-0-0	4	30	70	100
Discipline Specific Elective 3	One paper from the list of Group I		4-0-0	4	30	70	100
Discipline Specific Elective 4	One paper from the list of Group II		4-0-0	4	30	70	100
Core course practical 6	Bot 405	Board I consisting of first two theory papers	0-0-8	4	30	70	100
Discipline Specific Elective practical 2	Bot 406	Board II consisting of next two theory papers	0-0-8	4	30	70	100
Skill course IV	As per the list		2-0-2				
Total				24	180	420	600

*** The Department shall offer two skill courses per semester from the list of skill courses approved for the Department.**

In view of the course content, the Department of Botany distributed the Periods between Theory/Tutorial/Practical as under per paper

- 4 : 0 : 0 (four lectures only (no tutorial and no practical) per week) – For Theory
- 0 : 0 : 4 (no lecture, no tutorial, and four practical only per week) – For Practical per paper
- 2+0+2 (two lectures, no tutorial and two practical/field experimentations) – For Skill course

The Duration of the Period shall be forty five minutes. In each of these combinations, the first value stands for the same number of lecture instructions per week, whereas the last two values stand for double the number of tutorial / practical instructions per week.

In each practical group the number of students that can be accommodated will be fifteen.

Course Evaluation (Evaluation of the Students)

All courses (Core/ Elective) involve an evaluation system of students that has the following two components:-

(i) **Continuous Comprehensive Assessment (CCA)** accounting for 30% of the final grade that a student gets in a course; and

(ii) **End-Semester Examination (ESE)** accounting for the remaining 70% of the final grade that the student gets in a course.

(i) **Continuous Comprehensive Assessment (CCA)**: This would have the following components:

a. **Quizzes:** Two Quiz examinations of 45 minutes duration each having a maximum of 40 marks shall be arranged for theory paper during the semester course period

b. **Term Test**: One term test shall be arranged for each theory paper prior to End-Semester Examination; examination duration shall be of three hours; maximum marks is 70

c. **Seminar**: Each student shall prepare and deliver a seminar per theory paper; maximum marks shall be 15. The seminar shall commence after first quiz examination and shall be completed prior to term test for all the papers.

d. **Classroom Attendance –** Each student will have to attend a minimum of 75% Lectures / Tutorials / Practicals. A student having less than 75% attendance will not be allowed to appear in the End-Semester Examination (ESE). Attendance shall have 15 marks and will be awarded by following the system proposed below:

Those having greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:-

75% to 80%	=	3 marks
80% to 85%	=	6 marks
85 to 90%	=	9 marks
90% to 95%	=	12 marks
> 95%	=	15 marks

Each student's cumulative attendance shall be displayed in the Department Notice Board every month with a copy to the Dean, Faculty of Science.

e. CCA are based on open evaluation system without any bias to any student

f. Any grievance received in the Department from student shall be placed before the **Grievance Redressal Committee** with adjudicated comments

Each component marks will be added without rounding and the total thus obtained is ratio by a factor of six. This value shall be rounded.

Illustration : Quiz 1 – Marks obtained = 30

Quiz 2 – Marks obtained = 35.5

Term Test Marks obtained = 50.5

Seminar Marks obtained = 14

Attendance Marks obtained = 9

Total = 139.00

Conversion = 139/6 = 21.16666

Award = 22.00

Skill Course Evaluation: Based on his/her performance and hands on practice, the respective Department shall declare the result as "Satisfactory" or "Non-Satisfactory"; each student need to get a minimum of three "Satisfactory" declaration for the course completion

In laboratory courses (having only practical (*P*) component), the CCA will be based on students attendance (50%); collection of plant material (25%) and hands on Practical, records, etc. (25%)

For QUIZ (2 quizzes per semester), 40 marks per Quiz and total of 80 marks, 45 minutes duration for each quiz:

Types of question	Number of Questions	Marks Per question	Total marks per type
1. Multiple choice	10	1	10
2. Fill in the blanks	10	2	20
3. Short answer (15 words)	5	2	10
Total	25		40

For the Term test and ESE:

Part A

Ten short type questions (Definitions, illustrations, functions, short explanations, etc; 25-50 words) for two marks each. 10 × 2= 20 marks; two questions from each Unit; no choice in this part

Part B

Five short answer (250 words) type questions for four marks each. 5 × 4 = 20 marks; one question from each Unit with internal choice

Part C

Five questions of long/explanatory answer (500 words) type, one drawn from each Unit; student need to answer any three; ten marks each; 3 × 10 = 30 marks

20+20+30 = 70 marks

Qualifying for Next semester

1. **A student acquiring minimum of 40% in total of the CCA is eligible to join next semester**.

2. A student who does not pass the examination (CCA+ESE) in any course(s) (or due to some reason as he/she not able to appear in the ESE, other conditions being fulfilled, and so is considered as 'Fail'), shall be permitted to appear in such failed course(s) in the subsequent ESE to be held in the following October / November or April / May, or when the course is offered next, as the case may be.

3. A student who fails in one or more papers in a semester shall get three more chances to complete the same; if he/she fails to complete the same within the prescribed time i.e three additional chances for each paper; the student is ineligible for the Postgraduate degree in the Subject in which he/she is admitted. Additional chances examination fee shall be on additive basis.

Improvement Option:

Every student shall have the opportunity to improve Credit thorough University Examination only. Improvement opportunity for each paper is only with two additional chances; improvement examination fee shall be on additive basis; the Credit obtained in improvement examination shall be final. There shall be no improvement opportunity in Practical examinations**.**

Result Declaration:

The ESE (End Semester Examination/University Examination) results shall be declared within twenty days of the last examination. The Theory/ Practical Classes of even semesters shall begin from the next day of ESE; whereas odd semester classes shall commence after summer vacation.

Skill Based Course in Chemistry

S.No.	Course No.	Name of Course
A	SB-CH-1	Water Analysis
B	SB-CH-2	Food Adulteration and Testing
C	SB-CH-3	Application of solar Energy
D	SB-CH-4	Ores and building material
E	SB-CH-5	Polymer Technology
D	SB-CH-6	Conservation of Heritage Structure and Antiquities

M.Sc. Chemistry

(Under CBCS)

First Year (2015-16)

(Two Semesters each of 15 weeks)

TEACHING AND EXAMINATION SCHEME:

I SEMESTER

1.	**THEORY PAPERS (Four Papers)**	**Periods/ Wk**	**No. of Credits**	**CCA**	**ESE**	**Total**
CH-401	Inorganic Chemistry	**6**	**4**	**30**	**70**	**100**
CH-403	Organic Chemistry	**6**	**4**	**30**	**70**	**100**
CH-405	Phsical Chemistry	**6**	**4**	**30**	**70**	**100**
CH-407	Instrumental Methods of Analysis	**6**	**4**	**30**	**70**	**100**
	Grand Total					**400marks**

2. PRACTICALS EXAMINATIONS:

Lab Course	**Periods/Wk**	**No. of Credits**	**CCA**	**ESE**	**Total**
CH-409 (A) Inorganic Lab	**15**	**4**	**30**	**70**	**100**
CH-410 (B) Physical Lab	**10**	**2**	**15**	**35**	**50**
	Total				**150**
	Total marks of I Semester				**550**

II SEMESTER

1.	**THEORY PAPERS (Four Papers)**	**Periods/ Wk**	**No. of Credits**	**CCA**	**ESE**	**Total**
CH-402	Inorganic Chemistry	**6**	**4**	**30**	**70**	**100**
CH-404	Organic Chemistry	**6**	**4**	**30**	**70**	**100**
CH-406	Phsical Chemistry	**6**	**4**	**30**	**70**	**100**
CH-408	Analytical Chemistry	**6**	**4**	**30**	**70**	**100**
	Grand Total					**400marks**

2. PRACTICALS EXAMINATIONS:

Lab Course	**Periods/Wk**	**No. of Credits**	**CCA**	**ESE**	**Total**
CH-411 (A) organic Lab	**15**	**4**	**30**	**70**	**100**
CH-412 (B) Physical Lab	**10**	**2**	**15**	**35**	**50**
	Total				**150**
	Total marks of II Semester				**550**
	Total marks of M. Sc. I Year				**1100**

3.SKILL BASED COURSE

SB-CH for I Semester	**4pd/wk**	(For students of Chemistry Department only)
SB-CH for II Semester	**4pd/wk**	(For students of Other Department only)

M.Sc. Chemistry

(CBCS)

Second Year (2016-17)

(Two Semesters each of 15 weeks)

III SEMESTER:

A student will opt for any one of the four elective groups .

Out of the opted group first two papers will be studied in III Semester and remaining two in IV Semester

Elective Group A C. No 503/504/603/604

Elective Group B C.No. 505/506/605/606

Elective Group C C.No .507/508/607/608

Elective Group D C.No .509/510/609/610

1. THEORY PAPERS	Pds/Wk	No. of Credits	CCA	ESE	Total
CH 501 Group Theory & Inorganic Spectroscopy	6	4	30	70	100
CH 502 Application of Spectroscopy	6	4	30	70	100
Elective Paper I (503/505/507/509)	6	4	30	70	100
Elective Paper II (504/506/508/510)	6	4	30	70	100
Grand Total				Marks	400

PRACTICALS:

Practicals **5 pds** **25 pds./week** **375 pds./semester**

There will be 4 Labs. Namely Lab. 1, Lab. 2, Lab. 3 and Lab.4. Students will be divided into four groups. Each group of students will work for 7 weeks for two Lab Courses in one semester.

CH -511 : **Lab. Course 1 (Inorganic)**

CH -512 : **Lab. Course 2 (Analytical)**

CH -513 : **Lab. Course 3 (Organic)**

CH -514: **Lab. Course 4 (Physical)**

PRACTICALS EXAMINATION SCHEME

Lab Course	**Pds/Wk**	**No. of Credits**	**CCA**	**ESE**	**Total**
Lab Course 1 / Lab Course 3	**25**	**4**	**30**	**70**	**100**
Lab Course 2 / Lab Course 4	**25**	**4**	**30**	**70**	**100**
Grand Total				**Marks**	**200**
Total marks of III Semester					**600**

IV SEMESTER:

1. THEORY PAPERS	Pds/Wk	No. of Credits	CCA	ESE	Total
CH 601 Solid State Chemistry	6	4	30	70	100
CH 602 Bio Chemistry	6	4	30	70	100
Elective Paper I (603/605/607/609)	6	4	30	70	100
Elective Paper II (604/606/608/610)	6	4	30	70	100
Grand Total				Marks	400

PRACTICALS EXAMINATION SCHEME

Lab Course	Pds/Wk	No. of Credits	CCA	ESE	Total
Lab Course 3 / Lab Course 1	25	4	30	70	100
Lab Course 4 / Lab Course 2	25	4	30	70	100
Grand Total				Marks	200

Total marks of IV Semester **600**

SB-CH for III Semester 4pd/week (For students of Chemistry Department only)

SB-CH for IV Semester 4pd/week (For students of Other Department only)

M.Sc Chemistry

I YEAR-2016

SEMESTER – I

CH- 401: INORGANIC CHEMISTRY

Unit I

Stereochemistry and bonding in compounds of main group elements: Walsh diagram of tri atomic molecules, d π -p π bonds and synergic bonding, equivalent and in equivalent hybridization and Bent-rule. Energetics of hybridization Simple reactions of covalently bonded molecules, atomic inversion. Berry pseudo rotation and Nucleophilic displacement, Free radical reactions. Applications of valance shell election pair repulsion(VSEPR) theory in structure elucidation.

Unit II

Metal Ligand Bonding :Limitations of crystal field theory, Jahn Tellor theorem. And distortion of molecules. molecular orbital theory of hetero triatomic molecules viz . BeH_2 , CO_2 ,NO_2 , H_2O, Coulson diagrams of tri atomic molecules CO_2 , NO_2 , H_2O. Molecular orbital theory(MOT): octahedral, tetrahedral and square planer complexes, π - bonding and molecular orbital theory, Comparison with CFT.

Unit III

Metal Ligand Equilibrium in solution : stepwise and overall formation constant and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, Chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and spectrophotometry.

Unit IV

Correlation diagrams of Transition Metal Complexes:Types of transitions, selection rules for electronic transition, Spectroscopic ,ground States, correlation diagrams, Orgel and Tanabe

sugano diagrams for d_1 to d_9 states in Transitions metal complexes. Calculations of Dq. B and β parameters.

Unit V

Electronic spectra and Magnetic properties of transitions metal

Complexes, Spectroscopic methods of assignment of absolute configuration in optically active, metal chelates and their stereo chemical information, Charge transfer spectra, Anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Books Suggested:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. greenwood and A.Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. lever, Elsevier.
5. Magnetochemistry, R.L.Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and LA McCleverty, Pergamon.

CH -403: ORGANIC CHEMISTRY

UNIT I

Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, reasonance hyperconjugation, bonding in fullerenes, tautromerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbvonds, Huckel's rule, energy level of π-molecular orbitals, annulenes aromaticity, homo-aromaticity, PMO (approach).

Bonds weaker than covalent- addition compounds, crown ether complexes, cryptands inclusion compounds, cyclodextrins, catenanes and rotaxanes.

UNIT II

Stereochemistry I

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity conformation of sugars, steric strain due to unavoidable crowding. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

UNIT III

Stereochemistry II

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral crbon (biphenyls, allenes and spiranes), chirality due to helical shape.

UNIT IV

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control. Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanism isotope effects. Hard and Soft acids and bases.

Generation, structure, stability and reactivity of carbocations, carbanions free radicals, carbenes and nitrenes.

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.

UNIT V

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams, FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motions, 4n, 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions.

Sigmatropic rearrangements – suprafacial and antrafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic

rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.

5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall

6. Modern Organic Reactions, H.O. House, Benjamin.

7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.

8. Pericyclic Reactions, S.M.Mukherji, Macmillan, India.

9. Reaction Mechanism in Organic Chemistry S.M.Mukherji and S.P. Singh, Macmillan.

10. Stereochemistry Organic Compounds, D.N.asipuri, New Age International.

11. Stereochemistry of Organic Compounds, P.S.Kalsi, New Age Internationa.

12. Pericyclic Reactions by Jagdama Singh.

CH-405: PHYSICAL CHEMISTRY

UNIT I

Chemical Kinetics-I

Chemical Dynamics: Ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde). photochemical (hydrogen-bromine and hydrogen-chlorine reactions) .

UNIT II

Chemical Kinetics-II

Homogeneous and heterogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, and flash photolysis method.

Dynamics of molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reaction, Lindemann and Hinshelweed theories of unimolelcular reactions.

UNIT III

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation) Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids Electro-kinetic phenomenon and quantitative treatment of Zeeta potential.

Micelles: Surface active agents, classification of surface active agents, micellization, hydrobhobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles,

UNIT IV

Macromolecules

Polymer – definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerisation.

Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimention, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

UNIT V

Electrochemistry

Electrochemistry of solutions. Debye-Huckel – Onsagar treatment and its extension, Debye-Huckel-Jerrum mode, ion - solvent interactions, Born model.

Thermodynamics of electrified interface; Derivation of electrocapillary Lippmann equation (surface excess), Structure of electrified interfaces. Helmholtz, Guoy-Chapman and Stern models.

Books Suggested :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Megraw-Hill
3. Kinetics and Mechanism of Chemical Transformation, J.Rajaraman and J.Kuriacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.

5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N.Reddy, Plenum.

6. Introduction to Polymer Science, V.R.Gowarkar, N.V.Vishwananathan and J.Sridhar, Wiley Eastern.

CH- 407: INSTRUMENTAL METHODS OF ANALYSIS

UNIT I

Instrumental analytical methods : Types and range of determination.

Accuracy and minimization of errors

Precision and its determination (Standared deviation, R.S.D, C.V). confidence limit and confidence, level significance and tapes of "t" test in analytical chemistry.

Analysis of variance (ANOVA), Correlation coefficient and liniar regression.

Numericals based on above concepts

Unit II

Atomic spectral analytical techniques :

Atomic absorption Spectrophotometry : Theory with chemical and spectral interferances , Instrumentation and application.

Emission spectroscopy : Principle and application of Flame photometry; ICPAES- Salient features and application on multielement determination

UNIT III

U-V Visible Spectrophotometry;

Colorimetric estimation of metal ion with specific reagents Iron with 8-Hydroxyquinoline, Lead with Dithizone, Technique of dual wavelength and derivative spectroscopy and their applications.

Fluorescence Photometry: Theory with partial energy diagram, instrumentation and applications.

UNIT IV

Chromatography – I

Introduction, Classification and terms related to chromatography.

Basic principles, factors affecting column efficiency

Gas chromatography (GC)

Principle, layout of instrument with columns, detectors (TCD,FID, and Electron Capture) and applications.

Techniques of TLC and its applications

UNIT V

Chromatography II

High performance liquid chromatography (HPLC)

Principle, layout of instrument with columns detectors (UV-Visible, RI and electro chemical) and applications.

Super Critical Fluid chromatography: Principle and applications

Books:

1. Instrumental Analysis: Skoog, Hollar and Crouch, Cengage learning.
2. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK
3. Analytical Chemistry, G.D. Christian, John Willy & Sons.
4. Basic Concepts of Analytical Chemistry, S. M. Khopkar, Wiely Eastern.
5. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J.Holler. Publ. W B Saunders.

Laboratory Course- I-Semester

CH -409: Inorganic Chemistry

Qualitative Analysis.

Eight component mixture including two less common metal ions (TI, Mo, W, Ti, Zr, Th, V, U in cationic/anionic forms) and insoluble – oxides, sulphates and halides.

Quantitative Analysis

Separation and estimation of metal ions in a binary mixture Cu-Ni, Ni-Zn, Cu-Ag etc. involving volumetric and gravimetric methods.

Chromatography

Separation of cations and anions by

(a) Paper Chromatography: Separation of chloride, bromide and iodide

(b) Column Chromatography – separation of Cu, Ni, Co by Ion exchange.

Preparations

Preparation of selected inorganic compounds and their studies by I.R., electronic Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

(1) $VO(acac)_2$

(2) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$

(3) $Na[NH_3)_2(SCN)_4]$

(4) $Mn(acac)_3$

(5) $K_3[Fe(C_2O_4)_3]$

(6) Prussian Blue, Turnubull's Blue

(7) $[Co(NH_3)_6][Co(NO_2)_6]$

(8) Cis-$[Co(trine)(NO_2)_2]Cl.H_2O$

(9) $Hg[Co(SCN)_4]$

(10) $\{Co(Py)_2Cl_2]$

(11) $[Ni(NH_3)_6]Cl_2$

(12) Ni $(dmg)_2$

(13) $[Cu(NH_3)_4]SO_4.H_2O$

CH - 410: Physical Chemistry

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors, error distribution curves, precision, accuracy and combination; statistical treatment for error analysis, student 't' test, null hypothesis, rejection criteria F 7 Q test; linear regression analysis, curve fitting.

Calibration of volumetric apparatus: burette, pipette and standard flask.

Chemical kinetics

(i) To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of an ester.

(ii) Determination of the effect of (a) Change of temperature (b) Change of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of an acid hydrolysis of an ester.

(iii) Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.

(iv) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide by studying the kinetics as an iodine clock reaction.

(v) To study the effect of acid strength on the reaction of acetone and iodine.

Colorimeter

(i) To test the validity of Beer-Lambert law using colorimeter/spectrophotometer and determination of the unknown concentration of a solution.

Surface Tension

(i) To determine the parachor of carbon and hydrogen atoms by drop weight method.

(ii) To determine the relative efficiencies of different detergents by suface tension measurements.

Book Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J.Bassett, R.C. Denney, GH.H. Jeffery and J. mENDHAM, elbs.
2. Synthesis and Characterization of Inorganic Compounds, W.L.Jolly, Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D. Pasto, C.Johnson and M.Miller, Prentice Hall
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, John Wiley.
8. Practical Physical Chemistry, A.M.James and F.E. Prichard, Longman.

9. Findley's Practical Physical Chemistry, B.P.Levitt, Longman.

10. Experimental Physical Chemistry, R.C.Das and B.Behera, Tata McGraw Hill.

11. Advanced Practical Physical Chemistry, J.B.Yadav, Goel Publishing House.

12. Advanced Experimental Chemistry, Vol. I Physical, J.N.Gurtu and R.Kapoor, S.Chand & Co.

M.Sc Chemistry

SEMESTER-II

CH -402: INORGANIC CHEMISTRY

UNIT I

Reaction mechanism of Transitions metal complexes: Energy profile of a reaction (transition state or activated complex), Nucleophilic and Electrophilic Substitution, factors responsible for including SN_1 and SN_2 reaction, Lability and inertness of octahedral complexes acc to VBT and CFT. Acid hydrolysis, factor affecting acid hydrolysis, Base hydrolysis, Conjugate base mechanism (SN_1 CB), Evidences in favour of conjugate base mechanism, anation reactions, Substitution reaction without metal-ligand bond cleavage (Special reference to Co(III) complexes).

UNIT II

Substitution in square planer complexes: Trans-effect, mechanism of substitution reaction, polarization theory and π bonding theory. Redox reaction : electron transfer reaction, mechanism of 1e-transfer reaction, outer sphere reaction, Inner sphere reaction, bridge intermediate mechanism.

UNIT III

Metal π-complexes: Metal carbonyls, structure and bonding in metal carbonyls, vibrational spectra of metal carbonyls for bonding and structure elucidation. Preparation, bonding, structure and important reactions of transition metal nitrosyls.

UNIT IV

Boranes : Structure and bonding in diborane, preparations of higher boranes, Lipscomb's concept of bonding elements in higher boranes. Preparation, properties and structure of borazines.

UNIT V

Metal clusters: Metal carbonyl and halide type clusters, compounds with metal-metal multiple bonds, Metalloboranes, Carboranes, Silicates: types and Uses

Books Suggested:

1. F.A. Cotton and Wilkinson: Advanced Inorganic Chemistry, John Wiley.
2. J.E. Huhey: Inorganic Chemistry, Harper and Row.
3. N.N.Green Wood and A. Eafnshow: Chemisry of the element, Pergamon.
4. A.B.P. Lever: Inorganic Electronic Spectroscopy, Elsevier
5. R.L.Carlin: Magnetochemistry, Verlag.
6. G. Wilkinson, R.D. Gillars and J.A. MCeLEVERTY: Comprehensive Coordination Chemistry eds. Pergamon.
7. F. Basolo and R.G. Pearson: Mechanism of Inorganic Reaction, Wiley

   Eastern

CH- 404: ORGANIC CHEMISTRY

UNIT I

Aliphatic Nucleophilic Substitution

The SN_2, SN_1, mixed SN_1 and SN_2 and SET mechanisms.

The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.

Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.

The S_Ni mechanism.

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution

Bimolecular mechanisms- S_E2 and SE^i. The S_E1 mechanism, electrophilic substitution accompanied by double shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT II

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution

The S_NAr S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Ritcher, Sommelet-Hauser, and Smiles rearrangements.

UNIT III

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.

Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

UNIT IV

Addition to Carbon-Carbon Multiple Bouds

Mechanistic and sterochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidatio.

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, Organozinc and Organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.

Meehanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

UNIT V

Elimination Reactions

The E2, E1 and E1cB mechanisms and their spectrum, Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium.

Mechanism and orientation in pyrolytic elimination.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J.Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N.Boyd, Prentice-Hall
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M.Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

CH- 406: PHYSICAL CHEMISTRY

UNIT- I

Quantum Chemistry I

Introduction to Exact Quantum Mechanical Results: The Schrodinger's wave equation and its Hamiltonian operator form, postulates of quantum mechanics, operators. Discussion of solutions of the Schrodinger's wave equation to some model systems viz; particle in one dimensional box, particle in three dimensional box, the linear harmonic oscillator, the Hydrogen atom.

UNIT- II

Quantum Chemistry II

Concepts of spatial quantization and spinning electron hypothesis, Quantum numbers, Russell-Saunders terms and coupling schemes (L-S and j-j Coupling), spectral terms for p^n and d^n configurations, Magnetic effects: Normal and anomalous Zeeman effects.

UNIT - III

Classical Thermodynamics:

Partial molal properties; free energy – chemical potential, Gibbs – Duhem equation, physical significance of chemical potential, variation of chemical potential with temperature and pressure, chemical potential for ideal gas and mixture of ideal gases, Thermodynamic derivation of law of mass action.

Concept of fugacity, Change in fugacity with temperature and pressure, physical significance of fugacity, fugacity of a gas in a mixture of real gases, determination of fugacity (graphical method).

UNIT - IV

Statistical Thermodynamics I

Concepts of phase space, microstate and macrostate, ensemble, canonical, grand canonical and microcanonical ensembles, ensembles averaging, Maxwell-Boltzmann distribution law using Lagrange's method of undetermined multipliers.

Bose-Einstein statistics, Fermi-Dirac statistics and Maxwell-Boltzman statistics

UNIT – V

Statistical Thermodynamics II

Partition functions – translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions- Energy, specific heat at constant volume and constant pressure, entropy, work function, pressure and Gibb's free energy.

Books Suggested:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantium Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Theoretical Chemistry, S. Glasston, Princeton, London.
6. Fundamentals of Chemical GThermodynamics, E.N.Yeremin, Mir Publishers.

CH- 408: ANALYTICAL CHEMISTRY

Unit I

Basic components of analytical instruments, Operational Amplifiers (for current, potential, resistance/conducatnce), Analog &digital signals, basic digital circuit components, DAC & ADC.Automation in analysis: Automatic & Automated instruments, process control analyzer, continuous analyzer & discrete analyzer, Flow injection analysis, Microprocessor controlled smart instruments

Unit II

Thermal Analysis: Introduction to thermal Analysis**,** Thermogravemetric Analysis(TGA); Basic Instrumentation, methodology and applications.Differential Techniques: Principal Instrumentation and applications of differential thermal analysis (DTA) and differential scanning calorimetry (DSC).

Unit III

Electrochemistry

Electrochemical Cell, Ion Selective Electrodes: Types (Glass membrane, Precipitate, Solid State, Liquid-Liquid, Enzyme), Mechanism of membrane response, Advantages and limitations of ISEs. Introduction to sensors and biosensors, Design & working of Glucose Amperometric sensor.

Unit IV

Electroanalytical Methods

dc Polarography: theoretical principle, Ilkowic equation, Half wave potential and their significance. Different wave form & Current-Voltage Curves, Cyclic Voltammetry: Theoretical Principles, Randle-Sevick Equation, Determination of Heterogenous Rate Constant (K_s), Criteria of reversibility by CV.

Unit V:

Voltammetry

Theoretical Principle, Methodology and applications of Pulse Voltammetry, Differential Pulse Voltammetry, Square Wave Voltammetry, Stripping Voltammetry (Anodic, Cathodic and Adsorptive Stripping techniques). Voltammetry in Inorganic & Organic Analysis

.**Books Suggested:**

1. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, CBS Publ. Delhi.

2. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, Publ. W B Saunders

3. Instrumental Methods of Analysis, Strobel

4. Vogel's Textbook of Quantitative Chemical Analysis, G.H.Jeffery, J.Bassett, J. Mendham and R.C. Denney, Publ ELBS, Longman, UK

LABORATORY COURSE: II-SEMESTER

CH-411: ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid), chemical tests, Interpretation of IR Spectra of simple compounds.

Two Step Organic Synthesis

Acetylation: Acetylation of glucose and hydroquinone.

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.

Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline.

Quantitative Analysis

Determination of the percentage or number of hydroxyl group in an organic compound by acetylation method.

Estimation of amines/phenols using bromate bromide solution/or acetylation method.

Determination of Iodine and Saponification values of an oil sample.

Determination of DO, COD and BOD of water sample.

CH- 412: PHYSICAL CHEMISTRY

Adsorption

(a) To study surface tension – concentration relationship for solutions (Gibbs equation) and hence determine the limiting cross-sectional area of molecule.

(b) To study the adsorption of acetic acid/oxalic acid by activated charcoal and verification of Freundlich and Langmuir's isotherms.

Phase Equilibria

(i) Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system).

(ii) Determination of glass transition temperature of a given salt (e.g. $CaCl_2$) by solubility method.

(iii) To construct the phase diagram for three component system (e.g. Chloroformaacetic acid-water)

Conductometry

(i) To determine the strength of weak acid using NaOH conductometrically.

(ii) To determine the strength of strong and weak acids in a given mixture conductometrically.

(iii) To find out basicity of given acid (mono- di-and tribasic) conductometrically.

Polarimetry/Refractometry

(i) To determine the specific rotation of a given optically active compound.

(ii) To verify the law of refraction of mixture (e.g. glycerol and water) using Abbe's refractometer.

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, (revised)
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis – Qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman
9. Findley's Practical Physical Chemistry, B.P.Levitt, Longman
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill
11. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
12. Adevanced Experimental Chemistry, Vol. I – Physical J.N.Gurtu and R.Kapoor, S. Chand & Co.

SKILL BASED COURSE

SB-CH-1 Water Analysis

Introduction, water sources (ground water, surface water, municipal water supplies)

Characteristics of water, water standards, simple water analysis technique: for

a] physical parameter

B] Chemical parameter

Color, odour, turbidity, hardness (Ca^{+2}/Mg^{+2}) TDS, pH, alkalinity, conductivity, dissolve oxygen(DO), chloride, sulphate, nitrate, fluoride, biological oxygen demand(BOD) and chemical oxygen demand(COD) some important water analysis equipment/instruments. Interpretation of water quality parameter.

LABORATORY

Experiments

1- To find out the Colour, Turbidity and Odour of a given sample of water.
2- To determine the pH value of a given sample of water.
3- To determine the Electrical conductivity value of a given sample of water.
4- To determine the carbonate, bicarbonate and hydroxide alkalinity of a given sample of water.
5- To find out the concentration of chlorides in the given sample of water.
6- To estimate the hardness of the given sample of water by standard EDTA method.
7- To find out the amount of water sterilizing powder(Bleaching powder) required by Horrock's test and modified Horrock's test.
8- To determine the residual chlorine in a given sample of water.
9- To determine the residual chlorine in a water sample volumetrically
10- To determine the amount of dissolve oxygen (DO) in the given sample of water by Winkler method.
11- To determine 5 day BOD of the given sample of effluent.

12- To determine the quality of alum required to coagulate a given sample of water by jar test.

13- To determine the amount of chemical oxygen demand (COD) in the given sample of water

14- To determine the Antimicrobial Activity of water /bacteriological examination of water.

Books Recommended:

1. Industrial Chemistry (Including Chemical Engineering) : B.K. Sharma: Goyal Publishing House

2. Engineering Chemistry by Jain & Jain, Goyal Publishing House

3. Water Pollution by B.K. Sharma:

SB-CH-2 FOOD ADULTERATION AND TESTING

Introduction to food adulteration,

Adulterants: types, sources and their impact on health.

Criteria of adulterated food.

Detection methods of food adulterants.

Awareness towards food adulteration.

The Prevention of Food Adulteration Act & Rules

Practical

Detection of adulterants in

1. Milk and milk products

2. Oils and fats

3. Sweetening agents

4. Food grains

5. Spices

Books Recommended:

1. A Textbook Of Foods,Nutrition And Dietetics 2009 M Raheena Begum

2. Textbook of Food Science & Technology: Unique Book For B.SC., M.SC., Home Science, Food Science & Technology, Horticulture, Agriculture,2006. Avantina Sharma .

3. A First Course in Food Analysis .1999. A.Y. Sathay

4. FSSAI manual.

SB-CH-3 APPLICATION OF SOLAR ENERGY

Theory

Sunlight, spectral composition of surface illumination, solar intensity and solar irradiancy, photo chemistry and electricity generation, solar energy conversion and storage, energy conversion efficiency;

Fabrication, basic principles, characteristics and applications of various solar power devices like photo-electrochemical cells, photo galvanic cells and photovoltaic cells.

Practical

Study of photo galvanic cells; Study, fabrications and characteristics of solar power devices like solar charger, solar calculator, solar heater, solar cap, solar power desalination unit and solar power fountain.

Books Recommended:

1. Organic Photochemistry, J.Coxon and B. Halton, Cambridge University Press.
2. Solar Energy Hand Book, J.F. Kreider and F. Krejth, MacGraw Hill Book Co. 1981.
3. Solar Energy Conversion, R.C. Neville, Elsevier.
4. Alternative Energy Systems, B.K. Hodge, Wiley.
5. Advanced Energy Systems, Second Edition, Nicolai V. Khartchenko; Vadym M. Kharchenko, Taylor & Francis.
6. Non- Conventional Energy Resources, D.S. Chauhan, New Age International

SB-CH-4 ORES AND BUILDING MATERIAL

Theory:

Ceramics- general properties and classification

Cement-classification,composition,basic constituents and their significance.manufacturing of Portland cement by rotary kiln method,setting and hardening of cement.

Lime- manufacture of lime,setting and hardening and lime mortar.

Plaster of paris-manufacture,setting and hardening of plaster of paris.

Ore- definition ,basics of ores.

Ore and building material

Practical

1.determination of % of Cu in Cu ore.

2. estimation of calcium in lime stone.

3.determine the % of iron in the given iron ore.

4.determine the amount of chromium in the chromite ore.

5.analysis of cement.

List of books for Ores and Building Materials

Books Recommended:

1. Building Materials: S. K. Duggal
2. Industrial Chemistry: B K Sharma
3. Material Chemistry: S S Dara & S S Umare
4. Engineering Chemistry: Dr. Sunita Rattan
5. Engineering Chemistry: Jain & Jain
6. Experiments and Calculations in Engineering Chemistry: S S Dara
7. Laboratory Manual on Engineering Chemistry: S K Bhasin & Sudha Rani

SB-CH-5 POLYMER TECHNOLOGY

Polymer: Classification, introduction to concept of Average Molecular Mass, polydispersity, amorphous and crystalline state. Introductory rheology, polymer degradation, diffusion and mechanical properties.

Polymer Processing:

Mixing: Introduction, material flow to the mixture, feeding, incorporation, dispersion, distribution and plasticization.

Extrusion: Basic principles of extrusion, types of extruders; ram type and screw type.

Calendering: Types of calender rolls, roll positioning and adjustments. Calendering Operations, sheeting, fractioning, coating, profiling and embossing.

Moulding: Types; Compression, transfer, injection and blow moulding of low viscosity materials: casting.

Polymer testing and characterization: Introduction to thermal techniques; TGA, DTA.

Introduction to Chemical Characterization: Identification of materials by thermal, elemental, solubility and color tests.

Practical

1. Synthesis of PMMA, PS, PAN

2. Determination of free phenol and free formaldehyde in one stage synthesis of PF resin.

3. Identification of polymers by color test:

    i. Thermoplastics: PE, PS, PVC.

    ii Thermosetting: PF, UF, MF, Epoxy resin.

4. Determination of moisture content.

5. Determination of ash content.

6. Determination of Bulk Density.

7. Determination of percentage DOP absorption.

Books Recommended:

1. Polymer Science- V R Gowarikear, N V Vishwanathan and J Sridhar

2. Polymer Science & Technology: J R Fried

3. Science & Technology of Polymers-Plastics and Rubber: P Ghosh

4. Rubber Technology: M Morton

SB-CH-6 CONSERVATION OF HERITAGE STRUCTURE AND ANTIQUITIES

The primary objective is to build awareness and competence in the country on the recent developments in Heritage and historical aspects of conservation and Protecting and save our culture and civilization.

Course Contents / Syllabus:

Heritage and their types, Heritage and historical aspects of corrosion in India. Ethics of conservation, restoration and preservation and its history. Importance of knowledge of archaeology, chemistry, geology, art and architecture for conservation of heritage monuments. Guiding principles for conservation / preservation of monuments as per international conventions. Distribution of monuments in different geographical / seismic zones and their conservation problem. Stone classifications are identified by using the different methods. Metallic antiquities (gold, silver, copper, bronze, lead, iron) . Causes of Decay and corrosion of Heritage structure and Antiquities. Chemical Cleaning, consolidation and preservation. Elements and compounds ,Metals (Silver, Gold, Copper, Iron, Lead) and non-metals ,Alloys ,Acids, bases and salts ,pH, ionic and non-ionic solutions ,Solubility, solvents and insolubility ,Micro-climate

ESTABLISHMENT OF FIELD LABORATORY (NECESSARY INSTRUMENTS, TOOLS, EQUIPMENTS AND CHEMICALS)

PRACTICAL:

1. Preparation of conservation notes (history, architecture, building materials, problems, remedial measures to be adopted)
2. Macroscopic analysis by visual examination or the aid of a hand lens to record the texture, colour, shine, transparency, type of fracture.
3. Physical tests to determine hardness, cohesion, density, porosity, permeability, effect of heat.

4. Laboratory procedures and determination of pH, et
5. Practical training in -(i) Testing and chemical analysis of heritage building materials in the field and laboratory
6. Treatment and cleaning of metal antiquities
7. Cleaning and treatment of stones, marble, etc
8. Special form of examination to determine structure using high powered equipment such as x-rays crystallography.

M.Sc Chemistry (Under SAP)

II YEAR-2016-17

SEMESTER III

There will be two compulsory papers and Four Elective Groups each group has two papers. A student has to take any one of the four groups

LIST OF TWO COMPULSORY PAPERS:

Compulsory Paper-I

CH 501 GROUP THEORY & INORGANIC SPECTROSCOPY

Compulsory Paper-II

CH-502 APPLICATIONS OF SPECTROSCOPY

List of Elective Groups in M.Sc. III Semster:

GROUP A

CH 503 :ORGANOTRANSITION METAL CHEMISTRY.

CH 504: NANOMATERIALS AND NANOTECHNOLOGY

GROUP B

CH 505 : PHOTOCHEMISTRY

CH 506 : ORGANIC SYNTEHSIS-I

GROUP C

CH 507 : BIOINORGANIC AND SUPRAMOLECULAR CHEMISTRY

CH 508 : HETEROCYCLIC CHEMISTRY

GROUP D

CH 509 : NUCLEAR AND RADIOCHEMISTRY

CH 510 : MEDICINAL & PHARMACEUTICAL CHEMISTRY

Compulsory Paper-I

CH-501: GROUP THEORY & INORGANIC SPECTROSCOPY

Unit I

Molecular Symmetry and Group theory (A) : Symmetry elements and operation. Symmetry classification of group, relation between orders of a finite group and its sub groups. Conjugacy relation and classes. Schonfiles symbols, representation of groups by matrices (representation for the Cn,Cnv, Cnh, Dnh etc. groups to be worked out explicitly). Characters of representations.

Unit II

Molecular symmetry and group theory (B) : The great orthogonality theorm and its importance, character tables and their use in spectroscopy. Irreducible representations unit vector transformation, reducible representations.

Unit III

Vibrational Spectroscopy: Symmetry and shapes of AB_2 AB_3AB_4 AB_5& AB_6 mode of bonding of ambidentate ligands, ethylenediamine and di ketonato complexes, applications of Resonance . Raman Spectroscopy particularly for the study of activesites of metalloproteins.

Electron Spin Resonance Spectroscopy: Hyperfine coupling, spin polarization for atoms and transition metal ion, spen-orbit- coupling and significance of g-tensors, Applications to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH_4 , F_2 and $[BH_3]$.

Unit IV

Nuclear Magnetic Resonance of Paramagnetic substances in solution. The contact and pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclides with emphasis on195pt and 119sn NMR.

Unit V

Mossbauer Spectroscopy: Basic principles, spectral display applications of the technique of the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin, (2) Sn^{2+} and Sn^{4+} compounds nature of M-Lbond, coordination number, structure and (3) detection of oxidation state and in equivalent MB atoms.

Books Suggested:

1. Chemical Applications of Group Theory. F.A. Cotton
2. Physical Methods in Chemistry, R.S.Drago, Saunders College.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V.Parish, Ellis Harwood.
4. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
5. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
6. Progress in Inorganic Chemistry vol., 8 ed., F.A. Cotton, vol., 15, ed. S.J. Lippard, Wiley.

Compulsory Paper-II

CH-502: APPLICATIONS OF SPECTROSCOPY

UNIT I

Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm), Instrumentation, Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT II

Infrared Spectroscopy

General introduction, Instrumentation and sample handling, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactames and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT IR. IR, of gaseous, solids and polymeric materials..

Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD): Definition, deduction of absolute configuration, octant rule for ketones.

UNIT III

Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols,

carboxylic acids, amines & amides), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra-nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE). Resonance of other nuclei-F, P.

UNIT IV

Carbon-13 NMR Spectroscopy

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants.

Two dimension NMR spectroscopy – COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques. Instrumentation of H^1 and C^{13} NMR and sample handling.

UNIT V

Mass Spectrometry

Introduction, ion production – El, Cl, FD and FAB, factors affecting fragmentative, ion analysis, Instrumentation and sample handling. Mass spectral framentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometery. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books Suggested:

1. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.

2. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.

4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.

3. Introduction to NMR Spectyroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.

4. Application of Spectroscopy of Organic Compounds, J.R. dyer, Prentice Hall.

5. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw-Hill.

6. Spectroscopy, P. S. Kalsi New Age Publishers

Group A

Elective Paper-I

CH-503: ORGANOTRANSITION METAL CHEMISTRY

UNIT I

Organotransition metal compounds : Definition, Classification and nomenclature of organotransition metal compounds. Comparison of bonding between metal carbonyls and Organotransition metal compounds. Organometallic compounds of inner transition elements

UNIT II

Alkyls and Aryls of Transition Metals: Types, methods of synthesis, thermal stability and decomposition pathways.

UNIT III

Transition Metal π-Complexes

Transition metal π-complexes with unsaturated organic molecules, alkenes, cyclopentadienyls and arenas, methods of synthesis, properties, nature of bonding and structural features.

UNIT IV

Homogeneous Catalysis

Homogeneous catalytic hydrogenation of Alkenes, Zeigler Natta polymerization of olefins, Isomerisation of Alkenes, Hydroformylation, Dimerisation and polymerization of Alkenes and Alkynes.

UNIT V

Organocopper in Organic Synthesis : Conjugated additions, halogen substitution, alkylation of epoxides, alkylation of allylacetates, ketones from acid chlorides.

Books Suggested:

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organomettalic Chemistry of the Transition Metals, R.H. Crabtree, John, Wiley.
3. Metallo-organic Chemistry, A.J. pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.

Group A

Elective Paper-II

CH-504: NANOSCIENCE & NANOTECHNOLOGY

Unit I

Introduction: Nanoparticales, Nanoscience and Nanotechnology: Properties of Nanomaterials; Optical & magnetic.

Synthesis of nanomaterial: Chemical Approaches: Chemical reduction; sonochemical synthesis; Sol-Gel Synthesis; Self assembly. Physical Approaches: Sputtering, Aerosol spray; Chemical vapour deposition(CVD)

Unit II

Nanostructured materials: Quantum dots, wells & wires; Carbon Nanotubes (CNTs) : Single walled carbon nanotubes (SWNTs), Multiwalled carbon nanotubes (MWNTs), Graphenes, Fullerenes, Metal/Oxide nanoparticles (NPs), Nanorods, Nanotubes and Nanofibres, Semiconductor quantum dots, Polymer NPs.

Unit III

Characterization techniques for Nanomaterials-I:

Electron Microscopy: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning Probe Microscopic Techqnics; Atomic force Microscopy (AFM)

Unit IV

Characterization techniques for Nanomaterials-II

Particle size Analyser (Dynamic light scattering), X-ray Differaction (XRD) , Auger Emission Spectroscopy, Electron Spectroscopy for Chemical analysis (ESCA)

Unit V

Nanotechnology

Applications of Nanoscience in various fields: Pharmaceuticals, Medical & Health, Energy, Environment. Textiles, Water, Defence,

Books Recommended:

1. Charles P.Poole, Jr. and Frank J.Owens ;Introduction to Nanotechnology, , Wiley, 2003
2. G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, ICP, London, 2004.
3. C.M. Niemeyer and C.A. Mirkin, Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag

   Gmb H&Co, 2004.
4. G.M.Chow and K.E.Gonslaves ;Nanotechnology - Molecularly Designed Materials, (American chemical society)
5. K.P.Jain,Physics of semiconductor Nanostructures: Narosa Publishers, 1997
6. S.P. Gaponenko, Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1980.
7. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press, 2004.
8. T.Pradeep, "Nano: The essentials, Tata Mc Graw Hill, New Delhi, 2007.
9. Willard, "Instrumental Methods of Analysis", 2000.

Group B

Elective Paper-I

CH-505: PHOTOCHEMISTRY

UNIT I

Solar radiation spectrum, Insolation;Photochemical Reactions: Interaction of electromagnetic radiations with matter, types of excitations, fate of excited molecules, quantum yield, transfer of excitation; Properties of excited states: Structure, dipole moment, acid-base strengths, Reactivity; Bimolecular deactivation-quenching. Determination of Reaction Mechanism: Classification,, rate constants and life time of reactive energy states- determination of rate constants of reaction, Effect of light intensity on the rate of photochemical reactions, Types of photochemical reaction-photo-dissociation, gas-phase photolysis.

UNIT II

Photochemistry of Alkenes and Carbony1 Compounds: Intramolecular reactions of the olefinic bond – geometrical isomerism,cyclisation reactions, rearrangement 1,4- and 1,5- dienes; Intramolecular reactions of carbony1 compounds – saturated, cyclic and acylic, β,γ – unsaturated and α,β- unsaturated compounds, Cyclohexadienones; Intermolecular cyloaddition reactions – dimerisations and oxetane formation.

UNIT III

Photochemistry of Aromatic Compounds : Isomerisations, additions and Substitutions; Miscellaneous Photochemical Reactions; Photo-Fires reaction of anilides, Photo- Fries rearrangement, Barton reaction, Singlet molecular oxygen Reactions;Photochemical formation of smog, Photo degradation of polymers, Photochemistry of vision.

UNIT IV

Excited states of metal complexes: Excited states of metal complexes: Comparison with organic compounds, electronically excited states of metal complexes, charges transfer spectra, charge transfer excitations; Ligand field photochemistry: Photosubstitutuion, Photoreduction, lability and Selectivity, Zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states;Redox reactions by excited metal complexes: Redox reactions of metal complexes in excited states, excited electron transfer using examples [$Ru(bpy)]^{2+}$ complexes and $[Fe(bpy)_3]^{3+}$ complex , role of spin-orbit coupling, life times of excited states in these complexes; Metal complex sensitizers: Metal complex sensitizer, electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation and carbon dioxide reduction.

UNIT V

Photochemistry and electricity generation; solar energy conversion and storage; Concepts of solar power, maximum current, open-circuit potential, short-circuit current, i-v characteristics, Energy conversion efficiency, Thermodynamic efficiency limit, Quantum efficiency, Maximum power, Fill factor. Solar power storage;Basic principles, fabrication, characteristics, application and latest status of various solar power techniques like Solar steam generator (solar concentrating solar power), Solar chimney or solar cells, Organic/Polymer solar cells, Nanocrystal solar cells, Multijunction photovoltaic cells, Photoeletrochemical cells, Photogalvanic cells, Point-contact solar cells, Porous Nanaoparticulate PEC, Perovskite Solar Cell.

Books Suggested:

1. Fundamentals of Photochemistry, K.K. Rohtagi-Mukherji, Wiley-Easter.
2. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
3. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
4. Photochemistry, R.P. Kundall and A.Gilbert, Thomson Nelson.

5. Organic Photochemistry, J.Coxon and B. Halton, Cambridge University Press.

6. Solar Energy Hand Book, J.F. Kreider and F. Krejth, MacGraw Hill Book Co. 1981.

7. Solar Energy Conversion, R.C. Neville, Elsevier.

8. Alternative Energy Systems, B.K. Hodge, Wiley.

9. Advanced Energy Systems, Second Edition, Nicolai V. Khartchenko; Vadym M. Kharchenko, Taylor & Francis.

10. Non- Conventional Energy Resources, D.S. Chauhan, New Age International

11. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley

12. Inorganic Photochemistry, J.Chem.Educ.vol. 60 No. 10, 1983.

13. Progress in Inorganic Chemistry, Vol. 30ed. S.J. Lippard. Wiley.

14. Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic Press.

15. Elements in Inorganic Photochemistry, G.J. Ferraudi, Wiley..

Group B

Elective Paper-II

CH-506: ORGANIC SYNTHESIS I

UNIT I

Organometallic Reagents

Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details.

Group I and II metal organic compounds- Li, Mg, Hg, Cd, and Zn compounds.

Transition metals- Cu, Pd, Ni, Fe, Co, and Ti compounds.

Other elements- Si and B compounds.

UNIT II

Oxidation

Introduction, Different oxidative processes.
Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and unactivated).
Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids.
Amines, hydrazines, and sulphides.
Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate.

UNIT III

Reduction

Introduction. Different reductive processes.
Hydrocarbons – alkanes, alkenes, alkynes and aromatic rings.
Carbonyl compounds – aldehydes, ketones, acids and their derivatives
Epoxides.
Nitro, nitroso, azo and oxime groups.

Hydrogenolysis.

UNIT IV

Rearrangements

General mechanistic considerations – nature of migration, migratory aptitude, memory effects.A detailed study of the following rearrangements:

Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction.

UNIT V

Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds.

General considerations, synthesis and reactions of some representative compounds.

Books Suggested:

1. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
2. Somer Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.
6. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.

Group C

Elective Paper-I

CH-507: BIOINORGANIC AND SUPRAMOLECULAR CHEMISTRY

UNIT I

Metal storage Transport: Iron storage and Transport;

Oxygen carriers: Hb, Mb , ferritin and transferitin;

Bio-mineralization;

Iron Transport in Microbs: siderophores.

Calcium in Biology: Storage and Transport of Calcium & calcium in Muscle contraction, transport and regulation, intramoleculer process, extracellular binding protein, Ca^{2+} ATP ase structure, Ca^{2+} ATP ase reaction cycle, intracellular Ca^{+2} transport.

UNIT II

Metalloenzyms: Zinc enzymes- carboxy peptidase and carbonic anhydrase. Iron enzymes- Reactivity and structure of catalase, peroxidase and cytochrome P450. Copper enzymes- Reactivity and structure of superoxide dimutase (SOD).

Co enzyme vitamin B_{12} – Names of different forms, biochemical function of cobalamin, Vitamin $B_{12,}$ special characteristics of B_{12} co-enzyme.

UNIT III

Metals and chelates in medicine, metal deficiency and disease, toxic effect of metals, metal used for diagnosis and chemotherapy with particular reference to anticancer drugs.

UNIT IV

Supramoleculer chemistry: Concepts and language moleculer recognization, Principal of molecular receptors designs for different types of molecules, design and synthesis of co- receptor molecules and multiple recognition.

UNIT V

Supramolecular reactions and catalysis, supramolecular assemblies, Molecular and supramolecular devices, molecular and supra molecular photonic , electronic and ionic devices. supramolecular photochemistry

Books suggested:

2. Principles of Bioinorganic chemistry, SJ Lippard and J.M. Berg, University science books.

3. Bioinorganic chemistry, I Bertini, H.B. Garg, S.J. Lippard and J.S. Valentine, University science books.

4. Inorganic Biochemistry, Vol I and II Ed. G.S. Eichhorn, Elsevier progress in inorganic chemistry Vol. 18 and 38 ed. J.J. Lippard, Wiley.

5. Supra molecular chemistry, J.M. Lehn, VCH.

6. Bioinorganic chemistry, A K. Das Books and allied (P) Ltd.

7. Bioinorganic and supra molecular chemistry, Ajay kumar bhagi, G.R. Chatwal Himalaya publishing house.

Group C

Elective Paper-II

CH-508: HETEROCYCLIC CHEMISTRY

UNIT I

Nomenclature of heterocycles: Systemic nomenclature of monocyclic, fused & bridge heterocycles.

Three Membered Heterocyclic Compounds With One Hetero Atom:

Aziridines, Oxiranes and Thiiranes

UNIT II

Four Membered Heterocyclic Compounds with One Hetero Atom:

Azitines & Azitidines; Oxitanes, Thietanes

Bicyclic Ring Systems Derived from Pyrrole, Furan and Thiophene:

Benzopyrroles, benzofurans and benzothiophenes

UNIT III

Five Membered Heterocyclic Compounds with One Hetero Atom:

Tautomerism

Pyrroles, Furans and Thiophenes

Five Membered Heterocyclic Compounds with Two Hetero Atoms:

Pyrazoles, Imidazoles, Oxazoles and Thiazoles

UNIT IV

Six Membered Heterocyclic Compounds With One Hetero Atom:

Pyridines, Pyrylium salts and α- and γ-Pyrones

Six Membered Heterocyclic Compounds with Two Hetero Atoms:

Pyrazines, Pyridazines and Pyrimidines,

Cinnolines and Phthalazines

UNIT V

Seven Membered Heterocyclic Compounds with Two Hetero Atoms:

Azepines, Oxepins and Thiepins

Bicyclic Ring Systems Derived from Pyridine:

Quinoline and Isoquinolune

Books Suggested:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Hetrocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L., Gilchrist, Longman Scientific Techinal.
5. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
7. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press.

Group D

Elective Paper-I

CH-509: NUCLEAR AND RADIOCHEMISTRY

UNIT I

Stability of the nucleus, Mass Energy relationship for nuclear reactions, Properties of nucleus, Nuclear Models (The shell model, the liquid drop model, the fermi gas model, the collective model and the optical model).

Nuclear reactions, Energetics of nuclear reactions, fission and fusion reactions, spallation, fragmentation, stripping and pick up reactions, photonuclear and thermonuclear reactions.

UNIT II

Interaction of radiation with matter, passage of neutrons through matter, interaction of radiation with matter; measurement of radiations. Radiolysis of water, counting techniques (GM Ionisation, proportional and scintillation counter), counting statistics.

UNIT III

Applications of radioactivity, Activation Analysis, isotopic dilution analysis, radiometric titrations, application in chemical investigations and synthesis in physiochemical analysis, in age determination and in prospecting of natural reasources. Medical agricultural and industrial applications, source of electivity. Radiation hazards and protection.

UNIT IV

Nuclear reactors: Basic features, materials and design of nuclear power reactors, Conversion and Breeding, safety features of reactors, Health Physics: Radiation unit (exposure unit), External and doses from various sources of radiations, allowed limit of intake (ALI)

UNIT V

Applications of radioisotopes in biology & molecular biology: biodistribution, metallic & biochemical pathways for protein synthesis, purine nucleotide synthesis, role of methionine in research, radioligand assay, autoradiography, primer extension, Nick translation , hybridization, nucleic acid sequencing.

Books Recommended:

1. Essentials of Nuclear Chemistry, H.J. Arnikar.
2. Introduction to Nuclear Science, M.W. Sarton, East West Edition.
3. Theory of Nuclear Structure, M.K. Pal, East West Edition.
4. Principles of Radiochemistry, G.W.A. Newton and V.J. Robinson, Macmilan Education Ltd.
5. Nuclear Chemistry, A. Vertes and I. Kiss.
6. Fundamental of radiation Chemistry, A. Mojumdar, J. David, Morrisey, G. T. Seaborg
7. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J.Holler. Publ. W B Saunders.

Group D

Elective Paper-II

CH-510: MEDICINAL AND PHARMACEUTICAL CHEMISTRY

UNIT I

Drug design & Pharmacodynamics

Procedure followed in drug design, Concepts of lead compound and lead modification, concepts of pro drugs & soft drugs, structure-activity relationship(SAR), Theories of drug activity : occupancy theory, rate theory, induced fit theory .

An Introduction of pharmacodynamics, Mechanism of drug action, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides , drug metabolism

UNIT II

Antineoplastic agents :

Inroduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer.Mention of carcinolytic antibiotics and mitotic inhibitors.

Synthesis of cyclophosphamide , Uracil and mustards .

UNIT III

Cardiovascular Drugs :

Intoduction , Cardiovascular diseases, drug inhibitors of peripheral sympathetic function , Synthesis of amylnitrite, sorbitrate, Methyldopa and atenolol.

UNIT IV

Drugs: Psychotic and Antipsychotic –

Inroduction, , CNS depressants, general anaesthetics, mode of action of; hypnotics, sedatives, anti-anxiety drugs. Anti depressants, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, alprazolam and barbiturates..

UNIT V

Antibiotics :

Cell wall biosynthesis , inhibitors , β-lactam rings , antibiotics inhibiting protein synthesis , synthesis of penicillin –G , penicillin – V, Chloramphenicol and Tetracyclin.

Books Suggested:

1. Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH.
2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
3. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International.
4. Burger's Medicinal Chemistry and Drug Discovery, Vol-1 (Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
6. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.
7. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley.

M Sc II YEAR-2016-17

SEMESTER-IV

There will be two compulsory papers and Four Elective Groups each group has two papers. A student has to take any one of the four groups:

List of two compulsory papers:

Compulsory Paper-I

CH-601: SOLID STATE CHEMISTRY

Compulsory Paper-II

CH-602: BIO-CHEMISTRY

List of Elective Groups in M.Sc. IV Semester:

GROUP- A

CH 603: INDUSTRIAL CHEMISTRY

CH 604: POLYMERS

GROUP- B

CH 605: ORGANIC SYNTHESIS II

CH 606: ADVANCED ELECTROCHEMISTRY AND APPLICATIONS

GROUP- C

CH 607: CHEMISTRY OF NATURAL PRODUCTS

CH 608: ENVIRONMENTAL CHEMISTRY

GROUP- D

CH 609: PHYSICAL ORGANIC CHEMISTRY

CH 610: CHEMISTRY OF MATERIALS

Compulsory Paper I

CH-601: SOLID STATE CHEMISTRY

UNIT I

Solid State Reactions and Non-Stoichiometry

Crystalline solid, Solid State Reactions - General principles and Experimental procedures, Wagner's theory in reference to MgO and Al_2O_3, Enhancement of reactivity of solids, Co-precipitation as a precursor to solid state reaction, Kinetics of solid state reaction

Non-Stoichiometry – Introduction, Classification – Small and Large deviations from stoichiometry, Superlattice ordering of defects

UNIT II

Crystal Defects

Perfect crystal and Crystal Defect, Thermodynamic requirement of defect, Intrinsic and Extrinsic defects, Point defects - Schottky, Frenkel, Interstitial atom, Substitutional impurity atom and Color Centre, Line defect – Dislocation (edge and screw), Plane defects - Lineage boundary, Grain Boundary, Stacking fault, Thermodynamics of Schottky and Frenkel defect

UNIT III

Electronic Structure of Solids

Introduction to Free electron theory of Metals, Formation of Energy bands, Valence and Conduction bands, Kronig-Penny Model, Band theory of solids, Brillouin zone, Motion of electrons in a band – velocity and effective mass of an electron, f_k factor, Distinction between metal, semiconductor and insulator on the basis of Band theory

Electrically conducting solids – Conjugated systems, Charge-transfer complexes

UNIT IV

Semiconductors and Properties of Solids

Intrinsic and Extrinsic semiconductors, p-type and n-type semiconductors, Dependence of conductivity of n-type and p-type semiconductors on temperature, p-n Junction

Optical Properties – Photoconduction and Photoelectric effect

Magnetic Properties: Classification of materials – para-, dia-, ferro-, and antiferromagnet, Effect of temperature on magnetic susceptibility of para-, dia-, ferro-, antiferromagnetic substances, Magnetic Hysteresis

UNIT V

Superconductor

Superconductivity, Factors affecting superconductivity, Isotope effect, Meissner Effect, Magnetic effects – Type I and Type II superconductors, Persistent current, BCS theory of superconductivity, Cooper pair, Occurrence of superconductivity– conventional, organic and high temperature superconductors, Fullerene as superconductor

Books Suggested:

1. Solid State Chemistry and its Applications, A.R. West, Plenum
2. Principles of Solid State, H.V. Keer, Wiley Eastern
3. Solid State Chemistry, D.K. Chakrabarty, New Age International
4. Fundamentals of Solid State Physics, B.S. Saxena, R.C. Gupta and P.N. Saxena
5. Solid State Physics, A. J. Dekkar, Macmillan

Compulsory Paper II

CH-602: BIO-CHEMISTRY

UNIT I

Metal ions in Biological Systems: Role of metal ions in biological processes.

Dioxygen Uptake: Structure and function of haemoglobin, myoglobin, hemocyanins and hemerythrin, model system and synthetic complexes of iron and Copper. Electron Transfer in Biology: Structure and function of metalloproteins, Cytochromes and iron-sulphur proteins, synthetic models, peroxidases and catalases.

Nitrogenases: Biological nitrogen fixation, molyhydenum nitrogenases, model systems

UNIT II

Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, binding energy specificity and regulation. Kinetics of enzyme action that is activation energy, Michaelis- Menten equation, Lineweaver Burk plot & factors effecting enzyme activity. Nomenclature and classification. Fischer's lock and key and Koshland's induced fit hypothesis. Types of inhibition, concept and identification of active site by the use of inhibitors and affinity labeling. Transition state theory, acid-base catalysis and covalent catalysis.

UNIT III

Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzyme, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12, Mechanism of reaction catalysed by the above cofactors. Large-scale production and purification of enzymes, techniques.

UNIT IV

Bio-energetic and Bio-polymer Interactions: Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.

UNIT V

Diffraction Methods and Statistical Mechanics in Biopolymers: Evaluation of size, shape, molecular weight by various experimental techniques. Light scattering,X-ray scattering, X-ray

diffraction and photo correlation spectroscopy ORD. Chain configuration of macromolecules and calculation of average dimensions. Polypeptide and protein structures, introduction to protein folding.

Books Suggested:

1. The Inorganic Chemistry of Biological Processes, M.N.Hughes Wiles (1972).
2. Bioinorganic Chemistry-An Introduction, Enchiroochiai.
3. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M.Berg, University Science Books.
4. Bioinorganic Chemistry, I Bertini, H.B. Gray, S.J.Lipard and J.S. Valentine, University Science Books.
5. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C.Penny, Springer-Verlag.
6. Understanding Enzymes, Trevor Palmer, Prentice Hall.
7. Enzyme Chemistry:Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall.
8. Enzyme Mechanisms Ed. M.I.Page and A.Williams, Royal Society of Chemistry.
9. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
10. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Tevan, John Wiley.
11. Enzymatic Reaction Mechanisms, C.Walsh, W.H. freeman.
12. Enzynie Structure and Mechanism, A Fersht, W.H. Freeman.
13. Biochemistry: The Chemical Reactions of Living Cells, D.E.Metzler, Academic Press.
14. Principles of Biochemistry, A.L.Lehninger, Worth Publishers.
15. Biochemistry, L. Strver, W.H.Freeman
16. Biochemistry, J.David Rawn, Neil Patterson.

17. Biochemistry, Voet and Voet, John Wiley.

18. Outlines of Biochemistry, E.E.Conn and P.K.Stumpf, Johh Wiley.

19. Bioorganic Chemistry: A Chemical Approach to Enzyme Achon. H. Dugas and C.Penny, Springer-Verlag.

20. Macromolecules: Structure and Function, F.World, Prentice Hall.

Group A

Elective Paper-I

CH-603: INDUSTRIAL CHEMISTRY

UNIT I

Chemistry of colors

Introduction, Classification of dyes, according to chemical constitution and according to application. General ideas about the synthesis of different dye intermediate and synthetic dyes i.e. direct and reactive dyes , azoic colours, acid and basic dyes, newer cationic dyes for acrylics, Disperse dye, mordent and sulphur dyes. Pigment and fluorescence brightners. Colour fastness against light, washing, perspiration, rubbing etc. and its evaluation. Methods of colour measurements.

UNIT II

Industrial/ Commercial polymers and their compounding ingredients:

General characteristics of Fibers, Plastic, Rubbers and Adhesives-

Structure, properties and preparation of Polyamides, Polystyrene, Polychloride, Polymethylmethacrylate, Polymethacrylate, ABS, Epoxide, IR, SBR, NBR & IIR

Compounding Ingredients: Extenders, Fillers, plasticisers, stabilizers, anti oxidant and anti ozonants, Flame retardants, mould release agents, Sulphur valcanisation.

UNIT III

Ores and Minerals

Inorganic materials of industrial importance, their availability, forms and structure-

Bauxite, clay, mica, zeolites, copper pyrites, zinc blend, dolomite and coal.

UNIT IV

Characteristic Features of surfactants: Conditions under which interfacial phenomena and surfactants become significant. General structural features and behaviour of surfactants : General use of charge types, general effect of nature of hydrophobic group.

UNIT V

Micelle Critical micelle concentration (cmc), factors affecting the value of cmc in aqueous medium.factors determining the extent of Solubilization, effect of Solubilization. Formation of emulsions, factors determining emulsion stability, Mechanism of the cleaning process.

Books Recommended:

1. Hall, A.J.(8^{TH} ed.): The Standard Hand Book of Textiles, Butter-Worth, London.
2. Clark, W.: An Introduction to Textiles Printing, A Practical Manual for use in Laboratories College and School of Arts, Bottorworth, London.
3. Shinai, V.A.: technology OF textile processing, Sevak publication, Bombay, Vols. I to IX
4. Chakravarty, R.R. : Glimpses of Textile Technology, Caxton Press, Delhi.
5. Peters, R.H.: Textile Chemistry, Elsevier, Amsterdam, Vol. I to Vol. II
6. Surfactants and Interfacial Phenomenon. Milton J. Rosen, Johan-Wiley, 1978.
7. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
8. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Screedhar, Wiley-Eastern.

Group A

Elective Paper-II

CH-604: POLYMERS

UNIT I

Basics:

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. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

UNIT II

Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights End-group analysis and ultracentrifugation methods.

Analysis and testing of polymers-chemical analysis of polymers, Microscopy.

Thermal techniques: thermo gravimetric analysis, differential thermal analysis, and physical testing-tensile strength, impact. Tear resistance. Hardness and abrasion resistance.

UNIT III

Structure and Properties

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT IV

Polymer Processing

Plastics, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spining.

UNIT V

Properties of Commercial Polymers

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers – Fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Books Suggested:

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Screedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and RM. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J.M.G. Gowie, Blackie Academic and Professional.
6. J.M.G. Gowie, Blackie Academic and Professional.

Group B

Elective Paper-I

CH-605: ORGANIC SYNTHESIS II

UNIT I

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.

UNIT II

Protecting Groups, & Heterocyclic Compounds

Principle of protection of alcohol, amine, carbonyl and carboxyl groups.

Heterocyclic Compounds

IUPAC of Heterocyclic compounds, saturated heterocyclic compounds containing mono-hetero atom (O, S, N), synthesis of 3-, 4-, 5- and 6-membered rings, aromatic heterocyclic compounds in organic synthesis.

UNIT III

One Group C-C Disconnections

Alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

UNIT IV

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. Micheal addition and Robinson annelation.

UNIT V

Synthesis of Some Complex Molecules

Application of the above in the synthesis of following compounds:

Camphor, Longifoline, Cortisone, Reserpine, vitamin D, Juvabione, Aphidicolin and Fredericamycin A.

Books Suggested:

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis- Concept, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlage VCH.
3. Some Modern Methods of Organic Synthesis. W. Carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March, Wiley.
6. Principles of Organic Synthesis, R. Norman and J.M. Coxon, Blackie Academic & Professional.
7. Advanced Organic Chemistry Part B, F. A. Carey and R.J. Sundberg, Plenum Press.

Group B

Elective Paper-II

CH-606: ADVANCED ELECTROCHEMISTRY AND APPLICATIONS

UNIT I

Electrochemical Energy Storage

Properties of Electrochemical energy stores: measure of battery performance, charging and discharging of batteries, storage density, energy density, Classical Batteries: (i) Lead Acid (ii) Nickel- Cadmium (iii) Zinc- Manganese di oxide

Modern Batteries: (i) Zinc Air (ii) Nickel- Metal Hydride (iii) Lithium battery

Future electricity stores: storage in (i) hydrogen (ii) alkali metals (iii) non aqueous solution

UNIT II

Electrochemical Energy Generators

Fuel cells: Hydrogen –Oxygen Cell, Hydrogen –Air Cell, Hydrocarbon –Air Cell, Alkaline Fuel Cell, Phosphoric Acid Fuel Cell, Direct NaOH Fuel Cell, and Application of Fuel Cell. Comparisons of batteries, fuel cells and super capacitors, electrochemical processes of particular relevance to energy conversion.

UNIT III

Corrosion and Passivity

Electrochemical mechanism of corrosion of metals, thermodynamics and stability of metals, theories of corrosion, forms of corrosion, corrosion current and corrosion potential- Evans diagrams. Measurement of corrosion rate: Non electro chemical method and electrochemical method. corrosion monitoring and prevention methods,(i) by addition of substrates to the electrolyte environment (ii) by charging corroding method from external source, anodic protection ,(iii)by alternation in the medium,(IV) by alternation in the metal and design

consideration, organic inhibitors, Green inhibitors. Passivation: structure of passivation films, mechanism of passivation, spontaneous passivation, Nature's method for stabilizing surfaces.

UNIT IV

Kinetics of Electrode process and their nature

Kinetically and mass transport controlled electrochemical processes, Mass transport by migration, convection and diffusion. , essential of electrode reaction,. Current density, over potential, Tafel equation, Buttler- Volmer equation, Electrochemical and chemical reversibility, criteria of irreversibility information from irreversible wave, Meits Israel and Gellings methods for determining kinetic parameters for quasi reversible and irreversible processes. Potentiostatic and galvanostatic methods including chronoamperometry, chronopotentiometry.

UNIT-V

Electro- organic synthesis

Types of electro-organic reactions, constant current and constant potential, electrolysis, cell design, effect of variable, nature of medium, nature of electrode materials, overvoltage, effect of redox couples, application of sewage waste water treatment, electrochemical incineration of human waste in combined space, electro- organic synthesis of novel drugs.

Books Recommended:

1. Modern electrochemistry, Vol. l, IIA, Vol. II B, JOM Brockris and A.K.N. Raddy, Plenum publication, New York.
2. Electrochemical methods by Allen J. Bard and Larry R.Faulkner, John Wiley.
3. Techniques of Electro-organic synthesis part I, II and III by N.L. Weinberg, john wiley.
4. *Corrosion and Corrosion Engineering* chemistry by M.G. *Fontana*, N.D. *Green*, McGraw-Hill, New York.
5. Electro chemistry by Carl H. Hamann, Andrew Hamett and Wolf Vielstich. John Wiley.

Group C

Elective Paper-I

CH-607: CHEMISTRY OF NATURAL PRODUCTS

UNIT I

Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, biosynthesis.

Structure determination, synthesis of the following representative molecules: Citral, Geraniol, β - Terpeneol, Zingiberene, Phytol, Abietic acid and β-Carotene.

UNIT II

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, biosynthesis.

Structure, synthesis of the following:Ephedrine, (+)-Cocaine(concine), Nicotine, Quinine and Morphine.

UNIT III

Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon, Stereochemistry biosynthesis. Isolation, structure determination of Cholesterol and Bile acids.

UNIT IV

Plant Pigments

Occurrence, nomenclature and general methods of structure determination. Isolation structure and synthesis of Apigenin, Luteolin,Quercetin, Myrcetin, Vitexin, Diadzein, Butein, Aureusin, Cyanidin, Hirsutidin.

Biosynthesis of flavonoids : Acetate pathway and Shikimic acid pathway.

UNIT V

Porphyrins

Structure of Haemoglobin and Chlorophyll.

Prostaglandins

Occurrence, nomenclature, classification, physiological effects. Synthesis of PGE_2 and PGF_{20}

Pyrethroids and Rotenones

Structure and reactions.

Books Suggested:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol. 2 I.L. Finar, ELBS.
3. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Hardwood Academic Publishers.
7. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.

Group C

Elective Paper-II

CH-608: ENVIRONMENTAL CHEMISTRY

UNIT I

Environment; An Introduction, Atmosphere & Air Pollution

Concept & scope of Environmental chemistry; Environmental segments; Environmental Pollution;

Classification of pollutants; Bio-geological cycles in the environment: Hydrological cycle, C, N, O, S and P cycles in the environment; Bio-distribution of elements;

Structure and Composition of Atmosphere; Particles, Ions & Radicals in the atmosphere; Major sources of Air Pollutants.

Pollution by C, CO, NO_X, SO_X, HC, Acid Rain, Smog, Particulates; Green House effect/Global Warming, Ozone Layer; Effects & Control of Air Pollutants; Air quality standards; Sampling, Monitoring.

UNIT II

Hydrosphere & Water Pollution

Aquatic environment, Chemical composition of water bodies; Lakes, Streams, Rivers.

Classification of water pollution; Pollution by Pesticides, Polymers, Detergents, Agriculture and Sewage wastes; Purification and Treatment of water;

UNIT III

Lithosphere: Soil Pollution

Introduction: Soil formation, composition & classification; Acid-Base and Ion-exchange reactions in Soil; Macro- and Micronutrients, Soil Profile; Soil fertility and Productivity, Soil erosion, Soil Analysis (Moisture, Nitrogen & pH).

Soil Pollution: Sources & Classification, Effects of Pesticides, Fertilizers & Sediments, Control of soil pollution.

UNIT IV

Industrial Pollution & Toxicology

Classification, Nature and treatment of Industrial Effluents, Industrial Effluents from Distillery, Textile, Cement, Electroplating, Paper & pulp, Dairy & Detergent, Fertilizers, Tanning, .

Toxic Chemicals in the Environment, Biochemical Effects of Ozone, PAN, Carcinogens, Cyanides, Pesticides, Natural & Man-made Disasters.

Solutions to Environmental Problems; Preventive Environmental Management, Better Industrial Processes.

UNIT V

Green Chemistry

Principles and Goals of Green Chemistry, Green chemicals, reagents, catalysts, and solvents. Examples of green synthesis / reactions, Microwave assisted synthesis.

Books Recommended/Suggested

1. Environmental Chemistry: Edited by J. O'M. Bockris, Plenum Press.
2. Environmental Chemistry: S.E. Manahen, Lewis Publications.
3. Environmental Chemistry: H. Kaur, Pragati Prakashan.
4. Environmental Chemistry: AK Day, New Age Int. Publishers.
5. Environmental Chemistry: SM Khopkar, Wiley Estern.
6. Physico-chemical Examination of Water, Sewage & Industrial Effluents: K. Manivasakam.
7. An introduction to Green Chemistry, V Kumar, Vishal Publ..

Group D

Elective Paper-I

CH-609: PHYSICAL ORGANIC CHEMISTRY

UNIT I

Principles of Reactivity

Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrhenius equation. Transition state theory. Uses of activation parameters, Hammond's postulate.Potential energy surface model. Reactivity and selectivity principles.

UNIT II

Kinetic Isotope Effect and Structural Effects:

Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunneling effect. Solvent effects.

Linear free energy relationships (LFER) The Hammett equation, substituent constants, theories of substituent effects. Interpreation of σ-values. Reaction constant ρ. Deviations from Hammett equation. Dual-parameter correlations, inductive substituent constant. The Taft model, σ 1- and σ R-scales.

UNIT III

Solvation and Solvent Effects

Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of solvation. Effects of solvation on reaction rates and equilibria. Various empirical indexes of solvation based on physical properties, solvent-sensitive reaction rates, spectroscopic properties and scales for specific solvation.

UNIT IV

Steric and Conformational Properties

Various type of steric strain and their influence on reactivity. Steric acceleration. Molecular measurements of steric effects upon rates. Steric LFER. Conformational barrier to bond rotation, Rotation around partial double bonds. Winstein-Holness and Curtin-Hammett principle.

UNIT V

Nucleophilic and Electrophilic Reactivity

Structural and electronic effects on SN1 and SN2 reactivity. Solvent effects. Kinetic isotope effects. Intramolecular assisgtance. Electron trlansfer nature of SN2 reaction. SRN1 mechanism. Electrophilic reactivity, general mechanism. Kinetic of SE2-Ar reaction. Structural effects on rates and selectivity.

Books Suggested:

1. Molecular Mechanics, U. Burkert and N.L. Allinger, ACS Monograph 177, 1982.
2. Organic Chemists' Book of Orbitals. L. Salem and W.L. Jorgenses, Academic Press.
3. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.
4. Introduction to Theoretical Organic Chemistry and Molecular, Modeling, W.B. Smith, VCH, Weinheim.
5. Physical Organic Chemistry, N.S. Isaacs, ELBS/Longman.
6. Supramolecular Chemistry, Concepts and Perspectives, J.M. Lehn, VCH.
7. The Physical Basis of Organic Chemistry, H. Maskill, Oxford University Press.

Group D

Elective Paper-II

CH-610: CHEMISTRY OF MATERIALS

UNIT I

Multiphase Materials

Classification and properties of materials, Types of phase diagrams, Isomorphous, Eutectic, Peritectic, Monotectic and Eutectiod systems, Calculation of phase amounts from a phase diagram, Phase rule, Ferrous alloys Fe-C phase diagram, Non Ferro alloys, Phase diagrams of brass and tin bronze.

UNIT II

Ceramic Materials

Raw materials of glass, Cement and Ceramics, Refractories, Characterization, Properties and Applications, Abrasives, kinds and uses, Powder metallurgy, Manufacturing process, Properties and Applications, Advantages and Limitations**.**

UNIT III

Composite Materials

Traditional composites, concrete, Asphalt and Wood, Synthetic composites, dispersion reinforced, Particle reinforced, Laminated and fiber reinforced composites, applications of composites.

UNIT IV

Polymeric and advanced materials : Brief idea of following :Insulating material, Semiconductors, Superconductors, Fullerenes, Optical fibers, Organic electronic material.

UNIT V

Environmental effects of Materials : Corrosion mechanisms of dry and wet corrosion, Galvanic and concentration cell corrosion, Pitting and stress corrosion, Corrosion control

methods, Types, preparation and uses of adhesives, Types and Application of paints and Pigments.

Books Suggested:

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
2. Material Science and Engineering, An Introduction, W.D. Callister, Wiley.
3. Principles of the Solid State, H.V. Keer, Wiley Eastern.
4. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
5. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.

LABORATORY COURSES

III & IV Semester(2016-17)

CH-511: INORGANIC LAB: LABORATORY COURSE 1.

I. Preparation of some Inorganic coordination compounds/ Complexes.

II. Analysis the given mixture for four rare elements.

III. Estimation of three constituent in the given sample of alloy / Coin (Two gravimetrically and one volumetrically**).**

IV. Spectrophotometry

a. Iron- phenanthroline complex : Job's Method of continuous variations.

b. Find out the stability constant of metal complexes by Bjerrum's Method.

V. Complexometry

a. Estimate Zn in given tablet/ sample complexometrically using xylenol orange as an indicator.

b. Estimate Ni in given sample complexometrically using mureoxide as an indicator.

CH-512: ANALYTICAL LAB: LABORATORY COURSE 2.

I. pH metry:

1. To determine the dissociation constants of dibasic and tribasic acids.
2. Titration of mixture of acids (HCl + CH_3 COOH) against strong base.

II. Spectrophotometry:

1. Determination of P_{ka} of an indicator (e.g. methyl red) in (a) aqueous and (b) micellor media.

2. Determination of stoichiometry and stability constant of inorganic (e.g. Iron– salicylic acid) and organic (e.g. Amine – Iodine).

3. To determine the concentration of chromium and Complexes a binary mixture.

III. Polarography:

1. To study oxygen wave by polorography.

2. To characterize and determine Pb^{2+}. Cd^{2+} and Zn^{2+} , ions by polarography/ cyclic voltammetry

IV Fluorometry

1. Determination of strength of Vitamin B (Riboflavin) and Aluminium.

V. Nephelometry

1. Determination of sulphate content in water sample.
2. Determination of phosphate content in water sample.

VI. Flame photometry

1. Estimation of Mg, K and Ca.
2. Estimation in a mixture (Na and K; K and Ca).

VII. Water and Waste Water examination:

1. DO and BOD determination.

2. COD estimation.

3. Fluoride and nitrate determination.

VIII. Cement Analysis

IX. Chromatography: Column

Books Suggested :

1. Systematic Qualitative Organic analysis by H. Middleton.
2. Qualitative and Quantitative hand book of Organic analysis by H. Clark
3. Vogel's Text book of practical Organic Chemistry by Vogel

CH-513: ORGANIC LAB: LABORATORY COURSE 3.

I. Qualitative Analysis

Separation, purification and identification of three components of a mixture of organic compounds (three solids or two liquids and one solid, two solids and one liquid).

II. Multi-step Synthesis of Organic Compounds

Benzophenone → Benzpinacol → Benzpinacolone

→ Benzophenone → Benzophenone oxime → Benzanilide

Benzoin → Benzil → Benzilic acid

Skraup synthesis: Preparation of quinoline from aniline.

Synthesis using microwaves

To carry out oxidation of alcohols and oxime by PCC.

Synthesis using phase transfer catalyst

Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide.

III. Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and $R_f$value reported).
4. Isolation of piperine from black pepper.
5. Isolation of lycopene from tomatoes.

6. Isolation of -cartoene from carrots.

7. Isolation of eugenol from cloves.

IV. Paper Chromatography / TLC

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

V. Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, MS).

Spectrophotometric (UV/VIS) Estimations

2. Amino acids
3. Proteins
4. Carbohydrates
5. Ascorbic acid
6. Aspirin
7. Caffiene

Books Suggested:

1. Systematic Qualitative Organic analysis by H. Middleton.
2. Qualitative and Quantitative hand book of Organic analysis by H. Clark
3. Vogel's Text book of practical Organic Chemistry by Vogel
4. Practical Organic Chemistry by N.K. Vishnoi.

CH-514: PHYSICAL LAB: LABORATORY COURSE 4.

I. Chemical Kinetics

(i) To investigate the kinetics of the reaction between I^- and persulphate ion

(a) Order of the reaction

(b) Energy of activation of the reaction.

(c) Effect of ionic strength on rate.

(ii) To find out the order of the reaction of saponification of ester using unequal concentrations of reactants.

II. Chemical kinetics

(i) To investigate the kinetics of the reaction between ceric ammonium sulfate and glycollic acid.

(a) Order with respect to ceric ion.

(b) Order with respect to glycollic acid.

(c) Energy of activation of the reaction.

(d) Effect of ionic strength on rate.

(ii) To study the reaction between cericammonium nitrate and primary alcohol.

II. Thermodynamics

(i) Determination of partial molar volume of solute (e.g.,KCl) and solvent in a binary mixture.

(ii) Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

III. Phase Equilibrium

(i) To find out the equilibrium constant for the triiodide formation:

(ii) To find the formula of complex cuprammonium ion by distribution method.

IV. Conductometry

(i) To find out the equivalent conductance of strong electrolytes at different dilutions and to verify Debye Huckel Onsagar equation.

(ii) To determine the equivalent conductance of a weak electrolyte at infinite dilution.

(iii) To determine the dissociation constant of acetic acid/Oxalic acid and verify the Ostwald's dilution law.

(iv) To determine the degree of hydrolysis and hydrolysis constant of ammonium chloride at room temperature.

(v) To determine the activity coefficient of zinc ions in the solution of 0.002 M $ZnSO_4$ using Debye-Huckel's Limiting Law.

(vi) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by NaOH conductometrically.

(vii) To determine the solubility and solubility product of sparingly

soluble salt ($PbSO_4$, $BaSO_4$)

V. Potentiometry/pH metry

(i) To determine the dissociation constants of weak acids (oxalic, tartaric, phosphoric) using pH meter.

(ii) To determine the temperature dependence of emf of a cell.

(iii) To determine the degree of hydrolysis of aniline hydrochloride for three different solutions at room temperature and hence calculate the hydrolysis constant of the salt and dissociation constant of the base.

(iv) To study the acid-base titration in a non-aqueous media using a pH meter.

(v) To find out thermodynamic constants ΔG, ΔS and ΔH for the reaction by emf measurements.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

Books suggested:

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.

2. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.

3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

4. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.

5. Advanced Experimental Chemistry, vol.1 – Physical J.N. Gurtu and R. Kapoor, S. Chand & Co.