SHIVIJI UNIVERSITY, KOLHAPUR

M.Sc. Chemistry Syllabus

SEMESTER SYSTEM / (Credit system)

A] Shivaji University, Kolhapur.

Revised Syllabus for Master of Science

1. **TITLE: Subject:- Chemistry (Inorganic , Organic, Physical and Analytical)**

   Compulsory under the faculty of Science

2. **YEAR OF IMPLIMENTATION :**

   New Syllabus will be implemented from June 2008 on wards.

3. **PREAMBLE:**

   Total No. of Semester – 4

   (Two semesters per year)

   Total No. of Papers – 16

   Total No. of Practical course – 08

   No. of papers (theory) per semester – 04

   No. of practicals course per semester – 2

   Maximum marks per paper (practical) 100

   Distribution of Marks – Internal evaluation 20

   External evaluation 80

   (Semester exam.)

   Total Marks for M.Sc. Degree

   Theory Paper 1600

   Practical course 800

   2400

4. GENERAL OBJECTIVES OF THE COURSE:

Chemistry is a pervasive subject. All the branches of science need chemistry. It is an experimental science and students need to train in practicals to get expertise in doing fine experiments and handle sophisticated instruments. Along with the data obtained its statistical analysis is also required to establish authenticity in the fields like environmental science, space chemistry and biotechnology. There are an immense potentialities for chemistry and post graduates to undertake advanced research or in Industries as skilled chemists.

5. Duration:

- The Course shall be a full time course
- The duration of course shall be two years, four semesters

6. FEE STRUCTURE: Self Supporting Course

1. **Entrance Examination Fees: As per prescribed by Shivaji University, Kolhapur**
2. **Course Fee: As per prescribed by Shivaji University, Kolhapur.**

7. IMPLEMENTATION OF FEE STRUCTURE:

Revision of fee Structure: No

8. ELGIBILITY FOE ADMISSION:

As per O.M.Sc. 1.2 for graduates of this university and O.M.Sc. 1.3 from other Universities and the merit list.

9. MEDIUM OF INSTRUCTION: English.

10. STRUCTURE OF COURSE:

SEMESISTER

Semester - I

Theory courses :	Paper No.	Title
G-11101	CH-101 - I :	Inorganic Chemistry.-I
G-11201	CH-102 -II:	Organaic Chemistry.-I
G-11301	CH-103-III:	Physical Chemistry-I.
G-11401	CH-104-IV :	Analytical Chemistry-I.

Practical courses :

G-11601 CH-111- I) Relevant practicals.
G-11701 CH-112-II)

Semester -II

Theory courses	Paper No.	Title.
G-21101 -	CH-201 - V	Inorganic Chemistry - II.
G-21201 -	CH-202 - VI	Organic Chemistry - II.
G-21301 -	CH-203 - VII	Physical Chemistry - II.
G-21401 -	CH204 - VIII	Analytical Chemistry -II.

Practicals courses

G-21601 - CH-211-III
G-21701 - CH-212-IV

M.Sc.-II (General outline for each Branch).

Following codes will be used for papers of Part-II.

ICH : Inorganic chemistry
OCH : Organic chemistry
PCH : Physical chemistry.
ACH : Analytical chemistry.

Semester – III.

The students shall opt. three papers and one elective in each specialization.

Theory courses :

Inorganic chemistry :Core papers : ICH-301, ICH-302, ICH-303
Elective : ICH- 304 (A to …….)
Organic chemistry : Core papers : OCH-301, OCH-302, OCH-303,
Elective : OCH- 304 (A to……...).
Physical chemistry : Core papers : PCH-301, PCH-302, PCH-303,
Elective : PCH-304 (A to ……..).
Analytical chemistry : Core papers : ACH-301, ACH-302, ACH-303,
Elective : ACH-304 (A to …….).

Practical courses :

Semester – III

Two practical courses relevant to each Specilization : **Practicals**
Inorganic Chemistry : ICH- 311 and ICH- 312, V&VI

Orgnanic Chemistry	: OCH-311 and	OCH-312, ,	V&VI
Physical Chemistry	: PCH-311 and	PCH-312.	V&VI
Analytical Chemistry	: ACH-311 and	ACH-312.	V&VI

Semester– IV

The students shall opt. three papers and one elective in each specialization.

Theory courses :

Inorganic chemistry :Core papers : ICH-401, ICH-402, ICH-403
Elective : ICH- 404 (A to ....)

Organic chemistry : Core papers : OCH-401, OCH-402, OCH-403,
Elective : OCH- 404 (A to…).

Physical chemistry : Core papers : PCH-401, PCH-402, PCH-403,
Elective : PCH-404 (A to …).

Analytical chemistry : Core papers : ACH-401, ACH-402, ACH-403,
Elective : ACH-404 (A to ..).

Practicals

Two practical courses relevant to each Specialization	:		**Practicals**
Inorganic Chemistry	: ICH- 411 and	ICH- 412,	VII&VIII
Orgnanic Chemistry	: OCH-411 and	OCH-412, ,	VII&VIII
Physical Chemistry	: PCH-411 and	PCH-412.	VII&VIII
Analytical Chemistry	: ACH-411 and	ACH-412.	VII&VIII

1.3 Scheme of examination

- The semester examination will be conducted at the end of each term (both theory and practical examination)
- Theory paper will be of 80 marks each and 20 marks for internal evaluation test conducted in the mid of the term. Two practicals will be of 80 marks each and internal practical test of 20 marks in each practical.
- Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

1.4 Standard of Passing

As per rules and regulation of M.Sc. course.

1.5 Nature of question paper and scheme of marking

Theory question paper: Maximum marks -80

Total No. of question – 7

All questions are of equal marks. Out of these seven questions five question are to be attempted.

Question no.1. Compulsory and objective

Total no. of bits – 16, Total marks – 16 (which cover multiple choice, fill in the blanks, definition, true or false). These questions will be answered along with other questions in the same answer book.

.Remaining 6 question are divided into two sections, namely section-I and section – II.

Four question are to be attempted from these two section such that not more than two questions from any of the section. Both sections are to be written in the same answer book.

Syllabus:

i) Paper-

ii) Title of paper:

C) OTHER FEATURES:

INTAKE CAPACITY: 96 Students Organic- 30
Inorganic- 30
Physical- 20
Analytical- 16

D) Laboratory Safety Equipments:

Part: I Personal Precautions:

1. All persons must wear safety Goggles at all times.
2. Must wear Lab Aprons/Lab Jacket and proper shoes.
3. Except in emergency, over – hurried activities is forbidden.
4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part: II: Use of Safety and Emergency Equipments:

1. First aid Kits
2. Sand bucket
3. Fire exextinguishers (dry chemical and carbon dioxide extinguishers)
4. Chemical Storage cabinet with proper ventilation
5. Material Safety Date sheets.
6. Management of Local exhaust systems and fume hoods.
7. Sign in register if using instruments.

Credit system

Credits can be defined is the workload of a student in

1. Lectures
2. Practicals
3. Seminars
4. Private work in the Library/home
5. Examination
6. Other assessment activities

How much time a student gives for the examination per semester?

1) **4** Theory papers per semester each of the three hour duration. Time required is **12** hours
2) **2** Practicals per paper with **2** experiments per practical. Total 4 practical each of **3** hour duration. Time required is **12** hour.

Total time for a semester examination is **12 + 12 = 24** hrs

Time required for the other activities.

Seminars-as per the requirement of the course (minimum 2, One for each semester)

Library-book issue, Journal reference, reviews writing of research papers, internet access. Reading magazines and relevant information

Private work – project material, Industrial training, book purchase, Xerox, availing outside facilities etc

Home- Study, notes preparations, computations etc

Types of Credits

1) Credits by examination- test(theory and practical)
2) Credits by non examination- Proficiency in the state , national and international sports achievements, project, Industrial training , participation in workshop, conference, symposia etc

Social service (NSS) Military service (NCC) Colloquium & debate, Cultural programs etc

Credits by lectures and Practicals

- Total instructional days as per the UGC norms are **180**.
- 1 credit is equivalent to **15** contact hours
- For the M Sc course there are **4** theory papers with **4** hours teaching per week

Therefore the instructional days for the theory papers in semester are **4** x **15**(weeks) = 6**0**

- There are **4** practicals (with 1 project) each of **6** hour duration for the **2** practical courses.
  Total practical workload is **12** hours per week. Thus instructional days for the practical course of **4** practicals are **2** (practical papers) x **15 = 30**

The time for each student is busy in a semester is **90** days (Theory) + 6**0** days (Practical) = 15**0** days

- With **4** credits per theory paper will be **4 x 4=16** credits and 4 credits per practical will be **4 x 2= 08** credits

Credits for the practicals

Every practical (project) of **50** marks carries **2** credits.

Number of credits for M Sc course per semester will be **16 + 8 = 24**. Total no credits for entire M Sc course will be **4 x 24 = 96**.

There will be 4 credits for other assessment activities-

Total credits for entire M Sc course will be

Theory course, **4** credits x **16 = 64**

Practical course, **4** credits x **8 = 32**

Other activities **4** credits = **04**

Total = **100** credits

How to restructure the M. Sc course implementation of the credit system?

There will not be a major change in the restructured course. However some minor modification can be made in the syllabus wherever necessary.

In order to implement the credit system effectively it is necessary to make every semester duration of at least **12** weeks.

The examination must be scheduled in one month's time

The students must get at least 3 weeks time for the examinations preparations.

Every theory papers syllabus should consists of 4 units (sub units allowed) each carrying 1 credit.

In order to have uniformity in the credit transfer it is necessary to have internal examination in all the P.G. departments of equal weightage. **80** external + **20** internal appears to be ideal to begin with.

Theory paper	contact hours	credits
Unit-1 (sub units if any)	15	1
Unit-2(sub units if any)	15	1
Unit-3 (sub units if any)	15	1
Unit-4(sub units if any)	15	1

The practical course credit distribution

Practical paper	Practical	Contact hours	Credits	no of practicals
I (Unit-1)	1	6	2	12
I (Unit-1)	2	6	2	12
II (Unit-1)	3	6	2	12
II (Unit-1)	4	6	2	12

A project of **50** marks will be carrying **2** credits. Where a project of **50** marks is offered to the student, the student will have to perform 1 project, 1 practical paper (2 practical) for that semester. Time for the explanation for the practical course (contact ours) will be 1 week (12 hours)

This makes the practical workload of the student equal to **60** days in a semester.

Grades, grade point and average grade point's calculations

Table showing the grades, grade points and marks scored by a student

Grades	Grade points	marks out of 100
A^+	9	91 to 100
A	8	81 to 90
A^-	7	71 to 80
B^+	6	61 to 70
B	5	51 to 60
B^-	4	41 to 50
C+	3	31 to 40
C	2	21 to 30
C-	1	11 to 20
F	0	0 to 10

Sum grade point average SGPA) :- It is a semester index grade of a student

1. SGPA = $(g_1xc_1) + (g_2xc_2) + \text{--------} + (g_6xc_6)$/ Total credits offered by a student in a semester.
2. Cumulative grade point average (CGPA):- It is cumulative index grade point average of student

CGPA = $(g_1xc_1) + (g_2xc_2) + \text{--------} + (g_6xc_6)$/Total no of credits offered by students up to and including semester for which the cumulative average is required.

3. Final grade point average (FGPA): - It is a final index of student in the course FGPA=$(n/\sum c_i \text{ x } g_i)$ /(n/ cl)

Where c_1- credit of the course (paper) (4)

g_i – grade point secured (see the table for conversion)

n- No of courses (no of paper offered)

cl- Total no credits for the entire M Sc course (100)

Illustration with an hypothetical case

For M Sc I (or II/III/IV)

1 papers	I	II	III	IV	Practicals	I	II	III	IV
2 credits	4	4	4	4		2	2	2	2 = 24
3 grade point	7	6	8	6		7		7	= 41
Obtained									
4 $\sum c_i$ x gi	28	24	32	32		28		28	= 164

5 $\sum c_i$ x gi/cl =164/24 = 6.83

6 Overall grade = 6.83

The cumulative grade point average is the sum of SGPA of student of every semester.

Suppose it is 164(6.83) for semester- I, 170(7.08) for semester -II, 168 (7.0) for semester III and 176 (7.33) for semester IV.

The cumulative average for semester I and II will be = 334/48 = 6.958 = 6.96

Final grade point average for all semesters = 678/96 = 7.0265 = 7.03

Rules for opting the credits

1. A student from same department only will be eligible for opting the specialization of the choice.
2. It will be mandatory for a student admitted for a specialization to opt for the papers related to that specialization Other papers can not be offered as credits in lieu of these papers
3. Admission to the students from the other specialization for the credits will be restricted to 5 core papers only. A student from other department will be offered credits of his choice in multiples of 4. A theory paper can be offered as the credit. However number of such admissions will depends upon the seats available class room seating capacity.
4. Any student can have credits from the management course. In order to increase the employability of the students it is necessary that add on course in management be offered by the department of management. Separate fees can be charged from the students for taking this course. Such course can be arranged during the vacation.

M. Sc. Part – I (Semester – I)

CH – 101: Inorganic Chemistry – I

UNIT-I
Wave mechanics [15]

Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, matter waves, wave nature of the electron, the wave equation, the theory of hydrogen atom, particle in one dimensional box, transformation of coordinates,

Separation of variables and their significance.

UNIT-II

Stereochemistry and Bonding in main group compounds [15]

VSEPR theory &drawbacks, Pπ– Pπ, Pπ–dπ and dπ– dπ bonds, Bent rule, Hybridization involving f-orbital energies of hybridization, some simple reactions of covalently bonded molecules.

Unit-III [15]

a) Chemistry of transition elements (10)

General characteristic properties of transition elements, co-ordination chemistry of transition metal ions, stereochemistry of coordination compounds, ligand field theory, splitting of d orbitals in low symmetry environments, Jahn- Teller effect, Interpretation of electronic spectra including charge transfer spectra, spectrochemical series, nephelauxetic series, metal clusters, sandwich compounds, metal carbonyls

b) Bioinorganic Chemistry (05)

Role of metal ions in biological processes, structure and properties of metalloproteins in electron transport processes, cytochromes, ferrodoxins and iorn sulphur proteins, ion transport across membranes, Biological nitrogen fixation, PS-I, PS – II, Oxygen uptake proteins.

UNIT-IV

Electronic, Electric and Optical behaviour of Inorganic materials [15]

Metals, Insulators and Semiconductors, Electronic structure of solid, band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, the band gap, temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, synthesis and purification of semiconducting materials, single crystal growth, zone refining, fractional crystallization, semiconductor devices, rectifier transistors, optical devices, photoconductors, photovoltaic cells, solar batteries.

Recommended Books:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
2) J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
3) J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London
4) A. R. West, Plenum, Solid State Chemistry and its applications
5) N. B. Hanney, Solid State Physics

6) H. V. Keer, Principles of Solid State
7) S. O. Pillai, Solid State Physics
8) W. D. Callister, Wiley, Material Science and Engineering: An Introduction
9) R. Raghwan, First Course in Material Science
10) R. W. Cahan, The coming of Material Science
11) A. R. West, Basic Solid State Chemistry, 2nd edition
12) U. Schubest and N. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000)
13) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
14) A. H. Hanney, Solid State Chemistry, A. H. Publications
15) O. A. Phiops, Metals and Metabolism
16) Cullen Dolphin and James, Biological aspects of Inorganic Chemistry
17) Williams, An Introduction to Bioinorganic Chemistry
18) M. N. Hughes, Inorganic Chemistry of Biological Processes
19) Ochi, Bioinorganic Chemistry
20) John Wulff, The structure an properties of materials
21) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill
22) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
23) Willam L. Jooly, Modern Inorganic Chemistry
24) Manas Chanda, Atomic Structure and Chemical bonding
25) N. N. Greenwood and A. Earnshaw, Chemistry of elements,. Pergamon
26) Chakraburty, Soild State Chemistry, New Age International
27) S. J. Lippard, J.M . Berg, Principles of bioinorganic Chemistry, University Scienc e Books
28) G. L. Eichhron, Inorganic Biochemistry, Vol I and II, Elesevier
29) Progress Inorganic chemistry , Vol 18 and 38, J. J. Loppard, Wiley

Paper –CH-102: Organic Chemistry-1
UNIT-I **[15]**

a) Reaction Mechanism: Structure and Reactivity (8)

Types of reactions, potential energy diagrams, transition states and intermediates. Hard and soft acids and bases, strength of acids and bases. Generation, structure, stability and reactivity of carbocations and carbanions.

b) Aliphatic Nucleophilic substitutions: (7)

The SN2, SN1 and Sni reactions with respects to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. Ambident nucleophiles, Neighbouring Group Participation.

UNIT-II [15]

a) Aromatic Electrophilic Substitutions: (8)

Introduction, Concept of Aromaticity, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in their ring systems. Diazo-coupling, Vilsmeir reaction, Gatterman-Koch rection, Von Richter rearrangement . Nucleophilic aromatic substitution reactions SN1, SN2.

UNIT-III [15]

a)Addition to Carbon–Carbon Multiple Bonds (7)

Mechanism and steriochemical aspects of the addition reactions involving electrophiles and free radicals, regio and chemo-selectivity, orientation and reactivity. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Michael reaction.

b) Elimination Reactions: (8)

The E1, E2 and E1cB mechanisms. Orientation in Elimination reactions.

Reactivity: effects of substrate structures, attacking base the leaving group the nature of medium on elimination reactions. Pyrolytic elimination reactions.

UNIT-IV [15]

a) Study of following reactions: (7)

Beckman, Fries, Benzilic acid, Hoffman, Schmidt, Curtius, Lossen & Benzilic acid, Witting, Neber, and Prins.

b) Stereochemistry: (8)

Concept of Chirality and molecular dissymmetry, Recognition of symmetry elements and chiral centers, Prochiral relationship, homotopic, enantiotopic and disteriotopic groups and faces. Recemic modifications and their resolution, R and S nomenclature. Geometrical isomerism E and Z. Nomenclature. Conformational analysis : cyclohexane derivatives, stability and reactivity, Conformational analysis of disubstituted cyclohexanes.

RECOMMENDED BOOKS

1. A guide book to mechanism in Organic chemistry (Orient-Longmens)- Peter Sykes
2. Organic reaction mechanism (Benjamin) R. Breslow
3. Mechanism and structure in Organic chemistry (Holt Reinh.)B. S. Gould.
4. Organic chemistry(McGraw-Hill)Hendrikson, Cram and Hammond.
5. Basic principles of Organic chemistry (Benjamin) J. D.Roberts and M. C. Caserio.
6. Reactive Intermediates in Organic chemistry (John Wiley)N. S. Issacs.
7. Stereochemistry of Carbon compounds. (McGraw-Hill)E.L.Eliel

8. Organic Stereochemistry (McGraw-Hill) by Hallas.
9. Organic reaction mechanism (McGraw-Hill) R. K. Bansal.
10. Organic chemistry- R. T. Morrison and R. N. Boyd,(Prentice Hall.)
11. Modern organic reactions(Benjumin) H. O. House.
12. Principle of organic synthesis- R.O.C. Norman and J. M. Coxon.(ELBS)
13. Reaction mechanism in organic chemistry- S. M. Mukharji and S. P. Singh.
14. Stereochemistry of organic compoundsc) D. Nasipuri.
15. Advanced organic chemistry (McGraw-Hill) J. March.
16. Introduction to stereochemistry(Benjumin) K. Mislow.
17. Stereochemistry by P. S. Kalsi (New Age International)

Paper –CH-103: PHYSICAL CHEMISTRY – I

UNIT-I

THERMODYNAMICS-I [15]

1. Introduction, revision of basic concepts. 03
2. Second law of thermodynamics: Physical significance of entropy (Direction of spontaneous change and dispersal of energy), Carnot cycle, efficiency of heat engine, coefficient of performance of heat engine, refrigeration and problems. 06
3. Maxwell relations, thermodynamic equation of state, chemical potential, variation of chemical potential with temperature & pressure. Applications of chemical potential, phase rule, lowering of vapor pressure (Rault's law) and elevation in boiling point. 06

UNIT-II

THERMODYNAMICS-II [15]

1. Ideal solutions, Rault's law, Duhem-Margules equation and its applications to vaporpressure curves(Binary liquid mixture), determination of activity coefficients fromvapor pressure measurements, Henry's law. 08
2. Nonideal solutions : deviations from ideal behaviour of liquid mixtures, liquid-vapor compositions, conditions for maximum. 07

UNIT-III [15]

KINETIC THEORY OF GASSES

1. Postulates of kinetic theory of gases, P-V-T relations for an ideal gas, non-ideal behavior of gases, equation of state, compressibility factor, virial equation, van der Waal's equation, excluded volume and molecular diameter, relations of van der Waal's constants with virial coefficients and Boyle temperature. [05]
2. Molecular statistics, distribution of molecular states, deviations of Boltzmann law for molecular distribution, translational partition function, Maxwell-Boltzmann law for distribution of molecular velocities, physical significance of the distribution law, deviation of expressions for average, root mean square and most probable velocities, experimental verification of the distribution law. [05]
3. Molecular collision in gases, mean free path, collision diameter and collision number in a gas and in a mixture of gases, kinetic theory of viscosity and diffusion. [05]

UNIT-IV [15]

COLLOIDS AND MACROMOLECULES

1. Sols, Lyophilic and lyophobic sols, properties of sols, coagulation. Sols of surface active reagents, surface tension and surfactants, critical micelle concentration. (05)
2. Macromolecu les: Mechanism of polymerization, molecular weight of a polymer (Number and mass average) viscosity average molecular weight, numerical problems. Degree of polymerization and molecular weight, methods of determining molecular (05)

weights(Osmometry, viscometry, light scattering, diffusion and ultracentrifugation) 05

3. Chemistry of polymerization: Free radical polymerization(Initiation, propagation and termination), kinetics of free radical polymerization, step growth polymerization(Polycondensation), kinetics of step polymerization, cationic and anionic polymerization.(05)

(More stress should be given to solving numerical problems)

RECOMMENDED BOOKS

1. Physical Chemistry – P. W. Atkins, Oxford University press, VIIth edition,2002.
2. Text book of Physical Chemistry – S. Glasstone
3. Principles of Physical Chemistry – Marron and Pruton
4. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.
5. Physical chemistry- G. K. Vemulapalli, Prentice-Hall of India, 1997.
5. Thermodynamics for Chemists – S. Glasstone, D. Van Nostrand , 1965.
6. Thermodynamics A Core Course- R. C. Srivastava, S. K. Saha and A. K. Jain, Prentice-Hall of India, IInd edition, 2004.
7. Physical Chemistry of macromolecules- D. D. Deshpande, Vishal Publications.
8. Polymer Chemistry- F. W. Billmeyer Jr, John-Wiley & Sons, 1971.

Paper CH-104 Analytical Chemistry –I

UNIT-I

Errors and treatment of Analytical Chemistry [15]

Errors, Determinant, constant and indeterminate. Accuracy and precision Distribution of random errors. Average derivation and standard derivation, variance and confidance limit. Significance figures and computation rules. Least square method. Methods of sampling: samples size. Techniques of sampling of gases, fluid, solids, and particulates.

UNIT-II

Chromatographic methods: [15]

General principle, classification of chromatographic methods. Nature of partition forces. Chromatographic behavior of solutes. Column efficiency and resolution.

Gas Chromatography: detector, optimization of experimental conditions. Ion exchanges chromatography. Thin layer chromatography: coating of materials, prepative TLC. Solvents used and methods of detection Column chromatography: Adsorption and partition methods. Nature of column materials.

Preparation of the column. Solvent systems and detection methods.

UNIT-III

Electroanalytical Techniques: [15]

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principals, instrumentation, nature of titration curves, and analytical applications.

UNIT-IV

Computer Science: [15]

Introduction: History etc. Hardware: Central processor unit. Input devices. Storage devices. Periferals, Software: Overview of the key elements of basic program structure, loops, arrays, mathematical function. User defined functions, conditional statements, string. Applications. Data representation, Computerized instruments system. Microcomputer interfacing

RECOMMENDED BOOKS

1. Analytical Chemistry: (J.W) G. D. Christain
2. Introduction to chromatography : Bobbit
3. Instrumental Methods of analysis (CBS)- H.H . Willard, L.L. Mirrit, J.A. Dean
4. Instrumental Methods of Analysis : Chatwal and Anand
5. Instrumental Methods of Inorganic Analysis(ELBS) : A.I. Vogel
6. Chemical Instrumentation: A Systematic approch- H.A. Strobel
7. The principals of ion-selective electrodes and membrane transport: W.E.Morf
8. Physical Chemistry – P.W.Atkins
9. Principal of Instrumental Analysis- D. Skoog and D.West
10. Treatise on Analytical Chemistry: Vol Ito VII – I.M. Kolthoff
11. Computer, Fundamentals-P.K.Sinha
12. Programming in BASIC : E. Balaguruswamy
13. Computer programming made simples : J.Maynard.

M. Sc. Part I Inorganic Chemistry Practical Course
(Practical no. 111 and 112)

1. Ore analysis – '2' ores
2. Alloy analysis – '2' (Two and three components)
3. Inorganic Preparations and purity – '4'

References:

1) A text book of Quantitative Inorganic Analysis – A. I. Vogel
2) Experimental Inorganic Chemistry - W. G. Palmer
3) The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A.R. Powell, Charles, Griffin and Company Limited

SEMISTER-I

ORAGNIC CHEMISTY PRACTICALS

A) Preparations

(One stage preparations involving various types of reactions)

1.Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.
2.Aldol condensation: Dibenzal acetone from Benzaldehyde.
3.Sandmeyer reaction: p- Chlorotoulene from p-Toluidine.
4.Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
5.Aromatic Electrophilic substitutions: Synthesis of p-Nitroaniline and p-Bromoaniline.
6.Preparation of Cinnamic acid by Perkin's reaction.
7.Knoevenagel condensation reaction

8.Coumarin Synthesis
9.Synthesis of Heterocyclic compounds.
10. Synthesis of Dyes
B)Estimations:
1.Estimation of unsaturation.
2.Estimation of formalin.
3.Colorimetric Estimation of Dyes
4.Estimation of Amino acids
(Any suitable Expt. may be added.)
REFERENCE BOOKS
1.A text book of practical organic chemistry- A. I. Vogel.
2.Practical organic chemistry- Mann and Saunders.
3.A handbook of quantitative and qualitative analysis- H. T. Clarke.
4.Organic Synthesis Collective Volumes by Blat.

M.Sc I – Semester I
Physical Chemistry Practicals

Students are expected to perform 15-20 experiments of three and half hours duration.
Experiments are to be set up in the following techniques.
1. Potentiometry:
Determination of solubility and solubility product of silver halides, determination of binary mixture of weak and strong acid etc.
2. Conductometry :
Determination of mixture of acids and relative strength of weak acids.
3 Refractometry :
Determination of molecular radius of molecule of organic compound.
4 Polarimetry :
Kinetics of inversion of cane sugar in presence of strong acid.
5 Chemical Kinetics :
Kinetics of reaction between bromate and iodide.
6 Partial Molar Volume :
Determination of PMV by intercept method, density measurements etc.
(New experiments may also be added)
Books recommended for Practicals :
1 Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)
2 Text Book of Quantitative inorganic analysis : A.I. Vogel.
3 Experimental Physical Chemistry : R.C.Das and B. Behera
4 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan
5 Experimental Physical Chemistry :V.D. Athawale and Parul Mathur.
6 Systematic Experimental Physical Chemistry :S.W. Rajbhoj and T.K. Chondhekar

M. Sc. Part-I Semester-I
Practicals in Analytical Chemistry.

Physical Chemistry Section

1) To verify Beer-Lambert's Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample colorimetrically

2) To determine the solubility of calcium oxalate in presence of KCl (Ionic Strength Effect)

3) To determine the solubility of calciuum oxalate in presence of HCl (H+ ion Effect)

(Any other experiments may be added)

Organic Chemistry Section

1 Analysis of Pharmaceutical tablets.

2 To verify the Beer-Lamberts Law and determine the concentration of given dye solution colorimetrically.

3 To estimate the amount of D-glucose in given solution colorimetrically.

4 To determine the acid value of given oil

(Any other experiments may be added)

Inorganic Chemistry Section

1 Determination of sodium from the fertilizer sample using cation exchange chromatographically.

10

2 Determination of calcium from given drug sample.

3 Determination of hardness, alkalinity and salinity of water sample

4 Separation and estimation of chloride and bromide on anion exchanger.

(Any other experiments may be added)

M. Sc. Part – I (Semester – II)

CH 201: Inorganic Chemistry – II

UNIT-I [15]

Chemistry of non – Transition elements

General discussion on the properties of the non – transition elements, special features of individual elements, synthesis, properties and structure of halides and oxides of the non – transition elements, Polymorphism in carbon, phosphorous and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes, sulphur – nitrogen compounds, peroxo compounds of boron, carbon,sulphur, structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides.

UNIT-II

a) Organometallic Chemistry of transition elements [08]

Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (Hydrogenation, hydroformylation, isomerisation and polymerisation), pi metal complexes, activation of small molecules by coordination

b) Metal – ligand equilibria in solution [07]

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of formation constants by pH – metry, spectrophotometry methods.

UNIT-III

Studies and applications of Lanthanides and Actinides [15]

Spectral and magnetic properties, use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides, Organometallic chemistry applications of lanthanide and actinide compounds in Industries.

UNIT-IV

a) Chemistry in Non- aqueous solvents [07]

Classification of solvents, properties, leveling effect, type reactions in solvents, chemistry of liquid ammonia, liquid dinitrogen tetraoxide and anhydrous sulphuric acid with respect to properties, solubilities and reactions.

b) Nuclear and radiochemistry [08]

Radioactive decay and equilibrium, nuclear reactions, Q value, cross-sections, types of reactions, chemical effects of nuclear transformation, fission and fusion, fission products and fission yield

Recommended Books:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
2) J H Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
3) J. D. Lee, Concise inorganic Chemistry, Elbs with Chapman and Hall, London
4) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
5) Jones , Elementary coordination Chemistry
6) Martell, Coordination Chemistry
7) T. S. Swain and D. S. T. Black, organometallic Chemistry
8) John Wulff, structure and properties of materials, vol – 4, electronic properties, Wiley Eastern
9) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill
10) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
11) Willam L. Jooly, Modern Inorganic Chemistry
12) Manas Chanda, Atomic Structure and Chemical bonding
13) P. L. Pauson, Organometallic Chemistry
14) H. S. Sisler, Chemistry in non – aqueous solvents, Reinhold Publishing Corporation, USA, 4th edition (1965)
15) H. J. Arnikar, Essentials of Nclear Chemistry
16) Friedlander, Kennedy and Miller, Nuclear and Radiochemistry

Paper-CH-202: Organic Chemistry-II

UNIT-I

Study of following reactions: [15]
Mechanism of condensation reaction involving enolates Mannich, Benzoin, Stobbe, Dieckmann, Diels-Alder, Robinson annulation Reimer-Tieman, Chichibabin, Baeyer Villiger oxidation

UNIT-II [15]

a) Alkylation and Acylation
Introduction, Types of alkylation and alkylating agents: C-Alkylation and Acylation of active methylene compounds and Applications. (8)
b) .Hrdroboration and Enamines : Mechanism and Synthetic Applications. (7)

UNIT-III [15]

a) Reductions: (08)
Study of following reductions- Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol, Fe in HCl.
b) Oxidation : (07)
Application of following oxidizing agents: KMnO4, chromium trioxide, Manganese dioxide, Osmium tetraoxide, DDQ, Chloranil .

UNIT-IV [15]

a) Study of Organometallic compounds: (08)
Organo-magnesium, Organo-zinc and Organo-lithium, Hg and Sn reagents; Use of lithium dialkyl cuprate their addition to carbonyl and unsaturated carbonyl compounds.
b).Methodologies in organic synthesis -ideas of synthones and retrones. Functional group transformations and interconversions of simple functionalities. (07)

RECOMMONDED BOOKS

1.Modern synthetic reactions-(Benjamin) H. O. House.
2.Reagents in organic synthesis-(John Wiley) Fieser and Fieser
3.Principles of organic synthesis-(Methuen) R. O. C. Norman
4.Hydroboration- S. C. Brown.
5.Advances in Organometallic Chemistry- (A.P.)F. C. A. Stone and R. West.
6.Organic Chemistry (Longman)Vol. I & Vol. II- Finar
7.Oxidation by-(Marcel Dekker) Augustin
8.Advanced Organic chemistry 2nd Ed. R R. Carey and R. J. Sundburg.
9.Tetrahydron reports in organic chemistry- Vol.1, No. 8.
10.Organic Synthesis-(Prentice Hall)R. E. Ireland.
11.Homogeneous Hydrogenation-(J. K.) B. R. James.
12.Comprehensive Organic Chemistry- (Pargamon) Barton and Ollis.
13.Organic reactions- various volumes- R. Adams.
14.Some modern methods of Organic synthesis-(Cambridge) W. Carruthares.

Paper-CH-203: PHYSICAL CHEMISTRY – II

UNIT-I

PHOTOCHEMISTRY [15]

Absorption of light and nature of electronic spectra, electronic transition, Frank-Condon principle, selection rules, photodissociation, predissociation, photochemical reactions: photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photochemistry of environment: Green house effect.

UNIT-II [15]

Photo physical phenomena: Electronic structure of molecules, molecular orbital, electronically excited singlet states, designation based on multiplicity rule, life time of electronically excited state, construction of Jablonski diagram, electronic transitions and intensity of absorption bands, photphysical pathways of excited molecular system(radiative and non-radiative), prompt fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance enrgy transfer between photexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisional V quenching and Stern-Volmer equation.

UNIT-III. [15]

ELECTROCHEMISTRY

1. Arrhenius theory of electrolytic dissociation (Evidences and limitations), revision of basic electrochemistry(Types of electrodes and cells). (03)
2. Electrochemical cells with and without transference, determination of activity coefficients of an electrolyte, degree of dissociation of monobasic weak acid (approximate and accurate), instability constant of silver ammonia complex. (10)
3. Acid and alkaline storage batteries. 02

UNIT-IV [15]

CHEMICAL KINETICS

Experimental methods of following kinetics of a reaction, chemical and physical (measurement of pressure, volume, EMF, conductance, diffusion current and absorbance) methods and examples. Order and methods of determination(Initial rate, Integration, graphical and half life methods), rate determining step, steady state approximation and study of reaction between NO2 and F2, decomposition of ozone, and nitrogen pentoxide. 08

2. Kinetics of complex reactions, Simultaneous (first order opposed by first order), Parallel and Consecutive reactions. Examples and numericals. 07

RECOMMENDED BOOKS

1. Photochemistry – J. G. Calverts and J. N. Pitts, John-Wiley & Sons
2. Fundamentals of Photochemistry- K. K. Rohatgi-Mukharjii, Wiley Eastern
3. Introduction to Photochemistry-Wells
4. Photochemistry of solutions-C. A. Parker, Elsevier
5. Chemical Kinetics-K. J. Laidler, pearson Education,2004
6. Electrochemistry- S. Glasstone, D. Van Nostrand , 1965

7. Advanced Physical Chemistry- Gurdeep Raj, Goel Publishing House
8. Basic chemical Kinetics- G. L. Agarwal, Tata-McGraw Hill
9. Physical Chemistry – P. W. Atkins, Oxford University press, VIIth edition,2002.
10. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.

Paper CH-204 Analytical Chemistry- II

UNIT-I **[15]**

a) Ultraviolet and visible spectrophotometry (UV-VIS) (08)
Introduction, Beer Lambert's law, instrumentation, calculation of absorption maxima of dienes, dienones and polyenes, applications.

b) Infrared Spectroscopy (IR) (07)
Introduction, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications.

UNIT-II [15]

a) Nuclear Magnetic Resonance (NMR) 8
Magnetic and non magnetic nuclei, Larmor frequency, absorption of radio frequency. Instrumentation (FT-NMR). Sample preparation, chemical shift, anisotropic effect, spinspin coupling, coupling constant, applications to simple structural problems

b) Mass spectroscopy (MS) 7
Principle, working of mass spectrometer (double beam). Formation of different types of ions, Mclafferty rearrangements, fragmentation of alkanes, alkyl aromatics, alcohols and ketones, simple applications, simple structural problems based on IR, UV , NMR and MS

UNIT-III
a) Nephlometry and Turbidometry (07)
Introduction, Theory, Instruments, working and Applications

b) Radiochemical Analysis, NAA: Scintillation counter and G.M. Counter (08)

UNIT-IV
a) Atomic Absorption Spectroscopy (10)

Introduction, Principal, difference between AAS and FES, Advantages of AAS over FES, advantages and disadvantages of AAS. Instrumentation, Single and double beam AAS, detection limit and sensitivity, Interferences applications.

b) Inductively coupled Plasma Spectroscopy (5)
Introduction, Nebulisation Torch, Plasmsa, Instrumentation, Interferences, Applications

REFERENCE BOOKS

1. Instrumental Methods of analysis- Willard, Merrit, Dean and Settle.
2. Spectroscopic identification of organic compounds- R.M. Silverstein and G.C. Bassler
3. Spectroscopic methods in organic chemistry- D.H. Williams and I. Fleming
4. Absorption spectroscopy of organic molecules- V.M. Parikh
5. Applications of spectroscopic techniques in Organic chemistry- P.S. Kalsi
6. A Text book of Qualitative Inorganic Analysis- A. I. Vogel
7. Physical Methods in Inorganic Chemistry (DWAP)- R. Drago
8. Fundamentals of Analytical Chemistry – D.A. Skoog and D.M. West (Holt Rinehart and Winston Inc)

M. Sc. Part – I (Semester - II)
CH – 201: Inorganic Chemistry Practical Course
(Practical no. 211 and 212)

1. Ore analysis – ‘2’ ores
2. Alloy analysis – ‘2’ (Two and three components)
3. Inorganic Preparations and purity – ‘4’

References:

1) A text book of Quantitative Inorganic Analysis – A. I. Vogel
2) Experimental Inorganic Chemistry - W. G. Palmer
3) The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A. R. Powell, Charles, Griffin and Company Limited

SEM-II

ORGANIC CHEMISTRY PRACTICLES

1.Qualitative analysis:

Separation and identification of the two component mixtures using Chemical and physical methods.

2.Thin layer chromatography (TLC).

3.Column chromatography and steam distillation techniques.

4.Determination of percentage of Keto-enol form.

5.Estimation of pesticides

(Any other suitable experiments may be added).

REFERENCE BOOKS

1.A text book of practical organic chemistry- A. I. Vogel.

2.Practical organic chemistry- Mann and Saunders.

3.A handbook of quantitative and qualitative analysis- H. T. Clarke.

4.Organic Synthesis Collective Volumes by Blat.

M.Sc I – Semester II

Physical Chemistry Practicals

Students are expected to perform 15-20 experiments of three and half-hours duration.

Experiments are to be set up in the following techniques.

1 Potentiometery:

Determination formal redox potential of system, determination of binary mixture of halides.

2. Conductometry :

Titration of ternary acid mixture of acids, Verification of Onsagar Equation for 1:1 type strong electrolyte.

3 Refractometry :

Determination of atomic refractions of H, C and Cl atoms.

4 Cryoscopy:

Determination of apparent weight and degree of dissociation a strong electrolyte equilibrium methods.

5 Chemical kinetics:

Kinetics of iodination of acetone in presence of strong acid etc.

6 Phase Equilibrium:

Three component system etc.

(New experiments may be also be added)

Books recommended for Practicals :

1. Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)

2. Text Book of Quantitative inorganic analysis : A.I. Vogel.

3. Experimental Physical Chemistry : By F. Daniels and J. Williams

4. Experimental Physical Chemistry : R.C Das and B.Behera

5 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan

M. Sc. Part-I Semester-II

Practicals in Analytical Chemistry.

Physical Chemistry Section

1 To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.

2 Determine the solubility of lead iodide in presence of varying concentration of salt
KCl.
3 Determine the solubility of lead iodide in presence of varying concentration of salt
KNO3
(Any other experiments may be added)

Organic Chemistry Section

1 Analysis of pharmaceutical tablets: Ibrufen / INAH
2 Colorimetric estimation of drugs.
3 Preparation of pesticides.
4 Column and thin layer chromatography
(Any other experiments may be added)

Inorganic Chemistry Section

1 To determine the amount of copper in brass metal alloy colorimetrically.
2 Separation and estimation of Copper and Cobalt on cellulose Column.
4 Separation and estimation of Nickel and Cobalt on a anion exchanger.
5 Separation and estimation of Iron and aluminium on a cation exchanger.
(Any other experiments may be added)

Recommended books

1 A Text book of quantitative Inorganic Analysis – A.I.Vogel
2 Standards methods of Chemical Analysis-F.J. Welcher.
3 Experimental Inorganic Chemistry – W.G.Palmer.
4 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C.A.Moghe
5 Inorganic synthesis- King.
6 Synthetic Inorganic Chemistry-W.L.Jolly
7 EDTA Titrations –F.Laschka

M. Sc. Part-I Semester-II
Practicals in Analytical Chemistry.
Physical Chemistry Section

6 To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.
7 Determine the solubility of lead iodide in presence of varying concentration of salt KCl.
8 Determine the solubility of lead iodide in presence of varying concentration of salt KNO_3 (Any other experiments may be added)

Organic Chemistry Section

5 Analysis of pharmaceutical tablets: Ibrufen / INAH
6 Colorimetric estimation of drugs.
7 Preparation of pesticides.
8 Column and thin layer chromatography
(Any other experiments may be added)

Inorganic Chemistry Section
2 To determine the amount of copper in brass metal alloy colorimetrically.
2 Separation and estimation of Copper and Cobalt on cellulose Column.
9 Separation and estimation of Nickel and Cobalt on a anion exchanger.
10 Separation and estimation of Iron and aluminium on a cation exchanger.
(Any other experiments may be added)
Recommended books
8 A Text book of quantitative Inorganic Analysis – A.I.Vogel
9 Standards methods of Chemical Analysis-F.J. Welcher.
10 Experimental Inorganic Chemistry – W.G.Palmer.
11 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C.A.Moghe
12 Inorganic synthesis- King.
13 Synthetic Inorganic Chemistry-W.L.Jolly
14 EDTA Titrations –F.Laschka

M.Sc-II

INORGANIC

Paper No-ICH-301, INORGANIC CHEMICAL SPECTROSCOPY

Unit-I

Group Theory **[15]**

Molecular symmetry, elements of symmetry and symmetry operations, Products of operation, point group, classification of Molecules into point group, reducible and irreducible representation, the great Orthogonality theorem, character table, symmetry aspects of Molecular orbitals.

Unit-II

Electronic absorption Spectroscopy **[15]**

Term symbols, energies of atomic and Molecular transitions, Selection rule, Morse potential energy diagram, electronic transitions, polarized absorption spectra. Nature of absorption spectra, nature of absorption spectra of transition metal complexes, Orgel diagram, Tanabe Sugano diagram, charge transfer spectra.

Unit-III **[15]**

A] Infrared and Raman Spectroscopy [9]

Molecular vibrations, force constants, Molecular vibrations and absorption of Infrared radiations Raman Spectroscopy, polarized Raman lines, Use of symmetry considerations to determine the no. of lines in IR and Raman Spectra, Spectra of gases, applications of Raman and Infrared spectroscopy. Selection rule in Inorganic structure determinations, Hydrogen bonding and infrared spectra, metal ligand and related vibrations.

B] Microwave spectroscopy [6]

Basic concept, rotation spectra of simple inorganic compounds, Classification of molecules, rigid rotor model, effect of isotopic substitution on transition frequencies & intensities non rigid rotor, stark effect nuclear and electron spin interaction and effect of external field. Applications of Micro wave Spectroscopy.

Unit-IV [15]

A] Nuclear Magnetic Resonance Spectroscopy [8]

Principle Instrumentation of NMR, the chemical shift, mechanism of electron shielding and factors contributing to the magnitude of chemical shift. Local & remote effect, spin-spin splitting, applications of spin coupling to structural determination, double Resonance techniques. The contact and Pseudo contact shifts Factors affecting nuclear relaxation, an overview of NMR of metal nuclear with emphasis on 195pg & 119sm NMR.

B] Electron & Photo acoustic Spectroscopy [7]

Introduction, principle, Instrumentation and applications of following techniques photo acoustic Spectroscopy (PAS) photo electron Spectroscopy (PES), auger electron Spectroscopy (AES)

Recommended books:

1. K. Burger, Coordination Chemistry-experimental methods, Butterworth's
2. R. Drago: Physical method in Inorganic Chemistry, DUSAP.
3. Hill & Day advanced methods in Inorganic Chemistry, J.Weily
4. F.A. Cotton, chemical application of group theory, Weily eastern
5. Figgis, Introduction to ligand field theory field
6. Schaefer & Gilman: Basic principles of ligand field Theory, J. Wiely
7. P.R. Backer: Molecular symmetry and Spectroscopy A.P.
8. Ferraro Ziomeek, Introduction to Group theory, plenum
9. Soctland Molecular symmetry DVN
10. Dorian: symmetry in Chemistry EWAP
11. Hall: Group theory and symmetry in Chemistry MGLt
12. Nakamoto Infrared R Raman Spectra of Inorganic & Coordination compounds J.Weily
13. Nakanisha: Spectroscopy and structure J. Weily
14. Ferroro: Metal ligand and related vibrations
15. CNR Rao Spectroscopy in Inorganic Chemistry Vol I,II,III
16. Durie: vibrations spectra and structure Vol. I to IV, Elsevier
17. Dudd, chemical Spectroscopy Elsevier
18. Popel : H.N.M.R. Spectroscopy J.Weily
19. R.J. Abraham, J.Fisher and P Loftus Wiley Introduction to NMR spectroscopy.
20. P.K. Bhattacharya: Group Theory & Its Chemical Applications
21. K.V. Reddy: Symmetry & spectroscopy of Molecules.

Paper No. ICH-302 COORDINATION CHEMISTRY – I

UNIT-I

Theories of Metal-Ligand bonding [15]

Molecular Orbital treatment, Octahedral (with and without pi bonding) tetrahedral and square planer complexes in a qualitative manner, comparison of theories of bonding, VBT, CFT, LFT and MOT.

UNIT-II

Structural studies of coordination compounds [15]

Compounds of first transition series elements, with respect to their electronic spectra, magnetic & thermal properties (DTA, TGA)

UNIT-III

Magneto Chemistry [15]

Diamagnetic correction, single & multielectron system, types of the magnetic behaviour, Diamagnetism, Para magnetism, Ferro & Ferri, Antiferro and magnetic interaction, The origin of Para magnetism, Magnetic behavior of complexes, Simplification of Van Velck equation, magnitude of magnetic moments, Determination of magnetic susceptibility by Gouy and faraday method.

UNIT-IV [15]

A] Transition metal complexes & catalysis [8]

Introduction, General Principle, catalysis by transition metal complexes, Hydrocarbons Oxidation by Molecular oxygen, olefin Oxidation, olefin polymerization, olefin hydrogenation, Arene reactions catalyzed by metal complexes, catalysis of condensation polymerization reaction, Current and feature trend in catalysis.

B] Mixed Ligand complexes [7]

Stabilities of ternary complexes, Dynamics of formation of ternary complexes reaction of Coordination ligand in ternary complexes, Mimicking reactions in biological systems, enzyme models, Amino acids ester hydrolysis, peptide synthesis & hydrolysis, Detarbodylation of B keto acids

Recommended Books.

1. Jones: Elementary Coordination Chemistry. J. Weily
2. Graddon: Introduction to Coordination Chemistry. J. Weily
3. Drago: Physical methods of Inorganic Chemistry. J. Weily.
4. Graddon: Introduction to coordination Chemistry, Parasmom
5. Lewis and Wilkins: Coordination Chemistry. J. Weily
6. Msrtel: Coordination Chemistry Vol I, II VNR
7. Earnshaw: Introduction to Magneto Chemistry
8. Mabbs & Machin Magnetism & transition metal complexes Chamman hall
9. Calvin, Magnetic properties of transition metal complexes.
10. L.N. Maley: Magneto Chemistry
11. Datta & Shymlal Elements of Magneto Chemistry
12. Martel & Taqui Khan: homogeneous catalysis with metal complexes Vol.I & II AP.
13. James E. Huheey: Inorganic Chemistry Principles of Structure and reactivity, Harber & Row, Publishers Inc. New York 1972.
14. K.P. Purcell & J.C. Kote: An Introduction to Inorganic Chemistry Holt Sounders, Japan 1980.
15. William L. Jolly: Modern Inorganic Chemistry, Mecgrow Hill USA,1984
16. F.A. Cotton & R.G. Willkinson: Advanced Inorganic Chemistry.

Paper No. ICH 303 NUCLEAR CHEMISTRY

UNIT-I

Systematic of alpha, beta and gamma decays [15]

Alpha decay, energy curve, spectra of alpha particles, Giger-Nuttal law, theory of alpha decay, penetration of potential barrier, beta decay, range of energy relationship, beta spectrum, sergeants curve, Fermi theory of beta decay, matrix elements, allowed and forbidden transitions, curie plots, gamma decay, Nuclear energy levels, selection rule, isomeric transitions, Internal conversion, Auger effect.

UNIT-II

Nuclear Structure and Stability [15]

Binding energy, empirical mass equation, The nuclear models, the liquid drop model, the shell model, the Fermi gas model & collective nuclear model, nuclear spin, parity & magnetic moments of odd mass numbers nuclei.

UNIT-III [15]

A] Nuclear reaction. [8]

Introduction, Production of projectiles, nuclear cross section, nuclear dynamics, threshold energy of nuclear reaction, Coulomb scattering, potential barrier, potential well, formation of a compound nucleus, Nuclear reactions, direct Nuclear reactions, heavy ion induced nuclear reactions, photonuclear reactions.

B] Nuclear fission [7]

Liquid drop model of fission, fission barrier and threshold, fission cross section, mass energy and charge distribution of fission products, symmetric and A symmetric fission, decay chains and delayed neutrons.

UNIT-IV [15]

A] Reactor Theory - [10]

Nuclear fission as a source of energy, Nuclear chain reacting systems, critical size of a reaction, research reactors, graphite moderated, heterogeneous, enriched uranium reactors, light water moderated, heterogeneous, enriched uranium reactors, water boilers enriched aq. Homogeneous reactors, Thermonuclear reactors, gamma interactions, shielding and health protection. Reactors in India.

B] Nuclear Resources in India [5]

Uranium and Thorium resources in India and their extractions, Heavy water manufacturing in India.

Reference Books.

1. Friedlander, Kennedy and Miller, Nuclear and Radio Chemistry: John Wiley
2. B.G. Harvey, Nuclear Chemistry
3. Hassinsky: Translated by D.G. Tuck, Nuclear Chemistry and its application: Addison Wiley
4. B.G. Harvey, Introduction to Nuclear Physics and Chemistry
5. Maeclefort: Nuclear Chemistry: D.Van Nostrand
6. An N.Nesmeyannoy: Radiochemistry: Mir
7. Jacobs et al: Basic Principles of nuclear Science and Reactors, V.Nost & EWAP
8. N.Jay: Nuclear Power Today Tomorrow: ELBS
9. Kenneth: Nuclear Power Today, Tomorrow: ELBS
10. Essentials of Nuclear Chemistry, W.J. Arnikar, John Wiley
11. Nuclear and Radiation Chemistry: B.K. Sharma, Krishna Publication
12. A Introduction to Nuclear Physics: R. Babber. And Puri

Paper ICH 304A ENVIRONMENTAL CHEMISTRY

UNIT-I **[15]**

A] Air Pollution **[8]**

Sources and sinks of gases pollutants, classification & effects of air pollutants on living and nonliving things, Air pollution problems in India, pollution problems in industrial area, global air pollution problems, green house effect, acid rain, ozone depletion and their consequences on Environment. Major air pollution disasters.

B] Water pollution **[7]**

Types, sources and classification of water pollutants, Industrial water pollution, constituents of aquatic Environment, oxygen contents of water and aquatic life, oxygen electrode, and its use, mercury pollution and estimation of organomercurials, industrial water, Effects of water pollutants on life and Environment.

UNIT-II **[15]**

A] Method of control of air pollution **[8]**

Method of control of air pollution, electrostatic precipitation wet & dries scrubber, filters, gravity and cyclonic separation, Adsorption, absorption and condensation of gaseous effluent

B] Method of control of water pollution **[7]**

Water and waste water treatment, aerobic and anaerobic, aeration of water, principle of coagulation, flocculation, softening, disinfection, demineralization and fluoridation.

UNIT-III **[15]**

Sampling & analysis of air and water pollutants.

a) Methods of sampling gaseous, liquid and solid pollutants, analysis of CO, CO_2, NO_2, SO_2,H_2S,CO_2, analysis of toxic heavy metals, Cd, Cr, As, Pb, Cu, Separation of Co, Cu, Mg, Mn, Fe, analysis of
SO_4^{-2} P_4^{3-}, NO_3^-, NO_2^-, analysis of total cationic and anionic burdens of water.

b) Pesticide, residue analysis soil pollution, Sources of pesticides residue in the Environment, pesticides degradation by natural forces, effect of pesticide residue on life, Analytical techniques for pesticides residue analysis.

UNIT-IV **[15]**

A] Radiation pollution-classification & effects of radiation, effects of ionizing radiation on man, Effects of non ionizing radiation on life, radioactivity and Nuclear fall out, protection and control from radiation.

B] Environmental toxicology

Chemical solutions to environmental problems biodegradability, principles of decomposition better industrial processes, Bhopal gas tragedy, Chernobyl, three mile island, sewozo and minamata disasters.

Reference Books:

1. Environmental Pollution, A.K. De
2. Air Pollution, Wark & Werner
3. Environmental Pollution Control in Process Industries, S.P. Mahajan
4. Environmental Pollution, B.K. Sharma & H.Kaur
5. Introduction to Air Pollution, P.K. Trivedi
6. Environmental Pollution Analysis, S.M. Khopkar
7. A Text Book of Environmental Pollution: D.D. Tyagi, M. Mehre
8. Environmental Pollution Engineering and Control, C.S. Rao
9. Chemical in the Environment, Satake & M. Midu
10. Environmental Sciences, E.G. Engel
11. Environmental Chemistry, B.K. Sharma & H.Kaur

Paper No ICH 304B Bioinorganic Chemistry

UNIT-I

Metals in Life Processes **[15]**

Na-K-charge carriers & osmotic pressure, relation to sensitivity of nerves and control on muscles, Mg-Ca complexes with nucleic acid, nerve impulse transmission, trigger reaction, Mn, Fe, Co, Cu, Mo, ferridoxins, Zn-super acid catalysis.

UNIT-II

A] Oxygen Carrier Systems **[8]**

Structure and mechanism of hemoglobin, vitamin B12, B12 co-enzyme myoglobin, synthesis of oxygen carriers.

B] Photosynthesis **[7]**

Complexes of prophyries porphysins ring complexes, redox mechanism.

UNIT-III

A] Nitrogen Fixation **[8]**

Nitrogen in biosphere, nitrogen cycle, nitrification role of microorganisms, nitrogen fixation in soils

B] Metal poisoning and drug action of Inorganic complexes compounds **[7]**

Metal poisoning, treatment by using chelating agent, mercury, lead & cadmium poisoning & treatment. Platinum complexes in treatment of cancer, metal deficiency and use of metal chelates.

UNIT-IV

A] Trace Metals in Plant Life **[8]**

Micronutrients in soil, role of micronutrients in plant life

B] Biogeochemistry **[7]**

Biodegradation of minerals bacteria leaching and its applications.

Recommended Books:

1. Eichhorn: Inorganic Biochemistry : Vol I , 2 Elsevier
2. Ochiai: Bioinorganic Chemistry: Allyn & Bacon Burton
3. Williams: an Introduction to Bioinorganic Chemistry, C.C. Thomos Spring III
4. Wallace: Decade on synthetic chelating agent in Inorganic plant nutrition, Wallace
5. Williams: Metals in Life
6. Zagic: Microbial Biogeochemistry, Academic press
7. Ahuja: Chemical Analysis of the Environment, Plenum press

Paper No ICH304C Selected topics in Inorganic Chemistry

UNIT:I

1. Catalysis **[15]**

a) Basic principles, thermodynamics and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous & heterogeneous catalysis, reaction catalyzed by transition metal complexes and Organometallic compounds, Mechanism

of reaction viz. Hydrolysis, polymerization, esterification, hydrogenation, ammonia synthesis, sulpur dioxide Oxidation.

b) **Zeolites**, synthesis of different zeolites, characterization, determination of surface acidity, shape, selectivity and application.

UNIT-II **[15]**

Inorganic Polymers

Classification, types of Inorganic polymers, Chemistry of following polymers a) Silicones b) phosphonitric halides c) condensed phosphates d) coordinated polymers e)silicates f) Isopoly & heteropoly acids

UNIT-III

Non conventional sources of energy **[15]**

a) Alternate source of energy

Solar sources: Photochemical methods, thermodynamic efficiency of energy conversion, energy from solar radiations, transition metal complexes for energy production, solar hydrogen system, photochemical processes at semiconductors electrodes, photo galvanic & Photovoltaic cells based on Inorganic photochemical systems.

b) Geothermal energy

c) Energy from biogas sources

d) Tidal wind sources

e) Energy from fission and fusion reaction.

UNIT-IV

Fertilizers **[15]**

Classification of fertilizers, nitrogen fertilizers, phosphate fertilizers, NPK fertilizers, H3PO3 production without using H2SO4, position of fertilizer Industries in India.

Recommended Books:

1. Heterogeneous catalysis 2nd edn., Bond C. Chapman all (1987)
2. The application & Chemistry of catalysis by suitable transition metal complexes Parashall. W. Weily N. 1980.

3. Homogeneous transition metal catalysis, A general art, Masters C. Chapmann and Hall, London 1981.
4. Introduction to the principles of heterogeneous catalysis, Thomas J.M., Thomas W.J. Academic press N.Y. 1967
5. Inorganic polymers: Mark J.F., Allock H.R. West, Prentice hall
6. Inorganic polymers: Ring N.H., Academic Press N.Y. 1978
7. The Inorganic heterocyclic chemistry of sulphur, nitrogen, phosphorous, Heal A.G. Aca, Press N.Y. 1980.
8. Solar energy Principles of thermal collections and storage, Sukhatme S.P., Tata Macgrow Hill New Delhi 1984.
9. Fuel Cells, Bockeris JOM, Sriniwasan S. and Mac grow Hills 1969
10. Solar Energy Rai C.D.
11. Energy Resources, Simon A.L. 1975
12. Direct Energy Conversion, Addison Wesley, 1970, All M and Kottani S.
13. Outlines in Chemical Technology Vol I, S.D. Sukla & Pandey G.N.

M.Sc. II Practical Courses SEM - III, Inorganic Chemistry Course ICH - 311 & ICH 312

1. **Ore Analysis - 3**
2. **Alloy Analysis - 3**
3. Preparation of coordination complexes
4. Ion exchange study of separation of mixtures & estimations
5. Spectrophotometry
6. Separation & estimation of ions using ion exchange chromatography
7. Nephelometry
8. Potentiometry
9. Conductometry
10. Thermal analysis
11. Magnetic properties of transition metal complexes
12. Spectro Fluorimetry
13. Solvent extraction
14. Nuclear chemistry
15. Soil analysis
16. Data analysis

SEMESTER-- IV

Paper No. ICH - 401, Instrumental Techniques

UNIT-I **[15]**

X-ray & neutron diffraction

a) Fundamentals of x-ray diffraction

Theory of x-ray diffraction, diffraction of x-rays by crystals, determination of crystal structure (powder as well as single crystals), Instrumentation, determination of lattice parameters, x-ray intensity calculations and application of x-rays

b) Introduction to neutron diffraction, theory, Instrumentation and application.

UNIT-II

Thermal method of analysis **[15]**

Thermogravimetriy [TG], differential thermal analysis [DTA], differential Scanning calorimetric [DCS], Thermo mechanical analysis [TMA] Instrumentation and application, thermometric titrations.

UNIT-III **[15]**

Mossbaur Spectroscopy

Introduction to Mossabaur effect, recoilless emission & absorption of x-rays, Instrumentation, isomer shift, Quadrapole splitting and hyperfine interactions, application of Mossbaur effect to the investigations of compounds of iron and tin .

UNIT-IV [15]

A] Electron spin Resonance [ESR] [8]

Principles of ESR, hyperfine splitting in simple systems, Instrumentation, factors affecting G values, applications to inorganic complexes.

B] Nuclear Quadra pole Resonance Spectroscopy [NQR] [7]

Introduction, effects of magnetic field on the spectra, relation between electric field gradient and structure, application of NQR.

Recommended Books:

1. Elements of x-ray diffraction, B.DCullity, Addison Wisley, 1967.
2. Diffraction Method, Wormald, Oxford University, Press, 1973
3. Standard Method of Chemical Analysis IIIA6th end.
4. Neutron Scattering in Chemistry, Baun, G.E. Butleworth, London, 1971.
5. Mossbaur Spectroscopy, Greenwood N.N., Gibbs T.C., Chapmann Hall, 1971.
6. Chemical Application of Mossbaur Spectroscopy, Goldanski V.I & Harber R.H., Academic Press 1968.
7. Spectroscopy in Inorganic Compounds CNR Rao & Ferraro G.R., Academic Press, 1970.
8. Basic Principles of Spectroscopy Cheney R.Mac Grows Hill, 1971.
9. Thermal Method, Wendlandt, W.W. John, Wiley, 1986.
10. Principles of Instrumental analysis, Skoog, III rd edn., Sounders, 1985/

Paper No. ICH-402 CO-ORDINATION CHEMISTRY-II

UNIT-I [15]

A] Classification of Inorganic reactions, reaction intermediates, order of a reaction and reaction mechanism techniques to follow rate of reactions, liability of complexes and crystal field interpretation.

B] Substitution reaction, reactions of transition metal complexes, kinetics and mechanism of substitution reactions of octahedral complexes, acid hydrolysis, base hydrolysis, kinetics and mechanism of substitution reaction.

UNIT-II [15]

A] Stereo chemical aspects of substitution reaction of Octahedral Complexes, Stereochemical changes in dissociation (SN^2) and displacement (SN^2) mechanism through various geometries of coordination compounds. Isomerization and r-acemization reactions in octahedral complexes.

B] Substitution reaction of labile transition metal complexes

General discussion of some of the metal complexes, the effect of other bonded liquids on rate, reaction in nonaqueous solvents.

C] Mechanism of atom and electron transfer reactions

Key ideas concerning electron transfer, outer sphere electron transfer and inner sphere electron transfer two electron transfer, $[Co(CN)_5]_3$ A redox & catalytic reagent.

UNIT-III [15]

Photochemistry

Photochemistry of Coordination compounds, electronically exited states of metal complexes, types of photochemical reactions, substitution reactions, rearrangement reactions, redox reaction, and photochemistry of metallocene.

UNIT-IV [15]

Optical rotation and circular dichroism (CD) curves, their use in Coordination Chemistry, principles, optically active molecules, optically rotatory dispersion, circular dichroism, fundamentals, relationship between optically rotatory dispersion (ORD) and circular dichroism (CD) curves.

Recommended Books:

1. F.Basolo & R. Pearsons: Mechanism of Inorganic Reactions: A Study of Metal Complexes in Solution.
2. Obe, M.L. Inorganic reaction mechanism, Nelson, London, 1972.
3. Taube, electron transfer reactions of metal complex ions is solution. Academic Press, 1970.
4. E.S. Tould, Inorganic Chemistry
5. K.F. Purcell & J.C. Kotz, An Introduction to Inorganic Chemistry, Holt Sounder, Japan.
6. V. Balzani & V. Cavassiti, Photochemistry of Coordination compounds, AP, London, 1970.
7. K. Burger, Coordination Chemistry Experimental Methods, Butterworths's
8. K.K. Rastogi & Mukharjee, Fundamentals of photochemistry, Wiley eastern
9. J.G. Calverts & J.N. Pits, Photochemicals of Photochemistry, John Wiley
10. Wells, Introduction to Photochemistry.

Paper No ICH: 403 Chemistry of Inorganic Materials

UNIT-I [15]

A] Lattice Defects [8]

Introduction to types of Solids, Perfect & imperfect crystals, point defects, Line defect and plane defect defect (definition & explanation of meaning) order & disorder phenomena, thermodynamics of Schottky & frenkel defect formation, Determination of defect, Nonstiochiometric defect (structural and thermodynamic aspects) incorporation of stiochometric excess of defects, thermodynamics of Nonstiochiometric phases.

B] Synthesis of Inorganic materials [7]

Synthesis of solid state materials using different techniques ceramic techniques, co precipitation techniques, sol gel techniques, precursor techniques, high temperature & high pressure synthesis.

UNIT-II [15]

A] Ionic Conductors

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps, vacancy mechanism, diffusion, super ionic conductors, phase transition & mechanism of conduction in super ionic conductors, examples and applications of ionic conductors.

B] Electronic properties of materials

a) Organic semiconductors, examples, properties and application
b) Superconductivity, superconductivity in metals, alloys and ceramics materials (mixed oxides) BCS theory, Meissner effect, type I & II superconductors, application Fullerenes as superconductors.

c) Dielectric polarization: piezoelectricity and Ferro electricity.
d) Lasers and Masers actions, laser production and application.

UNIT-III **[15]**

A] Magnetic properties of Materials

Introduction, Magnetization, Electron spin and magnetic moment, Theory of diamagnetism, langevins theory & paramagnetic susceptibility of solids, ferromagnetism, Domain theory. Hysteresis in magnetism, ferrimagnetisms (ferries) Applications of magnetic materials.

B] Magnetic Materials

I] Structure and Properties of i) Metal and Alloys ii) Transition metal Oxides iii) Spinels iv) Ilmenites v) Perovskite and vi) Magneto-plumbites. II] Hard and Soft magnetic materials , hysteresis loop and their application in transformer cores, magnetic bubble memory devices for information storage and permanent magnets III] Spin glasses: Formation and characteristics.

UNIT-IV **[15]**

A] Advanced Inorganic Materials **[8]**

Nanotechnology and its business applications, Introduction to nanoscale, Potential applications of nanomaterials, Challenges and opportunities scope of nanotechnology, Commercialization scope Nanotechnology research in 21st century, Basic nanotechnology science and chemistry concepts, basic nanostructures , nanocomposites, Thin films, nanofoam, nanoclusters, smart nanostructures, manufacturing techniques of nanomaterials.

B] Glass, ceramics, Refractory materials **[7]**

Glassy states, Glass formers and glass modifiers, applications, ceramic structures, mechanical properties, clay products, refractory characterization, properties.

Recommended Books

1. Solid State Chemistry: A.H. Hanny
2. C.N.R. Rao, Solid State Chemistry : Dekker
3. Wilcox : Preparation and Properties of Solid State Materials: Vol I & II, Dekker
4. Hagenmuller, Preparative Methods in Solis State Chemistry
5. Lohn Wulff, The Structure and Properties of Materials Vol. IV, Electronic Properties (Wily Eastern)
6. N.N. Greenwood: Ionic Crystals, Lattice Defects and Nonstiochiometry (Butterworth's)
7. L.V. Azoroof and J.J. Brophy: Electronic Processes in Materials, MacGraw Hills.
8. T.J. Rey et al : The Defect Solid State (Interscience)
9. E.A. Kroger, Chemistry of Imprefect Crystals (Holland)
10. A.R. West, Solid State Chemistry
11. H.V.K Keer, Principles of the Solid State Chemistry, Wiley Eastern.
12. S.O. Pillai Academic press: Solid state physics

Paper No. ICH 404 A Separation Science

UNIT-I [15]

Solvent Extraction Separation

Principles of solvent extraction, formation of metal complexes, distribution of extractable species, quantitative treatment of extractable equillibria, Methods of extraction, techniques in extraction, application of diketone, hydroxyquinoline, oximes, dithiocarbamates, xanthets, thiols, macrocyclic polythenes and orgao phosphouous compounds in solvent extraction. Separation of nonmetals and metals.

UNIT-II [15]

Chromatographic separation techniques

Extraction chromatography, theoretical aspects of extraction chromatography, correlation between solvent extraction and extraction chromatography, techniques in extraction chromatography, chromatographic inert support, stationary phases, use of extraction chromatography for separation of fission products.

UNIT-III [15]

1. Ion exchange separation

Fundamental properties of ion exchangers, theories of ion exchange, exchange capacity, screening effect, penetration of electrolytes into the ion exchange resins, sorption of complex ions, ion exchanges equilibrium, column operation, theory of break through curves, elution steps, use of non aqueous solvents in one exchange separation, application of ion exchange separation in determination of total salt concentration, removal of interfering ions, separation of anions and metals.

UNIT-IV [15]

A] Separation by electrolysis [8]

Basic principles, over potentials, electrogravimetry, constant current electrolysis, separation with controlled electrode potentials, constant voltage electrolysis, potential buffers, and physical characteristics of metal deposits, internal electrolysis, electrography, electrophoresis, and electro chromatography.

B] Gas Chromatography [7]

Principles of gas chromatography, plate theory of gas chromatography, Instrumentation for gas chromatography, working gas chromatography, application of gas chromatography, programmed temperature chromatography, flow programming chromatography, gas-solid chromatography, and hyphenated techniques in chromatography Problems.

Recommended Books:

1. Solvent extraction in analytical A chemistry by G.H. Morrison, F. Frieiser, John Wiley & Sons, NY.
2. Ion exchange and solvent extraction of metal compounds by Y. Macros, A.S.Kertes, Wiley, Interscience.
3. Solvent extraction Chemistry, Selkine and alegagawa.
4. O.Samuelson, Ion exchange separation in Analytical Chemistry, J.Wiley & Sons.
5. A.I.Vogel, A Text Book of quantitative Inorganic Analysis, Longmann Green.
6. D.A. Skoog & D.M. West, Fundamentals of Analytical Chemistry - Holy Rinchart.
7. G.W. Ewing, Instrumentation Methods of Chemical Analysis, McGraw Hills.
8. S.M. Khopkar, Basic Concepts of Analytical Chemistry.
9. D. Ambrose and B.A. Amborse, As chromatography.

Paper No. CHI 404B, Radiation Chemistry

UNIT-I **[15]**

A] Isotopes

Isotope separation, thermodynamic and kinetic isotope effects, isotope exchange reaction kinetics, determination of exchange rate constant, production of radio isotopes.

B] Biological effects of Radiation.

Introduction, genetic and somatic effect on human being, effect of radiation on plants and aquatic Environment

UNIT-II **[15]**

Radiochemical Separation

The need of radiochemical separation techniques, carrier techniques, isotope and nonisotopic carriers, co precipitation and adsorption, ion exchange, solvent extract, electrolytes behavior of carrier free tracer radionuclide.

UNIT-III **[15]**

Principle of tracer chemistry

Application of tracers in physiochemical studies, diffusion studies, isotopic and exchange reactions, tracer in the study of the mechanism of the inorganic chemical reaction, atom transfer & electron transfer mechanisms. Heterogeneous catalysis and surface area measurements, radio carbon dating, tracer studies with tritium, application in metallurgy and preservation of food, geochemical application and hot atom chemistry.

UNIT-IV

Radiation detection and measurements. **[15]**

Ionization current measurements, multiplicative ion collector, methods not based on ion collection, auxillary Instrumentation and health physical instruments and counting staticsits.

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Recommended Books.

1. Friendlander, Kennedy & Miller, Nuclear and radio Chemistry, ohm Wiley.
2. B.G. Harvey, Nuclear Chemistry.
3. Haissinsky, Translated by D.G. Tuck, Nuclear physics and Chemistry.
4. Mark lefort, Nuclear Chemistry, D.V. Nostrand.
5. An N.Nesmeyanov, Radiochemistry, Mir.
6. Jacobs, et al, Basic Principles of nuclear science and reactors, V.Nost, EWAP.
7. N.Jay, Nuclear power, today tomorrow, ELBS.
8. Kenneth, Nuclear power, today and tomorrow, ELBS.
9. Essentials of Nuclear Chemistry, J.Arnikar, John Wiley.
10. D.C. Dayal, nuclear physics.

Paper No. C 404C Organometallic Chemistry.

UNIT-I [15]

A] Methyl derivatives of metals [8]

Structures, bonding, classification of methyl derivatives of metals, cleavage of metal carbon bonds, thermochemical consideration.

B] Catalytic processes [7]

Carbonylation, hydrogenation, isomerisation of olefins, olefin oxidation, oligomerization, polymerization.

UNIT-II [15]

Organometallic synthesis

Radicals + metals, carbonyls, olefins complexes, addition of metal hydrides to unsaturated carbons,, addition of metal alkyls to unsaturated hydrocarbons, substitution reactions, Hydrocarbons + metal Organometallic + metal, mettalation, metal halogen exchange reactions, Mercuration & related covalent metallation reactions of Organometallic compounds with metal salts, reactions of bimetallic compounds and halides, ligand exchange reactions of diazoalkanes with metal hydrides and halides, addition of M-OR to C=c, electrolyte reduction using metal cathode, decarboxylation.

UNIT-III [15]

A] Properties of reactions of Organometallic compounds [8]

Complex formation, reactions with active oxygen compounds, reactions with halogen, reactions with alkyl halides, acid halides, reactions with oxygen, carbonyls and others.

B] Metal carbonyls, isocyanides and acetyl ides. [7]

Preparation, structure, reactions of metal carbonyls with alkyl halides, reactions of metal carbonyls with metal alkyls, cyanides and isocyanides complexes, acetalynide complex adduct formation. Complexes: 2,3,4,5,6 and 7 electron donor carbametallic compounds, aromaticity of cyclopentadienyls.

UNIT-IV

.Techniques of Organometallic Chemistry [15]

Methods of synthetic chemistry, vacuum techniques, inert atmosphere, nonaqueous media, handling and hazards of organ metallic.

Recommended books.

1. Paulson, Organometallic Chemistry -Arnold.
2. Rochow, Organometallic Chemistry - Reinhold.
3. Zeiss, Organometallic Chemistry - Reinhold.
4. Advances in Organometallic Chemistry A.P.

Practical Course Sem -IV
PR (I) 411 & PR (I) 412A)

1. Ore analysis (Three)
2. preparation of coordination compounds(Three) and preparations of mixed metal oxides (two)
3. Ion exchange chromatography; separation of multicomponent mixtures
4. Solvent extraction
5. Spectrophotometry
6. Ph Metry
7. Conductometry
8. Polarography
9. Electrogravimetry
10. Nuclear and radiochemistry

B) Interpretation exercises

1. X-ray powder diffraction analysis of cubic compound

a. Determination of lattice constants and geometry
b. Partical Size
c. Density

2. Interpretation of Mossbaur spectrum with reference to determination of a) isomer shift b) quadruple splitting c) Internal magnetic field d) general comment
3. Interpretation of IR spectrum with reference to stretching vibration 0-2 C=N, C=O, N-, M-O
4. Interpretation of NMR spectrum with reference to calculation of chemical shifts and general comments.
5. Interpretation of absorption spectra for

a. Verification of position of ligands in spectrochemical series.
b. Determination of gemetry (Octahedral, square planer, tetrahedral) of a given compound.
c. Calculation of spectral splitting parameters.

6. Interpretation of polar gram for determination of half wave potentials and unknown concentration.
7. Calculation of band gap of semiconductors with the help of plots of log & vs. 10 3/4.

In all 20 experiments with at least five expts in each course should be completed. Addition of new expts in place of existing one may be allowed. A veriety of small projects designed by by teacher based on the interest of ttu stule and capabilities should be worked out. Project work and the review report will be examined by internal and external examiners.

M.Sc- II

Paper No. OCH-301.

Organic reaction mechanism

UNIT-I. Methods of determining reaction mechanism: [15]

Kinetic & non-kinetic methods of determining reaction mechanism. Hammet equation & Taft equations.

UNIT-II. Reactive Intermediates: [15]

Carbenes, nitrenes, arynes reactions, Phosphorous, nitrogen and sulphur yields, methods of generation and reactivity and applications. Non-classical carbocations.

UNIT-III

Study of following reaction: [15]

Mechanism, Stereochemistry, migratory aptitude, (application using complicated example): Favorskii, Baeyer-Villiger, Chichibabin, Dienone –Phenol , Pinacol- Pinacolone, Suzuki Coupling, Wolff, Smile's & Michael reactions

UNIT-IV Photochemistry: [15]

Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions, phtodissociation gas phase photolysis, photochemistry of alkynes, intramolecular reactions of the olefinic bonds, geometrical isomerism, cyclisation reactions, rearragements of 1,4 and 1,5 dienes, photochemistry of carbonyl compounds, intramolecular reactions of carbonyl compounds saturated cyclic and acyclic α,β unsaturated compounds, cyclohexadinones, intermolecular cycloaddition reactions, dimerisation and oxitane formation, photochemistry of aromatic compounds, miscellaneous photochemical reactions, photo fries reactions of anilides, photo fries rearrangements. Singlet molecular oxygen reactions, photochemistry of vision.

Books suggested:

1.A guide book to mechanism in organic chemistry
(orient- Longmans)- Peter Sykes
2.Organic Reaction Mechanism (Benjumin)- R. Breslow
3.mechanism and structure in Organic Chemistry
(Holt Reinhartwinston)- B. S. Gould
4.Organic chemistry (McGraaw Hill)- Hendrikson, cram and Hammond

5.Basic principles of organic chemistry (Benjamin)
J. D. Roberts and M. C. Caeserio.
6.Reactive intermediates in organic chemistry, (J. Wiley) N. S. Issacs.
7.Organic reaction mechanism (Mc Graw Hill) R. K. Bansal
8.Fundamentals of photochemistry K. K. Rohtagi- Mukherji Wiley- Eastern
9.Essentials of molecular photochemistry, A. Gilbert and J. Baggott. Blackwell Scientific Publication.
10.Molecular photochemistry, N.J. Urro, W. A. Benjamin
11.Introductory photochemistry. Cox and T. Camp Mc Graw –Hill
12.Photochemistry R.P. Kundall and A. Gilbert. Thomson Nelson.
13.Organic photochemistry J. Coxon and B. Hallon Cambridge University press.

Paper No. –302
Advanced Spectroscopic methods

UNIT-I

a) Ultraviolet Spectroscopy **6**

Woodward- Fisher rules for conjugated dienes and carbonyl compounds; Calculation of λ max. Ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

b) IR Spectroscopy **9**

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; lactams and conjugated carbonyl compounds] Effect of hydrogen bonding and solvent effect on vibrational frequencies; overtones; combination bands and Fermi resonance. FT-IR of gaseous; solids and polymeric materials

UNIT-II NMR Spectroscopy **15**

General introduction and definition; chemical shift; spin –spin interaction; shielding mechanism of measurement; chemical shift values and correlation for protons bonded to carbons [aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols; enols; acids; ammines; amides and mercapto]; 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

Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect. Fourier transform technique; nuclear overhauser effect [NOE] Resonance of other nuclei – F; P.

UNIT-III Mass Spectrometry **15**

Introduction, ion production- EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, nitrogen rule. High-resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

UNIT –IV **[15]**

a) Carbon-13 NMR Spectroscopy **6**

General considerations; chemical shift [aliphatic; olefinic; alkyne; aromatic; heteroaromatic and carbonyl compounds]; problems associated with ^{13}C, FT-NMR, proton decoupled off resonance.

b) Structural problems based on combined spectroscopic techniques. **9**

Books suggested.

1.V.M. Parikh, Application spectroscopy of organic molecules. (Mehata)
2. D.W. Williams and Flemming, Spectroscopic methods of organic compound.
3. Silverstein and Basallar, Spectroscopic identification of organic compounds V.M. Parikh ORPTION SPECTROSCIPY OF ORGANIC MOLECULES (J. Wiley)
4. P.S. Kalsi Spectroscope of organic compounds (New age publisher)
5. J.R. Dyer. Application of absorption spectroscopy of organic compounds.
6. Jackman and Sterneil , Application of NMR spectroscopy
7. J.D. Roberts, Nuclear magnetic resonance (J. Wiley)
8. Jafee and Orchin, Theory and application of U.V,
9. K. Benjamin. Mass spectroscopy
10. Beynon J H et.al , The mass spectra of organic molecules.
11. Wehli F.W, Marchand A. P. Interpretation of carbon 13 NMR (J. Wiley)

12. W. Kemp, Organic spectroscopy ELBS
13. Willard Merritt and Dean. Instrumental methods of analysis CBS
14. Das and Jame , Mass Spectroscopy.

Paper No. OCH-303

Advanced Synthetic methods

UNIT-I Disconnection approach : [15]

An introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. One group C-X and two group disconnections in 1,2,1,3 -,1,4-& 1,5- difunctional compounds , Retro- synthesis of Alkene ,acetylenes and aliphatic nitro Alcohols and carbonyl compounds, amines , the importance of the order of events in organic synthesis, chemoselectivity, regioselectivity. Diels Alder reaction, Michael addition and Robinson annulation. Retro- synthesis of aromatic Heterocycles and 3, 4, 5 and 6 membered carbocyclic and heterocyclic rings. Reversal of polarity (Umpolung).

UNIT-II [15]

a) Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups **[7]**

b) Application of the following in synthesis [8]

Merrifield resin, polymeric reagents. Solid phase synthesis of polypeptide & oligonucleotides, electro organic synthesis, enzyme catalyzed reaction in synthesis & resolution of racemic mixtures.

UNIT-III

Application of following reagents &reaction in synthesis. [**15]**

Complex metal hydrides, lithium dialkyl cuprate, lithium diisopropylamide (LDA) Dicyclohexylcarbodiimide(DCC), Trimethyl silyl iodide, tributyltin hydride, peracids, lead tetra acetate, PPA, Diazomethane , ozone phase transfer catalyst, woodward-prevost hydroxylation, Barton and Shapiro reaction Hoffmann – Loffler-Fretag, Miyamura, Stille, Negishi, Kamada Peterson synthesis

UNIT-IV **[15]**

a) Selenium dioxide, crown ethers, DDQ, Dess-Martin periodinane, periodic acid & Iodoisobenzyl diacetate. [7]

b) Application of following metal in organic synthesis [8]
Pd, Hg, and Rh, Tl and Si

RECOMMENDED BOOKS

1.S.Warren: Designing of organic synthesis
2.J. Fuhrhop & G. Penzlin. : Organic synthesis (2^{nd} ed.)
3.Carruthres: some modern methods of organic synthesis.
4.H.O.House: modern synthetic reaction.
5.Fieser & Fieser : Reagent in organic synthesis
6.R.O.C.Norman: principle of organic synthesis
7.CAREY & Sundharg: Advanced organic Chemistry
8.P.E.REALAND: Organic synthesis
9.Bartan and Ollis : comprehensive organic Chemistry
10.R.Admas: - organic reactions
11.Stone & west: Advances in organometallic Chemistry
12.C.W.Bird: Transition metal intermediate in organic synthesis
13.Swan & black :organometallic in organic synthesis.
14.A. Mitra : synthesis of prostaglandins
15.John Apsimon: Total synthesis of natural products
16. M. K. Mathur, C. K. Narang & R.E.Williams: polymers as aid in organic synthesis
17.P. HODGE & D.C.SHERRINGTON: Polymer supported reaction in organic synthesis.
18.C.J.Gray: Enzyme catalysed reaction s
19.T.W. Green & P.G.M.Wats : Protecting groups in organic Chemistry
20.T.Shona: Electroorganic Chemistry
21.Weber & Gokel : phase transfer catalyst in organic synthesis.
22. Protecting group chemistry J. Roberton (OX)

Paper No. OCH. 304
(DRUG & HETEROCYCLIC)

UNIT-I **[15]**

a) Drug design **[7]**

Development of new drugs, procedures followed in drug design, concepts of prodrugs and soft drugs. Theories of drug activity, Quantitative structure activity relationship. Theories of drug activity, Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors

b) Study of the Following types of drugs: [8]

a) Antibiotics: Preparation of semi synthetic penicillin, conversion of penicillin into cephalosporin, general account of tetracycline & macrocyclic antibiotics(no synthesis)
b) Antimalerials: Trimethoprim
c) Analgesic & Antipyretics: Paracetamol, Meperidine, methadone, Aminopyrine.

UNIT-II **[15]**

a)

i) Anti- inflammatory: Ibuprofen, Oxyphenylbutazone, Diclophenac, Indomethacin.
ii) Antitubercular & antileprotic : Ethambutol, Isoniazide & Dapsone
iii) Anaesthetics : Lidocaine, Thiopental.
iv) Antihistamines: Phenobarbital, Diphenylhydramine.
v) Tranquilizers: Diazepam, Trimeprazine.
vi) Anti AIDS: General study

vii) Cardiovascular: Synthesis of dilliazem, quinidine, methyldopa, atenolol, oxyprenol
viii) Anti-neoplastic drugs: Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.

UNIT-III **[15]**

a) Small ring Heterocycles **[8]**

Three membered and four membered Heterocycles- synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxitanes and thietanes.

b) **Benzo fused five membered Heterocycles** **[7]**

Synthesis and reactions of benzopyrroles, benzofurans and benzothiophenes.

UNIT-IV **[15]**

a) Six membered Heterocycles with one heteroatom **[5]**

Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium and thiopyrylium salts and pyridones. Synthesis and reactions of coumarins, chromones.

b) Six membered Heterocycles with two and more Heterocycles **[5]**

Synthesis and reactions of diazines & triazines.

c) Seven membered Heterocycles **[5]**

Synthesis and reactions of azepines, oxepines & thiepines.

RECOMMENDED BOOKS

1. Burger : Medicinal Chemistry.
2.A. Kar : Medicinal Chemistry (Wiley East)
3. W. O. Foye : Principals of medicinal chemistry.
4. Wilson, Gisvold & Dorque: Text book of organic medical and pharmaceutical chemistry
5. Pharmaceutical manufacturing encyclopedia.
6. R. M. Acheson : An introduction to chemistry of heterocyclic compounds (Interscience).
7. Joule & Smith : Heterocyclic chemistry (Van Nostrand).
8. R. K. Bansal: Heterocyclic chemistry (Wiley E).
9. L. A. Paquitte : Principals of modern heterocyclic chemistry.
10. M. H. Palamer : The structure and reactions of heterocyclic compounds.
11. A. R. Katritzky: Advances in Heterocyclic chemistry (A.P.).
12. Finar: Organic chemistry (Vol. 1& 2)
13. Cohn & Stumpt : Outline of Biochemistry.
14. Williams : Introduction to the chemistry of enzyme action.
15. The Organic Chemistry of Drug design and Drug action, R. B. Silverman Academic press.
16. Strategies for Organic Drug synthesis and Design, D. Lednicer, J. Willey.
17. Heterocyclic Chemistry, Vol-1-3, R. R. Gupta, M. Kumar and V. Gupta, Springer Veriag.
18. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme
19. Heterocyclic Chemistry, J. A. Joule, K. Mills and G. F. Smith, Chapman and Hall
20. Heterocyclic Chemistry, T. L. Gilchrist, Longman Scientific Technical

21. Contemporary Heterocyclic Chemistry, G. R. Nikome and W. W. Poudler, Willey.
22. An Introduction to Heterocyclic Compounds, R. M. Acheson, J. Willey
23. Comprehensive Heterocyclic Chemistry, A. R. Katrizky and C. W. Rees

Organic Chemistry Practicals
OCH-11: SEM-III

A. Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using the TLC and column chromatography, chemical tests. IR spectra to be used for functional group identification.

B. Quantitaive analysis

1. Three step Preparations
2. Colorimetry and pH metry experiments.
3. Expt. on Hammett equation

Recommended Books :

1. Textbook of Practical Organic Chemistry – A. I. Vogel.
2.Practical Organic Chemistry – Mann & Saunders.
3.A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4.Organic Synthesis Collective Volumes by Blat.

Semester-IV (Organic Chemistry)

Paper No-OCH-401:
Theoretical Organic Chemistry

UNIT-I Molecular Orbital Theory: [15]

Aromaticity in benzenoids, alternant and non alternant hydrocarbon**,** Huckels rule, energy level of pi molecular orbital and concept of aromaticity, calculation of energies of orbitals in cyclic and acyclic systems. Determination energies and stabilities of different systems calculation of charge densities PMO theory and reactivity index.

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UNIT-II Non benzenoid aromatic Compounds: [15]

Aromaticity in Non- benzenoids compounds Annulenes and hetroannulenes, fullerence C60 , Tropone, tropolone azulene, fulvene, tropylium salts, ferrocene**,** Three and five membered systems. Crown ether complexes, cyclodextrins, cryptands, catenanes and rotaxanes, bonding in fullerenes.

UNIT-III [15]

a)Free radical reactions: [8]

Types of free radical reactions, detection by ESR, free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in attacking radicals. The effect of solvent on reactivity. Allylic hydrogenation (NBS) , oxidation of aldehydes to carboxylic acids, auto oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt, Sandmeyers reaction. Free radical rearrangement, Hunsdiecker reaction.

b) Pericyclic Reactions: [7]

Molecular orbital symmetry, Frontier orbital of ethylene, 1,3 butadiene, 13,5 hexatriene and allyl system, classification of pericyclic reaction, Wood-ward Hoffman correlation diagrams, FMO and PMO approach, electrocyclic reactions, - conrotatory and dis rotatary motions, 4n , 4n+2 and allyl systems, cycloaddition , and supra and antra facial additions, 4n and 4n+2 systems, 2+2 additions of ketenes, 1,3 dipolar cycloaddition and chelotropic reactions, sigmatropic rearrangement , supra and antrafacial shifts of H Sigmatropic shifts involving carbon moieties,3,3 and5,5

sigmatropic rearrangement and Claisen and Cope and Aza Cope rearrangement, Ene reaction.

UNIT-IV [15]

a) Kinetic and thermodynamic control of reactions:

Reactions of naphthalenene, Wittig reaction, enolization, Friedel-Crafts reactions, Diels Alder. [8]

b) Reactions of carboxylic acids and esters **[7]**

Types of hydrolysis mechanisms catalyzed by acids and bases.

Recommended Books:

1.Lehar and Merchant: Orbital Symmetry.
2.R. B. Woodward and Hoffman: Conservation of orbital symmetry.
3.Kan: Organic Photochemistry
4.Cixon and Halton : Organic photochemistry
5.Arnold: Photochemistry
6.N. Turro : Modern molecular photochemistry
7.Rohatgi- Mukherji : Fundamentals of photochemistry.
8.Ginsburg: Nonbenzenoid aromatic compound
9.A. Streitwieser : Molecular orbital theory for organic chemistry.
10.E. Cler : The aromatic sextet.
11.Lloyd: Carbocyclic non- benzenoid aromatic compounds.
12.W. B. Smith; Molecular orbital methods in organic chemistry.
13.Grratt; Aromaticity.

Paper No. OCH- 402:
Stereochemistry

UNIT-I Newer methods of stereoselective synthesis: [15]

Introduction and stereoselective and stereospecific reactions. Enantioselective synthesis (chiral approach) reactions with hydride donors, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines. Sharpless epoxidation. Diels Alder selective synthesis, use of calculations of optical purity and enantiomeric excess.

UNIT-II [15]

a)Conformation and reactivity in acyclic compounds and of cyclohexanes. [5]

Stability and reactivity of diastereoisomers. Curtin- Hammett principle,

b) Some aspects of the stereochemistry of ring systems: [5]

Stereoisomerism and determination of configuration Stability of rings and ease of rings formation)

c) The shapes of the rings other than six membered: [5]

Shapes of five, six, and seven membered rings. Conformational effects in medium sized rings, Concept of I strain.

UNIT-III [15]

a) Fused and bridged rings: Fused bicyclic ring systems : [8 **]**

Cis and trans decalins and perhydrophenanthrene. Bridged rings, Nomenclature stereoichemical restrictions, and The Bredt's rule, Reactivities.

b) O.R.D. and C.D. : Types of curves, the axial haloketone rule. [7]

The Octant rule. Determination of conformation and configuration.

UNIT-IV

a) Stereochemistry of Allenes, Spiranes and Biphenyls [8]

Assignment of configuration

b) Configuration of diastereomers based on physical and chemical methods. [7]

Recommended Book

1.E.L. Eliel : Stereochemistry of carbon compounds
2.D. Nasipuri : Stereochemistry of organic compounds
3.P.S. Kalsi: Stereochemistry: conformation and Mechanism.
4.Eliel, Allinger, Angyal and Morrison : Conformational analysis
5.Hallas: Organic stereochemistry
6.Mislow and Benjamin: Introduction to stereochemistry.
7.H. Kagan : Organic stereochemistry.
8. Carl Djerassi ; Optical rotatory dispersion.
9.P. Crabbe : Optical rotatory dispersion and C.D.

Paper No. OCH-403
Chemistry of Natural Products

UNIT-I **Terpenoids** [**15]**

Structure and synthesis of abietic acid, zingiberene, santonin, cuparenonne and caryophyllene.

UNIT-II **Alkaloids** [**15]**

Structure, stereochemistry, synthesis and biosynthesis of the following Structure of morphine, reserpine, ephedrine, (+) Conin.

UNIT-III [15]

a) Steroids [8]

Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and study of the following hormones, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and cartisone. Biosynthesis of steroids.

b) Prostaglandins [7]

Occurrence, nomenclature, classification, biogenesis and physiological effects, Synthesis of PGE2 and PGF2

UNIT-IV [15]

a) Biogenesis [**8]**

Alkaloids (pyridine, morphine and indole type) terpenoids of classes with examples, cholesterol, flavones, coumarins, carbohydrates and proteins.

b) Vitamins [7]

Synthesis and structure of biotin and vitamin B_2, synthesis of vitamin B_1, biological functions of B_6, B_{12}, folic acid and thiamin.

Books Suggested

1. Apsimon: The total synthesis of natural products.
2. Manskey and Holmes: Alkaloids

3. A.A. Newmen: Chemistry of Terpenes.
4. P. D B.Mayo: The chemistry of natural products.
5. Simonson: Terpenes.
6. T.W. Goddwin: Aspects of terpenoid chemistry and biochemistry
7. Woguer: Vitamins and Co enzymes.
8.P. W. Bently: Chemistry of Natural products,
9. Fieser and Fieser: Steriods
10. I. Finar: Organic chemistry Vol. II and I
11. J.B. Hendrickson, The molecules of nature.
12. Peter Bernfield, The biogenesis of natural products,
13. R.T. Slickenstaff A.C. Ghosh and G.C. Wole , Total synthesis of steroids.
14. The chemistry of natural products, vol. Nakanishi

Paper No. OCH- 404A:
Applied Organic Chemistry

UNIT-I Agrochemical: [15]

a. Carbamate pesticides: Introduction, carbaryl, Baygon, Aldicarb, Ziram, Zineb
b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos
c. Natural and synthetic pyrethroids : Isolation and structures of natural allethrin, fenvalerate, cypermethrin,
d. Plant growth regulators: General survey synthesis of simple compounds
e. Insect repellents: General survey and synthesis
f. Jovenile harmone: introduction structures JHA importance synthesis
g. Pheromones: introduction, examples, and importance in IPM synthesis of juvabione bombycol, grandisol, and disparure

UNIT-II Manufacture of following: [15]

2-Phenylethanol, detergents, vanillin and other food flavours, synthetic musk , Acetic acid and butenaldehyde from ethanol butyl acetate, furfural, from bagasse, citric acid from molasses, Application of oro and marker process. Nicotine from tobacco waste and citral from lemon grass, synthetic detergents, glycerol.

UNIT-III Dyes and Intermediates: [15]

Synthesis of important dye intermediates. Commercial processes for Azo dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispenses dyes.

UNIT-IV Polymers: [15]

Mechanism of polymerization. Study of polyesters, polyamides, PVC, polystyrene, polyvinyl acetate and polyvinylalcohol, polyethenes, viscose rayon, synthesis of polyethylene, polypropylene. Synthetic rubbers: Styrene-butadiene, butyl polyisoprene, phenol formation formaldehyde resin. Plastictisers and anti oxidants for polymers, Natural polymers: Starch and cellulose.

Reference Books

1. Allan: Colour Chemistry
2. K. Venkataraman: Chemistry of Synthetic Dyes Vol- 1 to 7
3. Abrahart: Dyes & their intermediates
4. N. N. Melikov: The Chemistry of Pesticides and formulations

5. K. H. Buchel: Chemistry of Pesticides
6. R. Cleymlin: Pesticides
7. F. W. Billmeyer: Text book of Polymer Science
8. H. R. Alcock and F. W. Lambe: Contemporary Polymer Chemistry
9. J. M. G. Cowie, Blackie: Physics & Chemistry of Polymers
10. P. H. Groggins: Unit Processes in Organic Synthesis
11. B. Biollot & P. V. Wells: Perfumary Technology
12. M. Ash & I. Ash: A formulary of Cosmetic Preparations

Paper No. OCH-404-B
Bio organic chemistry (elective)

UNIT-I

a) Cell Structure and Functions [10]

Structure of prokaryotic and eukaryotic cells, Intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic process-catabolism and anabolism. ATP – the biological energy currency. Origin of life- unique properties of carbon, chemical evolution and rise of living system. Introduction to biomolecules, building blocks of bio- macromolecules.

b) Enzymes [5]

Structure activity and reactions, catalyzed determination of active site, inhibition mechanism chemical transformations using enzyme.

UNIT-II Carbohydrates [15]

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-aceylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysccharides- cellulose and chitin. Storage polysaccharides- starch and glycogen.

Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoprotines and glycolipides. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Carbohydrate metabolism- Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, pentose phosphate pathway.

UNIT-III Lipids [15]

Fatty acids, essential fatty acids, structures and function of triglycerides, glycerophspholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in arthrosclerosis.

Properties of lipid aggregates – micelles, bilayers, liposomes and their possible biological functions. Biological members . Fluid mosaic model of membrane structure.

Lipid metabolism - β-oxidation of fatty acids

UNIT-IV

a) **Amino acids, Peptides and Proteins [10]**

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of protein, forces responsible for holding of secondary structures. α-

helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein- folding and domain structure. Quaternary structure.

Amino acid metabolism- degradation and biosynthesis of amino acids, sequence determination: chemical/ enzymatic/ mass spectral, racemization/ detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

b) Nucleic Acids **[5]**

Purine and pyrimidine of nucleic acids, base pairing via H – bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and poly nucleosides.

Books Suggested

1.Principles of Biochemistry, A. L. Lehinger, Worth Publications.
2.Biochemistry, L. Stryer, W. H. Freeman.
3.Biochemistry, J. David Rawn, Neil Patterson.
4.Biochemistry, Voet and Voet, John Wiley.
5.Outlines of Biochemistry, E. E. Conn and P. K. Stumpt, John Wiley.

ORGANIC CHEMISTRY (PRACTICALS)
OCH-411 & OCH-412

Three stage preparations starting with 5g or less & TLC.

1. Estimation of sulphur, nitrogen and functional groups, pharmaceutical analysis.

2. Polyfunctional analysis

3. Organic preparations

1. Preparation of benzanilide by Beckmann rearrangement
2. Preparation of anthranilic acid
3. Preparation of phthalimide
4. Preparation of N- bromosuccinamide
5. Preparatin of p- Amino benzoic acid
6. Preparation of p- chloro nitrobenzene by Sandmeyer reaction
7. Preparation of p- Idonitrobenzene by Sandmeyer reaction
8. Pinacol- Pinacolone rearrangement

4. Project: Literature survey. Studies of reactions, synthesis, mechanism, isolation of natural products, standardization of reaction conditions, new methods etc. External and internal examiners will examine this jointly at the time of practical examination.

5. Any other experiments as may be necessary.

(Any other suitable experiments may be added)

REFERENCES BOOKS

1. A Textbook of Practical Organic Chemistry – A. I. Vogel.
2. Practical Organic Chemistry – Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes.
5. Organic Reactions (Wiley).

M. Sc. Part II (Physical Chemistry)

Revised Syllabus

SEMESTER- III

PAPERS

PCH-301 : Quantum Chemistry

PCH-302 : Electrochemistry

PCH-303 : Molecular Structure-I

PCH-304(A) : Solid State Chemistry

PCH-304(B) : Advanced Chemical Kinetics

PCH-304(C) : Radiation and Photochemistry

SEMESTER- IV

PAPERS

PCH-401 : Thermodynamics and Statistical Mechanics

PCH-402 : Chemical Kinetics

PCH-403 : Molecular Structure II

PCH-404(A) : Surface Chemistry

PCH-404(B) : Chemistry of Materials

PCH-404(C) : Biophysical Chemistry

PRACTICAL COURSE

PAPER NO. PCH- 311 & 312

PAPER NO. PCH- 411 & 412

And Project

Semester - III

Paper No. PCH-301: Quantum Chemistry

Unit - I: **Brief review of failure of classical mechanics.** [15]

Wave Particle duality. The dynamics of microscopic systems: the Schrodinger equation, the uncertainty principle, the interpretation of the wave function.

Unit - II: Formalism of Quantum Mechanics: [15]

a) Postulates of Quantum Mechanics , Eigen function and Eigen values

b) Operators

c) Acceptability of wave functions, Normalized and orthogonal wave functions.

d) Principles of superposition , Schnidt Orthogonalisation
e) Hermition operators ,
f) Theorems related to commutator operations, Stern- Gerlach experiment and spin of electron. Spin eigen function. Concept of angular momentum, angular momentum operators. Ladder operators.

Unit - III: Quantum Mechanics of some simple systems: [15]

a) Practical in a box: One dimensional Box - application to spectra of linear conjugated molecular. Degeneracy in multidimensional box.
b) Potential well of finite depth (Tunneling effect)
c) Rigid rotator,
d) Linear harmonic oscillator, the formal solutions, energy levels, degeneracy, properties of wave functions and selection rules.

Unit - IV: The hydrogen Problem: [15]

Schrodinger equation for hydrogen atoms (polar co. ordinates) and its solution. The radial distribution function and its significance, shape of atom orbitals.

Unit - V: A brief introduction to hydrogen like atoms. [15]

Helium atoms. Approximate methods: Perturbation theory and Self-consistent field theory, chemical bonding and hybridization.
Approximate methods: The veriation theorem and principles, its use to obtain optimum molecular orbital and energies.

Unit - VI: Secular equation and secular determinants. [15]

Huckel Molecular Orbital Theory, origin of aromatic stability and calculation of delocalization energy.
Brief introduction to hetero-nuclear systems. Use of symmetry based linear combination to simplify the problem of Huckel theory calculations for larger aromatic molecules.

REFFERENCE BOOKS

1. Introductory Quantum Chemistry by A. K. Chandra. Tata McGraw-Hill. 1988.
2. Basic Physical Chemistry by W. J. Moore, Prentice Hall, 1986.
3. Physical Chemistry, by P. W. Atkins , ELBS, 1986.
4. Quantum Chemistry, W. Kauzmann, Academic press.
5. Quantum Chemistry by Hanns.
6. Theoretical Chemistry by S. Glasstone , Van Nostrand .
7. Physical Chemistry by Alberty .
8. Quantum Chemistry by Prasad
9. Huckel Molecular theory by Keith Yates

Paper No.PCH-302: Electrochemistry

Unit - I : Electrolytic conductance: (15)

Debye - Huckel theory of inter-ionic attraction , ionic atmosphere, time of relaxation, relaxation and electro-phoretic effects, Debye-Huckel-Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions. Debye-Falkenhagen and Wein effects. Abnormal ionic conductance of hydroxyl and hydrogen ions.
Activity coefficients: forms of activity coefficients and their interrelationship. Debye-Huckel limiting law its applications to concentrated solutions. Debye-

Huckel Bronsted equations. Quantitative and qualitative verification of Debye-Huckel limiting law, ion association. Bjerrum theory

Unit - II : Ion solvent interactions and electrolysis: (15)

The Born Model and expression for the free energy of ion- solvent interactions. Thermodynamic parameters for the ion - solvent interactions. Calculations of heats of hydration of ions and the concept of hydration number .

Electrolysis: Decomposition potentials: calculations and determinations. Polarization: types of polarization, over voltage and hydrogen and oxygen over voltage.

Unit - III: Electrode reactions. (15)

Tafel equations, kinetics of discharge of hydrogen ions . Diffusion over potentials. Fuel cells: significance of fuel cells: hydrogen - oxygen, hydrocarbon - air, natural gas and carbon monoxide, air fuel cells.

Corrosion: concept and importance, mechanism of corrosion and Pourbaix diagrams.

UNIT-IV [15]

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

REFFERENCE BOOKS

1. An Introduction to Electrochemistry by S. Glasstone
2. Modern Electrochemistry Vol. I & II by J. O. M. Bockris and A.K.N. Reddy .
3. Physical Chemistry by S. Glasstone
4. Electrolytic Solutions by R. A. Robinson and R. H. Strokes
5. Physical Chemistry by P. W. Atkins. ELBS.

Paper No. PCH- 303: Molecular Structure - I

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

Symmetry elements, symmetry operations and point groups, properties of group, symmetry operations as a group, multiplication table. Classes of symmetry operations, basis, representative and matrix representations of operations. Reducible and irreducible representations, orthogonality theorem. Properties of irreducible representations. Constructions of character table for point groups. Explanations for the complete character table for a point group. Representations of vibrational modes in nonlinear molecules. Infrared and Raman activities of normal modes of vibrations.

Unit - II: Introduction of spectroscopy and Rotational Spectra : (15)

Characterization of electromagnetic radiation. The qualification of energy. Regions of Spectrum, transition probability, the width and intensity of spectral transitions.

Classification of molecules according to their moment of inertia. Rotational spectra of rigid and nonrigid diatomic molecules. The intensities of spectral lines. The effect of isotopic substitution. Polyatomic and symmetric top molecules. The stark effect.

Unit- III Infrared spectroscopy and Raman Spectroscopy: (15)

Diatomic molecules : 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero point energy, isotope effect. The Anharmonic oscillator, the diatomic vibrating rotator, the interactions of rotations and vibrations.

Polyatomic molecules:Fundamental vibrations and their symmetry, overtone and combination frequencies. The influence of rotations and molecular spin on the spectra of polyatomic molecules. Analysis by Infrared techniques.

Raman Spectroscopy :Rayleigh scattering . Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra , rotational fine structure. Polarization of light and the Raman effect . Structure determination from Raman and Infra-red spectroscopy.

Unit - IV Electronic Spectroscopy : (15)

General nature of band spectra. Beer- Lambert Law integrated absorption coefficient and oscillator strength. Term symbols for atoms and molecules. The hydrogen atom and hydrogen like species spectrum.

Sequences and progressions, the vibrational course structure and rotational fine structure of electronic band. The Franck-Condon principle, dissociation energy and dissociation products. Birje-Sponer extrapolation. The fortrat diagram. Predissociation, classification of electronic states. The spectrum of molecular hydrogen. Electronic spectra of polyatonic molecules. Chemical analysis by electronic spectroscopy. (d-d), (□ □) and (□-n*) transitions. Photochemical mechanism of vision.

REFFERENCE BOOKS

1. Fundamental of molecular spectroscopy by C. N. Banwell Tata McGrew Hill.
2. Physical Chemistry by P. W. Atkins , ELBS, 1986
3. Symmetry, Orbitals and spectra by M. Orchin & H. Jaffe, Willey , interscience.
4. Chemical applications of group theory by F. A. Cotton Willey , interscience
5. Symmetry in chemistry by H. Jaffe and M . Orchin , Jhon willey.
6. Group theory and its applications to chemistry by K. V. Ramen , Tata McGrew Hill.
7. Molecular Structure and Molecular Spectra by G. Herzberg, Van Nostrand .
8. Molecular Spectroscopy by I. N. Levine , Willey interscience.
9. Molecular Spectroscopy by G. M. Barrow.

PAPER: PCH-304 (A): Solid State Chemistry (elective)

Unit I: The solid state : (15)

Types of solids, isomorphism and polymorphism, laws of crystallography, lattice types, X-ray diffraction, Bragg's equation, Miller indices, Bragg Method, Debye-Sherrer method of X-ray structure analysis of crystals, indexing of reflections, identification of unit cells from systematic absence in diffraction pattern, structure of simple lattice and X-Ray intensities, structure factor and its relation to intensity and electron density, phase problem, procedure for an X-ray structure determination.

Unit II: Solid State Reactions: (15)

General principle, types of reactions: Additive, structure sensitive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the reactivity of solid state reactions.

Unit III: Electronic Properties and Band Theory: (15)

Metals, insulators and semi conductors, free electron theory and its applications, electronic structure of solids, band theory, band structure of metals, insulator, and

semiconductors, doping in semiconductors, p- n junction, super conductors, optical properties, photo-conduction and photoelectric effects, laser action, solid state laser and their applications.

Unit IV: Preparation of materials: (15)

Purification and crystal growth, zone refining, growth from solution, growth from melt and preparation of organic semiconductors for device applications.

REFFERENCE BOOKS

1. A guide to laser in chemistry by Gerald R., Van Hecke, Keny K. Karokitis
2. Principals of solid state, H. V. Keer, Wiley Eastern,
3. Solid state chemistry, N. B. Hannay
4. Solid state chemistry , D. K. Chakrabarty , New Age International
5. An Introduction to Crystallography : F. G. Philips
6. Crystal Structure Analysis: M. J. Buerger
7. The Structure and properties of materials:
Vol. III Electronic properties by John Walss
8. Electronic processes in materials : L. U. Azroff and J. J. Brophy
9. Chemistry of imperfect crystal : F. A. Krogen
10. Elements of X-ray Diffraction by B. D. Cullity, Addison- Weily.
11. Solid state Chemistry by A.R.West (Plenum)
12. Electronics made simple by Jacobwitz.

Paper : PCH : 304 B : Advanced Chemical Kinetics(Elective)

Unit-I: Hydrogen ion dependence of reaction rates: (15)

Protonation and hydrolysis equilibria, determination of active reactant species form kinetic data, interpretation of hydrogen ion effect with example.

Unit-II: Electron transfer reaction: (15)

Complimentary and non-complimentary reactions, outer and inner-sphere electron transfer reactions, proton transfer, hydride transfer and hydrogen, oxygen and chlorine atom transfer reactions.

Unit-III: Catalysis: (15)

Trace metal ion catalysis and their mechanisms. Micellar catalysis, Berezini, Menger-Portonoy, cooperative and pseudo-phase ion exchange models and examples.

Unit-IV: Mechanism of chromium(VI) oxidations: (15)

One and two equivalent reductants oxidation, assumptions, limiting forms of rate laws, Westheimer mechanism and its validity. Catalysis, Induced and cooxidations. Mechanisms other than Westheimer mechanism.

REFERENCE BOOKS AND ARTICLES

1) Chemical Kinetics by K. J. Laidler.
2) Kinetics and Mechanism by A. A. Frost and R. G. Pearson
3) Micellar effect on the kinetics and mechanism of chromium(VI) oxidation of organic substrates By Asim K. Das, Coordination Chemistry Reviews,Vol 248, p 81-89 (2004).
4) Some aspects of electron transfer reactions involving organic molecules by B. Sethuram, Allied Publishers, 2003.
5) Surfactants and polymers in aqueous solution by Bo Jonsson, Bjorn Lindman, Krister Holmberg and Bengt Kronberg, John-Wiley & Sons, 1998.
6) Inorganic reaction mechanisms, Part II Edited by John O. Edwards, Interscience, 1972.

Paper : PCH : 304 C : Radiation and Photochemistry(Elective)

Unit - I : Radiation Chemistry : (15)

Introduction, Radiation Types, their characteristics, Radiation in chemical processes.

Unit - II: Lasers and Lasers in Chemistry : (15)

Introduction, characteristics of laser, uses of lasers in chemical process, laser induced chemical reactions, organic photochemistry, lasers as a photochemical tool, laser induced selective bond chemistry , overview , bond selective chemistry of light atom molecules.

Unit - III: Basics of photochemistry : (15)

Electrochemistry of excited states , life time measurements , flash photolysis, energy dissipation by radiative and non-radiative processes, properties of excited states, structure , dipole moment, acid-base strength, reactivity , photochemical kinetics, calculations of rates of radiative process , bimolecular quenching, Luminescence for sensors and switches , charge transfer excited state, photoinduced electron transfer reactions.

Unit - IV : Micellaneous Photochemical reaction : (15)

Photo-fries reaction of anilides , photo - fries rearrangement, Barton reaction , singlet molecular oxygen reactions , photochemical formation of smog , photodegradation of polymers , photochemistry of vision .

REFRENCE BOOKS

1) Molecular Photochemistry , N. J. Turro, W.A. Benjamin
2) Fundaments of Photochemistry , K. K. Rohatagi - Mukherji, Weiley - Eastern
3) Elements of Inorganic Photochemistry : G. S. Ferraudi , Wiley
4) Concepts of Inorganic Photochemistry , A.W. Adamson & P. J. Fleischauer , Wiley
5) A Guide To lasers in chemistry , Gerald R. Van Hecke & Kerry K. Karukstis.
6) Photochemistry , R.P. Kundall, A Gilbert, Thomson Nelson

PARCTICAL COURSE

Paper No. PCH- 311 & 312

Potentiometry

1. To determine instability constant & stiochiometry of silver ammonia complex potentimetrically.
2. Determination of Thermodynamic Parameters for electrochemical reactions. (To determine ΔG^o, ΔH^o,and ΔS^o for the formation of 1 mole cadmium in 1 wt. % amalgam at 25^o C and activity coefficient of solution).

Spectrophotometry

1) To determine pK value of methyl red indicator at room temperature spectrophotometrically
2) To determine stoichiometry & stability constant of ferric Sulphosalicylic acid/ salicylic acid complex by Job's Method and mole ratio method spectrophotometrically.
3) To dsetermine equilibrium constant of reaction $KI + I_2 \rightleftharpoons KI_3$ spectrophotometrically

Amperometry

To determine unknown concentration of Iodine using amperometry

Chemical Kinetics

To determine the order of reaction between acetone and iodine catalyzed by acid.

Conductometry

To determine equivalent conductance at infinite dilution of strong electrolytes and weak acid by using Kolharausch Law and dissociation constant for weak acid conductometrically.

Cryoscopy
To determine molecular weight and state of benzoic acid in benzene.
Moving boundary Method
To determine transport of H+ ions by using Moving boundary method.
pH - Metry
To determine dissociation constant of carbonic acid pH metrically.
Polarography
To determine half wave potential of a given ion using half height method, differential method and wave equation method
Latent heat of Fusion
Determination of latent heat of fusion of a given solid.
Thermochemistry
Determination of heats of dilution and integral heat of solutions.

Semester - IV

Paper-PCH-401:Statistical Mechanics and Thermodynamics

Unit - I :Modern Theoretical principals : (15)
Exact and inexact differential expressions in two variables. Total differentials. Techniques of partial differentiations. Transformation of variables. Maxima and mimima . Integrating factors, Paff differential equations, Caratheodorys theory. Legendre transformations. Derivation of thermodynamic identities . The second law of thermodynamics, classical formulations, mathematical consequences of second law. Entropy changes , Clausius inequality . free energy concept. General condition of equilibrium. Thermodynamic potentials.
Unit - II:Phase space, stirlings appronimation : (15)
Configuration and weights, the most probable configuration. Statistical Equilibrium. Postulates of equal probabilities. Ensembles. Ensemble average and time average of property.
The Boltzmann Distribution law. Principle of the equipartition of energy , Quantum Statistics : BE and FD statistics, Comparison of three statistics, comparison of three statistics and radiation , Fermi - Dirac systems. Fermy energy. Electron gas in metals.
Unit - III : Molecular partition function: (15)
Expressions for transnational, rotational, vibrational and electronic partition functions, relation between the partition function and thermodynamic properties, rotational contribution to entropy. Free energy functions, ortho and para hydrogen, use of spectroscopic and structural data to calculate thermodynamics functions.

Molecular and statistical interpretation of entropy, third law of thermodynamics and equilibrium constant.

Heat capacity of solids, Einstein and Debye specific heat equations. Characteristic temperature.

Unit - IV: Thermodynamics of irreversible processes. (15)

Conversion of mass in closed and open systems . conservation of energy in closed and open systems . Law of increasing entropy. Non - adiabatic process and clausius inequality, steady state. Thermodynamic equations of motion. Generalized fluxes. Forces and their transformation. Phenomenological equations and coefficients . concepts of reciprocity relations and Onsager theorem of microscopic reversibilities.

Entropy production in closed and open systems. Entropy production due to heat flow. Chemical potentials. Diffusion, electromotive force and other reactions involving cross relations. Saxens relations. Oscillatory reactions.

RECOMMENDED BOOKS

1) Elements of statistical thermodynamics - L. K. Nash, Addison Wesley
2) Statistical thermodynamics by B. J. McCelland, Chapman and Hall.
3) A Introduction to Statistical Thermodynamics by T. L. Hall
Addison - Wesley
4) Thermodynamics of Irreversible Processes by Iila Prigofine.
5) Thermodynamics of steady state by Denbeigh
6) Advanced physical Chemistry by S. N. Blinder, The Macmilan Company, 1967.
7) Themodynamics by R. C. Srivatsava, S. Saha and A. K. Jain, Prentice-hall, India.
8) Theoretical Chemistry by S. Glasstone.

Paper No.PCH- 402 : Chemical Kinetics

Unit - I :Chemical kinetics: (15)

Steady State Approximation Collision theory of gas reaction , collision frequency. The rate constant , molecular diameters , collision theory vs. experiment

Kinetics of Fast reactions: Relaxation techniques, pressure jump and temperature jump methods, NMR relaxation, flash photolysis and molecular beam methods.

Unit - II : Theories of reaction rates: (15)

Activated complex theory of reaction rates, reaction coordinate and transition state, formation and decay of activated complex, Eyring equation, thermodynamic aspects

Theory of unimolecular reactions.

Unit - III: Reactions in solution: (15)

Oxidation –reduction reactions: One-electron & two-electron transfer reactions. Inner sphere & outer-sphere reactions, complimetntary two equivalent changes (Tl^{+}-Tl^{3+} exchange). Unstable oxidation states. Tests for Marcus Hush theory.

Unit- IV: organic reaction mechanisms: (15)

Linear free energy relationships: Hammet Plots, hammet equation, substituent and reaction constants and their physical significance, calculation of k and K values, Yukawa-Tsuno equation.

Taft equation, steric parameters

Solvent effects, Grunwald-Winstein equation.

REFFRENCE BOOKS

1) Chemical Kinetics by K. J. Laidler.
2) Kinetics and Mechanism by A. A. Frost and R. G. Pearson.
3) Fast Reactions by Haque.
4) Theory of chemical reaction rates by K. J. Laidler, McGrew Hill, New York , 1969.
5) Fast Reactions by J. N. Bradley , Clarendon Press Oxford , 1974
6) Physical Chemistry by W. J. Moore.
7) Physical Chemistry by P.W. Atkins

8) Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, John Wiley & Sons Inc., 2nd Edition,1967.
9) A Guidebook to Mechanism in Organic Chemistry, Peter Sykes, Orient Longmann, 6th Edition, 2003.

Paper No. PCH-403: Molecular Structure - II

Unit - I: The Electric Properties of Molecules: (15)

Electric dipole moment of molecule, polarization of a dielectric , polarizability of molecules, Clausius-Mossotti equation. Debye equation . limitation of the Debye theory , determination of dipole moment from dielectric measurements in pure liquids and in solutions. Dipole moment and ionic character, Bond moment, Group moment, vector addition of moments, bond angles, The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction. Lennard-Jones potential .

Unit - II:The Magnetic properties of Molecules: (15)

Diamagnetism and paramagnetism. Volume and mass susceptibilities. Lengevins classical theory of diamagnetism and paramangnetism Atomic and ionic susceptibility. Pascal constants , Curie - Weiss law . Van Vleck general equation of magnetic susceptibility. Determination of magnetic susceptibility. Ferro and ferri magnetism, application to coordination complexes and complex ions of transition metals.

Unit - III:Nuclear Magnetic Resonance Spectroscopy: (15)

The nature of spinning particles , interaction between spin and a magnetic field. Population of energy levels, The larmor precession . relaxation times . the meaning of resonance and the resonance condition. NMR experiment, singnificance of shielding constants and chemical shift . the origin and effect spin - spin coupling , factors affecting chemical shift, chemical analysis by NMR. Exchange phenomena , ^{13}C NMR spectroscopy, double resonance and nuclear-overhauser effect.

Unit - IV: **[15]**

a)Electron Spin Resonance Spectroscopy:

(8)

Electron spin and Magnetic moment , Resonance condition in ESR and significance of 'g' value . ESR spectra of organic free radicals , McConnel relation , Electron Exchange reactions , applications of ESR,

b) **Massbauer Spectroscopy:**

(7)

Basic principle of Mossbauer spectroscopy , hyperfine structure , quadrupole splitting, instrumentation and applications of Mossbauer spectroscopy, Problems related to Mossbaur spectra.

REFFERNCE BOOKS

1. Fundamentals of molecular spectroscopy by C. N. Banwell.
2. Physical chemistry by P. W. Atkins . ELBS. 1986
3. Introduction to molecular spectroscopy by G. M. Barrow.
4. Molecular spectroscopy by I. N. Levins , Wiley interscience.
5. Nuclear magnetic Resonance by J. D. Roberts , Mcgrew Hill .
6. Introduction to Magnetic resonance by A. Carrrington and A. D. McLachlan. Harper and Row.
7. Electron Spin Resonance , Elemenatry theory and practical applications by J. E. Wetz and J. R. Boulton , McGrew Hill .
8. Introduction to Magnetochemistry by Earnst Shaw. Academic Press
9. Electrical and optical properties of molecular behavior by M. Davies, pergman press.
10. Polar molecules by P. Debye , Dover publications.

Paper No. PCH - 404 A: Surface chemistry (Elective)

Unit I: Adsorption and surface phenomenon: (15)

Physisorption and chemisorption , adsorption isotherms, Langmuir and B. E. T. equation and significance in surface area determination, surface films, states of insoluble films, L. B. films and their application, adsorption from solution, adsorption types, surface excess concentration , Gibb's adsorption equation : derivation , significance and experimental verification , catalytic activity of surfaces.

Unit II: Micelle: (15)

Surface activity, surface active agents and their classification, micellisation, critical micelle concentration (cmc) thermodynamics of micellisation , factors affecting cmc, methods of determination of cmc , reverse micelle , solubisation of water insoluble organic substances , use of surfactants in oil recovery ,

Unit III: Emulsion:

(8)

Types of emulsion, theories of emulsion and emulsion stability, identification of emulsion types, inversion emulsion, microemulsion : theory and application ,

Unit IV: Liquid gas and liquid interfaces: (15)

Surface tension, capillary action, methods of determination of surface tension, surface tension across curved surfaces, vapor pressure of droplet (Kelvin equation) , surface spreading , spreading coefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

Unit V : Solid - Solid interfaces : (15)

Surface energy of solids, adhesion and adsorption, sintering and sintering mechanism, Tammann temperature and its importance, surface structure and surface composition.

REFFERNCE BOOKS

1. Physical chemistry of surfaces: A. W. Adamson.
2. Theory of adsorption and catalysis by Alfred Clark ,
3. Chemisorption by B. M. W. Trapnell and H.O. Hayward.
4. Introduction to colloide and surface chemistry by D. J. Shaw.
5. Theories of chemical reaction rates by A. J. K. laidler
6. Surface chemistry by J. J. Bikermann

Paper No.PCH- 404 (B): Chemistry of materials (Elective)

Unit I: Glasses, Ceramics, Composite and Nanomaterials: (15)

Glassy state, glass formers and glass modifiers, applications, Ceramic structures, mechanical properties, clay products. Reformatories, characterizations, properties and applications.

Microscopic composites; dispersion - strengthened and particle - reinforced, fibre - reinforced composites, macroscopic composites. Nanocrystline phase, preparation procedures, special properties, and applications.

Unit II: High Tc Materials: (15)

Defect perovskites, high Tc superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, and normal state properties; anisotropy; temperature dependence of electrical resistance; optical photon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption - pairing and multigap structure in high Tc materials , applications of high Tc materials.

Unit III: Polymeric Materials: (15)

Molecular shape , structure and configuration, crystallinity, stress- strain behavior, thermal behavior , polymer types and their applications, conducting and ferro - electric polymers.

Unit IV: (15)

a)Thin films and Langmuir- Blodgett Films: [7]

Preparation techniques; evaporation / sputtering, chemical processes, MOCVD, sol - gel etc. Langmuir- Blodgett (LB) film, growth techniques, photolithography, properties and application of thin and LB films.

b) Materials of Solid Devices: (8)

Rectifiers, transistors, capacitors IV-V compounds, low dimensional quantum structure; optical properties.

REFFERNCE BOOKS

1. Solid State Physics, N. W. Ashcrott and N. D. Mermin, Saunders College
2. Material Science and Engineering, An introduction , W. D. Callister, Willey.
3. Principals of Solid State, H. V. keer, Willey Eastorn.
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 Willey.
6. Text book of liquid crystals, Kelkar and Halz , Chemie Verlag

Paper No :PCH- 404 C: Biophysical Chemistry (Elective)

Unit - I Chemistry and Biology : (15)

Amino acids , proteins , enzymes , DNA & RNA in living systems , electrolytes, the chirality of biological molecules , the biochemical process , weak and strong interactions, macromolecules and rubber elasticity , polyelectrolytes , biopolymers.

Unit - II Physical aspects of biopolymers: (15)

X-ray diffraction, electronic absorption & luminescence Spectroscopy, optical activity , magnetic activity , magnetic-optical activity. Osmosis, hydrophobic hydration and interactions. The properties of amino acids and their aqueous solutions.

Unit - III Photo biological Process : (15)

Photosynthesis , mechanism of vision , the molecular mechanism of photoreceptor .

Unit - IV : Mechano-chemical processes : (15)

Introduction, thermodynamics, nerve conduction and membrane equilibria, muscle and muscle proteins, their chemistry and physics , kinetic properties of muscle, mechano- chemical systems , biomachanics.

REFFERENCE BOOKS

1) Biophysics by M.V. Volhenshfein.
2) Natural products : Chemistry & Biological Significance , J. Mann , R.S. Davidson, J. B. Hobb's , D. V. Banthrope and J. B. Harborne , Longmar Essex
3) Elements of Inorganic Photochemistry , G. J. Ferrandi , wiley
4) Principals of bioinorganic chemistry , S. J. Lippard and J. M. Beng , University Science Books,
5) Principals of biochemistry , A. L. Lechinger, worth publisher
6) Biochemistry , J. David Rawn , Neil Patterson
7) Hydrophobic interactions by Ben-Naim, Plenum.

PARCTICAL COURSE

Paper No. PCH- 411 & 412

Spectroscopy:
1) Characterization of the complexes by electronic and IR spectral data.
2) Determination of indicator constant and isobestic point of an indicator.
3) Determination of stability constant of ferric thiocyanate complex.

Potentiometry:
Determination of E^o value of Ag / AgI electrode and thisombility product of AgI and PbI_2.

Conductometry:
1) Kinetic study of hydrolysis of ethyl acetate in presence of OH^- ions.
2) Determination of the critical micelle concentration of sodium lauryl sulphate in aqueous solution.

pH - Metry:
Determination of acid - base dissociation constants of an amino acids.

Polarography:
Determination of unknown concentration of Cd^{+2} / Zn^{+2} ion in the given solution by standard addition method.

Fluorimetry:
Estimation of quinine as quinine sulfate from medicinal tablets.

Cryoscopy:
Determination of mean activity coefficient of sulfate by freezing point depression method.

Kinetics:
Study of the effect of ionic strength on the reaction between persulphate and iodide by visual method.

Thermometry:
Determination of normality of given HCl & $CuSO_4$ by thermometric titration.

And project work

Semester III & IV

Semester III

ACH – 301	:	General Analytical Techniques
ACH – 302	:	Organo Analytical Chemistry.
ACH – 303	:	Fundamental and Electro-analytical Elective Methods
ACH – 304(A)	:	Environmental Chemical Analysis and Controls.(Elective)
ACH – 304(B)	**:**	**Recent Advance in Analytical chemistry.(Elective)**

Practical: ACH – 311 & 312

Semester IV

ACH – 401	**:**	**Method separation method in Analysis.**
ACH – 402	**:**	**Organo Industrial Analysis.**
ACH – 403	**:**	**Advanced Methods in Chemical Analysis.**
ACH – 404 A	**:**	**Applied Analytical Chemistry.**
ACH - 404 B	**:**	**Techniques in Forensic sciences and** Microbiological analysis.

Practical :ACH – 411 & 412 And Project

Semester-III

ACH – 301: General Analytical Techniques

Unit-I: Theory of Volumetric and Gravimetric Analysis: (15)

Standard solutions Indicators, theory of indicators , types of titrations, Acid , base , precipitation, Redox and complexometric titrations, Acid–base titrations in nonaqueous media , solvent characterisation , living effect , applications of non – aqueous titrations , MnO_2 in pyrolusite, $Na_2Co_3 + NaHCo_3$ and $NaOH + Na_2CO_3$ Mixture analysis , Gravimetric Analysis purity of the precipitate – Co precipitation's

and post Post precipitations , precipitation from homogenous solution , organic precipitation.

Unit-II: Ion Exchange separation : (15)

Theories of ion exchange , exchange capacity , screening effects, Ponetrations of electrolytiones in ion exchange resin , sorption of complex ions , ion exchange equilitria , column operation , theory of break through curre , elution steps , use of non aqueous solvents in ion – exchange separation. Separation of halides , Rare earths and

Unit-III : Solvent Extraction : Transition metal ions using ion exchanges. **(15)**

Basic principles, Classification of solvents extraction systems, Extraction equilibria, Factors affecting extraction process , application of B- dikefones , δ -Hydroxy quinoline , dithicarbamaes , xanthates , Thiois , separation of non metals and metals.

Unit-IV : Thermal Methods of Analysis : **(15)**

Effect of heat on Materials, Chemical decomposition and T. G. Curres, Analysis of T.G. curve to show nature decomposition reactions , the product and qualities of compounds expelled, applications, instrumentation , T.G. in controlled atmosphere DTA, instrumentation and Methodology, application, DSC, theory , instrumentation and applications, Thermometric titrations method and applications.

Reference Books :

1) A. I. Vogel : A text book of Quantitative inorganic Analysis , Lonqmans. 2) O. Samuelson : Ion Exchange separation in analytical chemistry (Jhon wiley , 1963)

3) Y. Marcus and A. S. Kertes : Ion Exchange and solvent Extraction of metal complexes . (Wiley – interscience , 1969)

4) J. A. Marinsky and Y . Marcus : Ion exchange and solvent Extraction (Marcel Dekker, INC , New York , 1973)

5)G. H. Morrison and H, Freiser : Solvent Extraction in Analytical Chemistry (Jhon wiley New York, 1958)

6) A . K Da , S. M . Khopkar and R. A. chalmers : solvents Extraction of metals (Von Nostrant Ravinhold, 1970)

7) J. Stary , the solvent extraction of metals chelates (Pargaman)

8) Willard , Merrit and settle : Instrumental Methods of analysis.

ACH-302: Organ analytical Chemistry

Unit-I: Hyphenated Techniques: **(15)**

Advanced techniques of analysis: UV-Visible, IR, ^{1}H & ^{13}C NMR, Mass spectrometry, GC-MS, HPLC-MS, HPTLC-MS and their applications.

Unit-II:Pharmaceutical Analysis **(15)**

Introduction to drugs, their classification, sources of impurities in pharmaceutical raw materials such as chemical, atmospheric and microbial contaminants etc. Limit tests, limit tests for impurities like, Pb, As, Fe, moisture, chlorides, sulfates, Boron, free halogen, selenium etc.Analysis of some commonly used drugs likes sulfadrugs, antihistamines, barbiturates, vitamins (A, B6, C , E, K) etc.

Unit-III: Analysis of dyes and paints **(15)**

Types of dyes, and their analysis.

Composition and analysis of paints, determination of volatile and non-volatile constituents, flash points, separation of pigments, estimation of binders and thinners

Unit-IV:Analysis of pesticides Analysis of organochlorine, organophosphorus and carbamate pesticides. (15)

Reference Books:

1. F. J. Welcher: Standard methods of Chemical analysis, 6th Ed. Vol. I and II(D. Van Nostard Comp.)
2. I. M. Kolthoff: Treatise on Analytical Chemistry Vol. I & II
3. F. D. Snell: Encyclopedia of industrial Chemical Analysis Vol. 1 to 20 (John Wiley)
4. Riech: Outline of Indutrial Chemistry.
5. K. H. Buchel: Chemistry of Pesticides (John Wiley)
6. Indian, Pharmacopoeia, British Pharmacopoeia and U. S. Pharmacopoeia.
7. V. M. Parikh: Absorption spectroscopy of organic molecules (Addision Wesley)
8. Willard, Merrite, Dean and Settle: Instrumental methods of analysis (CBS)
9. D. H. Williams and J. Fleming: Specroscopic methods in organic chemistry (Mc Graw Hill)
10. Silverstein : Spectroscopic Identification of organic compounds (John Wiley)
11. Jackmann and Sternhill : Applications of NMR spectroscopy of organic Chemistry (Pergamon Press)
12. J. D. Roberts : Nuclear Magnetic Resonance (Mc Graw Hill)
13. K. Benjamin : Mass Spectrometry
14. Nichollas: Aids to the Analysis of foods and Drugs.
15. A. H. Beckett and J. B. Stanlake; Practical Pharmaceutical Chemistry Vol. I & II (CBS publishers)
16. S. Ranganna:Handbook of analysis and quality control for fruits and vegetable products (McGraw Hill)
17. Ramalu: Analysis of pesticides

ACH – 303: Electroanalytical techniques in chemical analysis

Unit-I: Polarography: (15)

Theory, apparatus: derivative polarography, modified polarographic techniques, sinusoidal AC polarography, pulse polarography, chronopotentometry and their application in qualitative and quantitative analysis,

Unit –II: Coulometry : (15)

Introduction: principles, technique, coulometry at constant current and controlled potential coulometry , applications and stripping analysis.

Unit-III: High frequency titration : (15)

Introduction: theory and instrumentation, high frequency titrimetry, types of cell. Advantage of high frequency methods, applications.

Unit –IV : (15)

a)Ion selective electrodes: (7)

Terminology, types and construction of electrodes, glass electrode, solid state and precipitate electrodes, liquid – liquid membrane electrodes, enzyme and gas electrodes, and applications.

b) **Electrophoresis: (8)**

Introduction: paper electrophoresis: Technique, factors affecting migration of ions, capillary and zone electrophoresis and applications.

Reference Books:

1. R.D. Braum, Introduction to Instrumental Analysis.
2. Willard, Deritt, Dean and Settle, Instrumental methods of Analysis.
3. F. J. Welcher, standard Methods of chemical Analysis Vol.3,PartA & B.
4. G.W. Ewing, Instrumental Methods of Analysis 4^{th} and 5^{th} editions.
5. Chatawal and Anand, Instrumental Methods of Analysis.
6. Bassett, Denney-Jeffer and Mendham, Vogel's Textbook of Quantititative Inorganic Analysis,(5^{th} edition).
7. Electro-analytical chemistry, edited by H.W.Nurnberg.
8. Kortum and Bockris, A Textbook of Electrochemistry.
9. D.A. Maclines, Principles of Electrochemistry.
10. Stulic, Ion selective electrodes (John Wiley).

ACH –304(A): Environmental Chemical Analysis and Control

Unit-I: Sampling in analysis : Definition, theory and techniques of sampling , sampling of gas , liquids and solids , Criteria of Good sampling , Minimization of Variables , transmission and storage of samples , high pressure ashing techniques (HPAT), particulate matter , its separation in gas stream, Filtering and gravity separation. Analysis of particulate matter like asbestos, mica, dust and aerosols etc**.** **[15]**

Unit-II: **Environment its characteristics and Classification:** Metallic and non-metallic pollutants, Cr, Hg, Pb,Cd,Cu,As etc. Their physiological manifistation, source, analysis and control of inorganic compounds. (15)

Unit-III: Chemistry of Air pollutants, Characterization. Source, methods of analysis of air pollutants ; CO,CO2, NOX,NH3,H2S,SO2,etc. Monitoring Instruments, Potable and Industrial water, major and minor components, dissolved oxygen(DO) Chemical oxygen demand(COD) Biochemical oxygen demand(BOD) and their measurements and significance in waste water treatments, Threshold odour number. [15]

Unit-IV: Quality of Industrial waste Water analysis for organic and Inorganic constitutents, Chemistry of odour and its measurements, Radioactive wastes and its control, Seweage and sludge analysis. Treatment, disposal and source of phenolic residue, Analytical methods, treatment by using stream. Gas stripping, ion exchange, solvent extraction, oxidation method and microbiological treatment. (15)

Recommended books ;

1. A.K. De : Standard Methods of Waste and Waste water analysis.

2. S.M. Khopkar, Environmental Chemistry ; Environmental pollution analysis.
3. M.S. Creos and Morr, Environmental Chemical Analysis, American publication(1988)
4. A.K. De, Environmental Chemistry, New Age International publishers.Moghe and
5. Ramteke, Water and waste water analysis : (NEERI)
6. A.C. Stern, Air pollution: Engineering control vol.IV(AP)
7. P.N.Cheremisinoff and R.A.Young, Air Pollution controland Design.Hand Book Vol.I&II (Dekker)
8. R.B.Pohasek, Toxic and Hazardous waste disposal, Vol.I&II (AAS)
9. M.Sitting, Resources Recovery and Recycling, Handbook of industrial Waste.
10. B.K.Sharma, Industrial Chemistry.
11. S.P.Mahajan, Pollution Control in Process Industries.
12. R.A.Horne, Chemistry of our Environment.

ACH-304(B) : Recent Advances in Analytical Chemistry

Unit-I: Ultra Purity and Ultra trace Analysis: (15)

Ultra purity and ultra trace analysis, laboratory dosing, purification of reagents, Preconcentration Techniques, Methods of trace analysis such as NAA, XRF,AAS and ICP, High purity materials for electronic industry, contamination control during analytical operations.

Unit-II: Radio-analytical Chemistry: (15)

Separation methods, Precipitation, solvent extraction and chromatographic methods. Activation analysis, basic principles, fast neutron activation analysis, radiochemical methods in activation analysis, Applications if Geo-chemistry, oxygen in metals.

Isotope dilution analysis: Principles and applications.

Sub-stoichiometric determination of traces of metals: Principles, techniques and experimental methods in the determination of As, Pb and Hg.

Unit-III : Advanced Techniques in Analysis: (15)

C^{13},P^{15}, O^{17} MNR Spectroscopy applications.

Unit-IV : Electron Spin Resonance Spectroscopy: (15)

Electron behavior, ESR spectrometer, Spectra, Hyperfine interaction, free radical and interpretation of the spectra, Applications in quantitative analysis. Numerical problems.

Recommended Books:

1. Garen W. Ewing, Analytical Instrumentation, Handbook, Marcel Dekker Inc. (1997).
2. Mereitt, Dean, Settel, Instrumental methods of Chemical Analysis.
3. M. Zeif and J.W.Mitchell, Contamination Control in trace elemental analysis.
4. Ajuja, Ultrapurity.

5. Minczewski,Chwastowska and Dycozynski, Separation and pre-concentration methods in Inorganic trace analysis.Ellis Haward.
6. Cali, trace Analysis of semiconductor Materials Pergamon.
7. Overman and Cleark, Radioisotopes techniques MGH.
8. Tolgyessy, Brown and Kyrs, Isotope dilution analysis.
9. Leniham and Thomson, Activation Analysis(AP)
10. Ruzica and Stary, Substopchiometry in Radiochemical Analysis. Pergamon.
11. Ladd and Lee, Radiochemistry.
12. Clerk, Handbook of Radiochemical methods
13. Price, Nuclear radiation detections.

ACH-304(C):Chemical Analysis in Agro, Food and Pharmaceutical Industries.

Unit – I :Analysis of soil, Fuel, Body Fluids and Drugs (15)

Analysis of soil: Moister, pH, total nitrogen, phosphorous, silica, lime, Magnesia, Manganese, sulfur & alkali salts.

Food analysis: Solid, liquid and Gas , ultimate and proximate analysis heating values , grading of cool , liquid fuels , flasks points , aniline point , octane number and carbon residue , gaseous fuels – producer gas and water gas – calorific value.

UNIT-II [15]

Clinical Chemistry: Composition of blood collection, and preparation of samples, clinical analysis – serum electrolytes, blood glucose, blood urea nitrogen , uric acid , albumin , globulin , barbiturates , acidic and alkaline phosphates , Immunoassay , principals of radiimmunoassry, , and applications . The blood gas analysis – trace elements in the body.Drug analysis: Narcotics and dangerous drugs, classification of drugs, screening by gas m thin layer chromatography and spectrophotometric analysis.

Unit – III: Food analysis : (15)

Moister, ash, crude protein, fat, crud fiber, carbohydrate, calcium, potassium, sodium, and phosphates, food adulteration – common adulteration in food, contamination of food stuffs, microscopic examination of foods for adulterants, Pesticide analysis in food products, Bxdraction and purification of sample, HPLC, gas chromatography for organo – phosphates, thin layer chromatography for identification of chlorinated pesticides in food products

Unit –IV: Fluorescence in Biological, Medical and Drug Development (15)

Fluorescence instrumentation for analysis, fluro phare and their modification , pH – indicators , membrane potential probes , lipid membrane protein labeling of protein and DNA.

Recommended Books:

1. Fundamentals of analytical chemistry by D. A. Skuog , D. M. West and F. J. Honer, W. B. Saunders.

2. Chromic phenomenon , The Technological application of color chemistry Peter Bamfield .

Practical Course

ACH-311 & 312

List of Experiments:

1.Determination of Al/Mg 8-Hydroxyquinoline as complexing agents by spectrophotometric method.
2. Analysis of Pyrolusite ore with respect to Acid insoluble residue, Iron and MgCl2.
3. Analysis of bauxite with respect to silica, Aluminium and Iron.
4. Analysis of Cupranickel(monel metal) alloy for copper and Cickel content.
5. Fertilizer analysis for N,P,K.
6. Estimation of Na, K and Li individually by Flame Photometry.
7. Determination of sulphate by Turbidimetry.
8. Estimation of nitrogen,oxygen and Carbon dioxide in mixture by Orsat apparatus.
9. Analysis of iodized table salt.
10. Analysis of soda ash.
11. XRD and Thermal analysis Kaolinite, cobalt oxalate and zinc oxalate.
12. Analysis of glass and fluxes.
13. Estimation of hydroxy group by acetylation.
14. Analysis of vitamin A infood products.
15. Analysis of vitamin C in juices and squashes.
16. Determination of sap value and iodine value of an oil.
17. Estimation of the purity of a given azo dye by colorimetry.
18. Analysis of Lindane in BHC powder.
19. Analysis of malathion by colorimetry.
20. Determination of moisture in pharmaceuticals.
21. Estimation of nitrite in meat colorimetrically.
22. Estimation of mercury in skin ointment.
23. Chemical analysis of chill/turmeric powder.
24. Kjeldahl's method of protein estimation in foods and feeds.
25. Determination of strength of acetic acid I commercial vinegar by conductometric method.
26. Determination of pK value of an indicator.
27. Photometric titration of Ca and Mg with EDTA.
28. Simultaneous estimation of Cl and I by potentiometric method.
29. Estimation of bicarbonate and carbonate by potentiometric method.
30. Estimation of Fe by ceric sulphate and potassium dichromate titration potentiometrically.
31. Polarographic estimation of traces of Cu, Cd, Ni, Zn and Fe in sample solution.
32. Electrogravimetric estimation of copper in solution.

33. Coulometry: Coulometric determination of simple ions.
34. Identification of organic compounds by their IR spectra.
35. Determination of chloride and sulphate with an adsorption indicator.
36. Estimation of vitamin B2 in the medicinal tablets fluorimetrically.
37. Kinetic study of hydrolysis of ethyl acetate in presence of OH^- ions conductometrically.
38. Determination of normality of given HCl and $CuSO_4$ thermometrically.
39. Determination of pK of given dibasic acid pH-metrically.
40. Determination of concentration of Fe ion in ferric salicylate complex spectrophotometrically.
41. Any other suitable experiment as needed.

SEMESTER – IV

ACH-401: Modern Separation Methods in Analysis:

Unit-I : Gas Chromatography: (15)
Principles, Plate theory, Instrumentation and working of a Gas Chromatograph, Detectors, programmed, temperature G.C., Applications.

Unit-II : High Performance Liquid Chromatography; (15)
Principles, Instrumentation, Stationary support in HPLC, Applications, Super Critical Fluid Chromatography (SCFC), Characteristics, Instrumentation and Applications. Comparison of HPLC and GLC with SCFC.

Unit-III: Ion Chromatography: (15)
Principles, Structure and characteristics of resins, eluent, supressor columns and detectors used in Ion Chromatography, analytical applications, environmental speciation by Ion Chromatography.

Unit –IV: Extractive Chromatographic Separations: (15)
Introduction, Theoretical aspects of extraction chromatography, solvent extraction and extraction chromatography with chelating ligands, extraction chromatography by ion pair formation, extraction chromatography by solvation, extraction equilibria, nature of stationary phase in extraction chromatography, inert support, techniques in extraction chromatography, extraction chromatography with tributyl phosphate and other applications.

Recommended Books:

1.A.I.Vogel, a text Book of Quantitative Inorganic Analysis.
2. W H Willard, L L Merritt and J A Dean, Instrumental Methods of Analysis.
3. S. M.Khopkar, Basic Concepts in Analytical Chemistry.
4. LR. Shyder and C.H.Harvath, An Introduction to separation Science. Wiley Interscience.
5. James S Fritz and George H.Schenk Jr. Quantitative Analytical Chemistry, 2nd editions Allyn and Bacon Inc. Bosten.
6. J.G.Dick, Analytical Chemistry.
7. R.L.Pescok and L.D.Shield, Modern Methods of Chemical Analysis.

ACH-402: Organic Industrial Analysis

Unit-I: Analysis of oils, fats, soaps and detergents (15)
Introduction to natural fats and oils, Analysis of oils and fats: Softning point, Congent point, Titre point, cloud point, Iodine, Saponification, acid, hyroxyl, R-M and Polenske value, Elaiden test.Introduction to soaps, analysis of soap (saponifiable, unsaponifiable) and for unsaponified matter in soaps, Estimation of free alkali and phenol in soap. Classification of detergents (in Brief): Analysis of active ingredients from detergents (methylene blue and Hyamine-1622 method); Estimation of CMC, Chlorides, total phosphates etc.

Unit- II: Analysis of cosmetics **(15)**

a) Composition of creams and lotions: Determination of water, porpylene glycol non-volatile matter and ash content. Determination of borates, carbonates sulphate, phosphate, chloride, titanium and Zinc oxide.

b) Analysis of face powder: Estimation of boric acid, Mg, Ca, Zn, Fe, Al, and Ba.

c) Analysis of ingredients of hair dyes.

Unit- III: Food Analysis: **[15]**

Food flavours ,food colours, food preservatives, Milk and milk products , fluor staches , honey, jam, and their major component analys

Unit-IV:Analysis of petroleum products: **[15]**

Cloud point, pour point, flash point, vapour pressure, specific gravity and their determination, Estimation of 'S' and 'Pb' in petrol

Reference Books:

1. S. R. Junk and H. M. Pancoast: Hand book of sugars(AVI)
2. B. Bilot and B. V. Well: Perfumary technology (JW)
3. I. M. Kolthoff: Treatise on Analytical Chemistry Vol. I and II
4. D. Pearson: Laboratory techniques in food analysis.
5. S. Ranganna: Handbook of Analysis and Quality control for fruits and vegetable products, 2nd Ed.(Mc Graw Hill.)
6. Nicholls : Aids to the analysis of foods and drugs.
7. G. J. Mountrey: Poultry product technology (AVI)
8. Karamer Twig: Quality control for food industry (AVI)
9. G. F. Longonan: the analysis of detergents and detergent products (JW)
10. A. Davidsohn & B. M. Mlwidaky : Synthetic detergents (Book center, Mumbai)
11. M. Ash and L. Ash: A formulary of cosmetic preparations. (G. Goodwin)
12. Kurl Bauer, Dorothea Garhe, Horst Surburg: Common fregrance and flavour materials, (VCH publisher, New York)
13. F. J. Welcher: Standard Methods of Chemical analysis Vol I & II (6th Ed.)
14. S. N. Mahendru: Analysis of food products (Swan Publishers)

ACH – 403. Advanced methods in chemical analysis

Unit – I : Fluorescence and Phosphorescence Spectrophotometry; **(15)**

Structural factors, photoluminescence intensity as related to the concentration, instrumentation for phosphorescence measurements, problems.

Unit-II : Kinetic Methods: **(15)**

Theoretical basis of kinetic methods of analysis, methods of determining amount of the substance , Tangent Method, Fixed Time and Concentration method. Addition Method, Oxidation Reactions of H2O2 with thiosulphate, iodide and amino, Enzyme catalyzed reactions. Inhibitors and Activators.

Unit – III : Photoelectron spectroscopy: **(15)**

Basic principles, photoelectric affects, Photoionization process, Koopman's theorem, photoelectron spectra of simple molecules, ESCA, chemical shift, Auger electron spectroscopy – basic idea.

Unit – IV: X – ray spectroscopy: (15)

Introduction, X-Ray generation, Properties of X-radiation, X-Ray Instrumentation, X-Ray Absorption, Fluorescence and Diffraction methods of analysis and their applications.

Recommended Books:

1. H. Kaur, Instrumental Methods of Chemical Analysis. Pragati Prakashan , Meerut.
2. W H Willard, L L Merritt and J A Dean, Instrumental Methods of Analysis.
3. S. M.Khopkar, Basic Concepts in Analytical Chemistry.
4. D. Skoog and D. West, Principle of Instrumental Analysis.Holl Seamlers.
5. E. Berlin, Principles and Practice of X-Ray Spectrometric Analysis, Plenum, NewYork.
6. J. Winefordner, S. Schulman and T O Haver :Luminescence Spectrometry in Analytical Chemistry.Wiely Interscience NewYork.
7. H. Mark and G Rachnitz, Kinetics in Analytical chemistry. Interscience NY.

ACH-404(A): Applied Analytical Chemistry;

Unit-I: Analysis of Minerals and Ores: (15)

Bauxite, haematite, dolomite, phosphates, monazite, pyrites and the chemicals from sea.

Unit-II ; Analysis of metals and alloys: (15)

Foundry materials, analysis of coal, ferroalloys, and special steels, slags, fluxes, brass and bronze.

Unit-III ; analysis of soil and fertilizers: (15)

Method of soil analysis, soil fertility its determination, determination of inorganic constituents of plant materials, Chemical analysis as measure of soil fertility, analysis of fertilizers.

Unit-IV: (15)

a)Analysis of Pesticide residues: (5)

Estimation of Malathion, parathion. Organomercurials and related pesticides residues in food samples.

b)Types of plastics and their Identifications: (5)

Determination of molecular weight of plastic and determination of metallic impurities in plastics.

c) **Explosives:** **(5)**

Types and Analysis.

Recommended Books:

1.Hillebrand Lhundel, Bright and Hoffiman, Applied Inorganic Analysis, John Wiley.
2. Snell and Biffen, Commercial Methods of Analysis.
3. P.G. Jeffery, Chemical Methods of Rock Analysis, Pergamon.
4. Buchel, Chemistry of Pesticides. J Wiley.
5. Rieche, Outlines of Industrial Organic Chemistry, ButterWorth.
6. F.A.Henglein, Chemical Technology, Pergamon.
7. Kent, Riegl's Industrial Chemistry,Rainhold.
8. Chopra and Kanwar,Analytical Agriculture Chemistry, Kalyani Publishers.
9. Aubert and Pintes, Trace Elements in Soils.
10. Bear, Chemistry of Soil.
11. Hauson, Plant Growth Regulators, Noyes.
12. P.G.Jeffery and D.J. Hatchinson, Chemical Methods of Rock Analysis.
13. F.J.Weleher, Standard Methods of Chemical Analysis, A Series of Volumes Robert and Krigeger Publishing Company.
14. I. M.Kolthoff and PJ Ewing, Treatise o Analytical Chemistry, A series of Volumes.
15. R.D. Reeves and R.R. Brooks, Trace element Analysisof Geological Materials, John Wiley & Sons NewDehli.
16. W.M. Johnson and J.A.Maxwell,Rock and Mineral Analysis, John Wiley and Sons, NewYork.
17. W.F.Hildebrand, G H C Landell and HABrighot, Applied Inorganic Analysis, John Wiley 2nd Edition.
18. K.J.Das, Pesticide Analysis(MD).

ACH-404(B): Techniques in Forensic Science and Microbiological Analysis

Unit-I: Forensic Analysis: [15]

Special features of Forensic analysis, sampling, sample storage, sample dissolution, classification of poisons, Lethal dose, significance of LD 50 and LC 50.

Unit-II: Identification and Analysis in the suspects: **[15]**

Poisonous elements viz As, Sb, Pb, Cr and Hg.

i)Insecticides Analysis of metals, Gun powder Residues, portland cement in Forensic samples.

ii) Poisoning due to cyanide dioxines & asbestos.

iii) Physiological effects of natural poisons such as Col Chicine, Morphine, Hashish , Nicotinoids.

iv) Health hazards and Remedial measures.

Unit-III: Analytical Microbiology **[15]**

Morphological structure and characteristics nutrition and physiology, classification of microorganisms, Taxonomy and nomenclature Nutritional requirements Phathoseas and Spoilage organics Microscopy, Staining techniques, Aspatic Techniques, isolation and use of differential media, sterilization and disinfection.

Unit-IV: Applied Microbiology [15]

Air Microbiology with respect contamination control, Food Microbiology, Walia microbiology, Industrial microbiology with respect to quality control.

Recommended Books:

1.Allan Cury,Irvins Sunshine,Forensic Analysis, Academic Press Publications.
2. E.G.J.Clarics, Isolation and Identification of drugs, Pharmaceutical Press.
3. C.J.Creswell, C.A.Runquist and M.M.Campbell, Spectral Analysis of Organic Compounds.
4. F.J.Welcher, Robert E,Standard Methods of Chemical Analysis, A series of volumes.
5. Hawk's Physiological Chemistry.
6. D.J.Holme and H. Pack, Analytical Biochemistry, Longman.
7. G. Keleti and W H Liederer, Hand book of micro methods for the biological science-VNR.
8. C H Collins, Microbiological Methods, Butterworths.

ACH – 404(C) : Computational Chemistry

Unit_I: Fortran/C: **(15)**

Programming and numerical method feature of fortran C : Basic theory

a)Solution of equation: Bisection, regular tabs, Newton – Raphion and related method for solving polynomical and trancendented equation, convergence. errors and ill – containing

b) Liner simultaneous equation : Gaussion alimination , Gauss – seidel method , Gauss jorden method . Fivolting strategy, errors and ill - ----------

UNIT-II [15]

c) Numerical Differentiation :

Solution of simple differential equation by Tegler seies and Rurge – Kutta methods.

d) Numerical Differentiation :

Newton – coted formulae, Romberg integration , errors in integration formulae .

Unit – III : Internet: **(15)**

Introduction to networking and search using Internet.

Unit – IV: Running of advanced scientific packages. **(15)**

Project:

The student will develop utilities such as analysis of spectra, simulation programs which will supplement laboratory of theory exercises in Physical, Organic, Inorganic or Analytical chemistry.

Recommended Books:

1.Computational Chemistry, A.C.Norris, John Wiley.
2. Computer Programming in FORTRAN 77, Rajaraman, Prentice Hall.

3. Numerical Analysis, C.E.Frogberg, Macmillan.
4. Numerical Analysis, A Practical Approach, M.J. Maron, John Wiley.
5. Numerical Methods for Scientists and Engineers, H.M.Anita, Tata McGraw Hill.
6. Computers in Chemistry, K.V. Raman

Practical Course

SEMESTER-IV

Course No. ACH-411 &412

List of Experiments

1. Standardization of perchloric acid by nonaqueous titrations.
2. Estimation of calcium from chalk.
3. Colorimetric and spectrophotometric determination of manganese insteel.
4. Statistical Revaluation of spectrophotometric data.
5. Estimation of N-methyl and c-methyl groups.
6. Determination of total salts by cation exchange.
7. Anion exchange separation of Iron, cobalt and nickel.
8. Solvent extraction separation of iron from marncrike using diethyl ether and their determination by titrimetrically.
9. Estimation of amount of copper(II) with EDTA spectrophotometrically.
10. To study the complex formation between Fe(III) and salicylic acid and determine the stability constants of the complex by Job's variation method.
11. Calculation of standard deviation from the results obtained by redox titration of Fe(III) against standard solution of K2Cr2O7.
12. Simultaneous spectrophotometric determination of Cr and Mn and Ti and V.
13. Analysis of chrome steel alloy for chromium and nickel content.
14. Agricultural analysis of,
    Soil sample, animal feeds, soil micronutrients, milk powder for Ca, Fe and P content.
15. Estimation of sulphadiazine/ sulphonamide.
16. Estimation of sodium benzoate/sodium metabisulphite, boric acid and salicylic acid in food.

17. Analysis of Ferrosilicon and Ferrovanadium.
18. Estimation of Ibuproven/Paracetamol in a pharmaceutical sample.
19. Solvent separation of U(VI) from Mg(II) by oxine.
20. Experiments on chromatography such as quantitative determiantion of methanol Ethenol.
21.Estimation of Aluminium in steels by Rludrescence Method.
22.Determination of sovalrility product of Aqel and Ag2 Cro4
23.Analysis of Felspar ore.
24.Analysis of Rocks (Available in this region)
25. Estimation of Zinc, Managanese in moisture by direct campleometric method at controled Ph.
26. Chromatographic sepration of sugars ,amino acids by paper,T.L.C.and Ion exchange methods (both qualitative and quantitative method) sepration organic compounds by column chromatograpy.
27. Analysis of milk.
28. Analysis of some common pesticides,insecticides,plastics and detergents.
29.Estimation of Urea,Uricacid and creathinine in Urine.
30.Estimation of blood sugar,calcium ,and total nitrogen and non-protien nitrogen in blood.
31.Determination of dissociation constant of weak acid pH-metrically.
32.Esimation of B2 fluorimetrically.
33.Estimation of Zn in the given solution fluorimetrically.
34.Determination ofpK`s of tribasic acid,by potentiometry.
35.Latent heat of fusion of solid naphthalene.
36.Conductometry;
a)Determination of critical micellae concentration of given surfactants.
b)Estimation of acetyl salicylic acid in given aspirin tablet by titration against alkali.
37. **Potentiometry:**
Determination of dissociation constant of Cu-ammonia complex potentiometricaly.
And
Estimation of acetyl salicylic acid in the givn aspirin tablet by titrating against 0.1N alcoholicKOH potentiometrically.
38. **Polarography:**
Determination of concentration of given solution by std addition method polarographically.
39. **Amperometry:**
To determine the stength of lead nitrate by titrating against std. K2Cr2O7 solution amperometrically.
40**.pH-metry**
Determination of hydrolysis constant of aniline hydrochloride pH-metriclly To determine the acid base dissociation constant and isoelectric point of aminoacid pH-metrically
41. **Spectrophotometry-**
Determination of an indicator constant and isobestic point of an indicator spectrophotometrically
and
Determination of stability constant of ferric thiocynate complex spectrophotometrically.

42.Kinetics:

To determine the thermodynamic parameters such as Free Energy,Heat Content,Change in Entropy for formation of Zinc amalgam at 298K by emf mesurement.

B) **Project :**

Literature survey,synthesis,Reaction mechanism and Kinetics,Analysis of air, water and soil samples, solid state materials, organometallic,Bioinorganc materials,The Project/Review work will be exemined jointly by internal and enternal examiners at the time of practical examination.

C) Any other experiments as may be needed.