Jananayak Chandrashekhar University Ballia

New

Faculty of Science

Department of Chemistry

Syllabus

(W.E.F. 2022-2023)

JANANAYAK CHANDRASHEKHAR UNIVERSITY

BALLIA, UP- 277001

Department of Chemistry

(To be effective from session 2022-23)

Programme: M.Sc. Chemistry

1. Preamble of the Syllabus:

Master of Science (M.Sc.) in Chemistry is a post graduation course of Jananayak Chandrashekhar Universiy Ballia. The aim of this programme is to impart in-depth knowledge and skill to meet the current needs of industry, educational and R&D (research and development) institutions. The revised curriculum is based on Choice Based Credit System and is developed with a viewpoint to keep pace with quality and quantity of knowledge of modern chemical science. In formulating these courses care has been taken to keep in mind the regional and national priorities maintain national and international educational standards.
The term credit is used to describe the quantum of syllabus for various programs in terms and hours of study. It indicates differential weightage given according to the contents and duration of the courses in the Curriculum design. Credit based system is flexible curriculum pattern with many merits. It is devoid of many limitations associated with the conventional rigid pattern of curriculum. Each course is assigned a weight (credit) depending upon its relative importance to the programme of definite total credit rating. In addition, several elective papers (choices) have been included in order to suit for the career of the students.
The curriculum to be implemented with this system would allow students to migrate between different institutions due to their own compulsions without losing their precious time. This system also has a benefit for students to develop a strong footing in the fundamentals with flexibility in selecting courses of specialization in the discipline of his/her liking and abilities.

2. Programme Structure

a. Master's degree programme in chemistry would be of 100/101 credits and 2300 marks.

b. Every student shall complete 100/101 credits and 2300 marks in four semesters.

c. In each semester, there will be 4 theory papers, one Practical and one project of 4 credits each. Thus, there will be 24 credits in each semester.

d. The student will have to complete a project of 4 credits in each semester (total -16 credits in 4 semesters) under the supervision of a supervisor.

e. The projects reports carried out in 1st and 2nd semesters and 3rd and 4th semesters will be submitted in end of second and fourth semester before/after examination. Both projects will be evaluated out of 100 marks (8 credits) by the supervisor and the external examiner appointed by the University at the end of the first and second year respectively.

f. One of the projects reports (1st or 2nd and 3rd or 4th semesters) will also presented in form of PPT in end of first and second year after submission.

g. In 1st or 2nd semester, the student will have to opt for a **minor elective paper** of 4/5 credits from a faculty other than their main faculty.

h. Academic calendar showing dates of commencement and end of teaching and examination will be prepared and duly notified before commencement of each semester every year.

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M.Sc. I

Semester I

Paper No.	Paper (Core course)	Course Code	Teaching hours	Credits	Max. Marks
I	Inorganic Chemistry	CHE-101	60	4	100
II	Organic Chemistry	CHE-102	60	4	100
III	Physical Chemistry	CHE-103	60	4	100
IV	Sec- A Computer for chemist (compulsory for all students)	CHE-104	60	2+2= 4	50+50=100
	Sec- B Mathematics for Chemist (for students without mathematics in B.Sc.) **or** Sec-C Biology for Chemist (for students without biology in B.Sc.)				
V	Practical	CHE-105	60	4	100
VI	Project I	CHE-106		4	
	Total		*300*	*24*	*500*

M.Sc. I

Semester-II

Paper No.	Paper (Core Course)	Course Code	Teaching hours	Credits	Max. Marks
I	Inorganic Chemistry	CHE-201	60	4	100
II	Organic Chemistry	CHE-202	60	4	100
III	Physical Chemistry	CHE-203	60	4	100
IV	Spectroscopy and Diffraction methods	CHE-204	60	4	100
V	Practical	CHE-205	60	4	100
VI	Project II	CHE-206		4	100*
	One Minor Elective paper from other faculty in 1st or 2nd Semester		60	04/05	100
	Total		*360*	*28/29*	*700*
	Grand Total M.Sc. I		***660***	***52/53***	***1200***

- *The projects reports carried out in 1st and 2nd semesters will be submitted in second semester before/after examination. Both projects will be evaluated out of 100 marks (8 credits) by the supervisor and the external examiner appointed by the University at the end of the first year.
- One of the projects reports (1st or 2nd semesters) will also presented in form of PPT in second semester before/after examination.
- In 1st or 2nd semester, the student will have to opt for a **minor elective paper** of 4/5 credits from a faculty other than their main faculty.

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M.Sc. II

Semester-III

Paper	Paper (Core course)	Course Code	Teaching hours	Credits	Max. Marks
I	Application of Spectroscopy	CHE-301	60	4	100
II	Sec-A Bioinorganic & Sec-B Bioorganic Chemistry	CHE-302	60	2+2=4	50+50= 100
III	Sec-A Environmental Chemistry & Sec-B Photochemistry	CHE-303	60	2+2=4	50+50=100
IV	Biophysical Chemistry and Solid state Chemistry	CHE-304	60	4	100
V	Practical	CHE-305	60	4	100
VI	Project III	CHE-306		4	
	Total		*300*	*24*	*500*

M.Sc. II

Semester-IV

Paper	Paper	Course Code	Teaching hours	Credits	Max. Marks
I	Organic Synthesis-I	CHE-401	60	4	100
II	Polymers Chemistry	CHE-402	60	4	100
III	Organo Transition Metal Chemistry **(O)**	CHE-403	60	4	100
IV	Analytical Chemistry **(O)**	CHE-404	60	4	100
V	Natural Product **(O)**	CHE-405	60	4	100
VI	Medicinal Chemistry **(O)**	CHE-406	60	4	100
VII	Practical	CHE-407	60	4	100
VIII	Project IV	CHE-408		4	100*
	Total		*300*	*24*	*600*
	Grand Total M.Sc. II		***600***	***48***	***1100***
	Grand Total (For Semester I,II,III and IV)		**1260**	**100/101**	**2300**

- The students should select any two papers from optional papers (O).
- *The projects reports carried out in 3rd and 4th semesters will be submitted in fourth semester before/after examination. Both projects will be evaluated out of 100 marks (8 credits) by the supervisor and the external examiner appointed by the University at the end of the second year.
- One of the projects reports (3rd or 4th semesters) will also presented in form of PPT in second semester before/after examination

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M.Sc. I
Semester-1

CHE-101 Paper-I (4 credits), 100 Marks
Inorganic Chemistry

Learning Outcomes - After going through the course the students will be able to

- Understand basic concepts of group theory and its applications.
- Define Symmetry of molecules and relations between molecular spectra and molecular structure.
- This paper focuses on the mathematical tools which are necessary to apply symmetry concepts to spectroscopy.
- Fundamental aspects of classifying molecules based on various symmetry elements, point groups and constructing character table.
- To prepare the students to understand and correlate preparation, structure, bonding and properties of main group elements and complexes.
- Advanced principles of bonding in inorganic compounds. Kinetic and thermodynamic parameters as a measure of stability of coordination compounds.
- Advanced theories of bonding in complexes along with their stereochemistry.
- Mechanisms of inorganic redox reactions involving coordination compounds.

UNIT-I: Symmetry and Group Theory

Symmetry elements and symmetry operations with reference to water, ammonia, ethane, benzene, etc.
Classifications of molecules/ions based on their symmetry properties.
Derivation of matrices for rotation, reflection, and inversion operations
Symmetry point groups applied to all types of molecules Cnh, Dnh, Cnv, Id, Oh.
Group multiplication basis, matrix representation, character of a representation, character table, reducible and irreducible representation, group, groups and subclasses.

UNIT-II: Stereochemistry and Bonding in Main Group Compounds

VSEPR. Walsh diagrams (tri and penta-atomic Molecules), d7r-p7r bonds, bent rule and energetic of hybridization, some simple reactions of covalently bonded molecules.

UNIT-III: Metal-Ligand Equilibria in Solution

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

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UNIT — IV: Metal-Ligand Bonding

Limitation of crystal field theory and molecular orbital theory. Octahedral, tetrahedral and square planar complexes π-bonding and molecular orbital theory.

Assignments-

What do you mean by group theory?
What are main feature of VSEPR theory.
What is the stability of metal complexes?
What are the concepts of MOT?

Books Recommended.

1. F.A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn.(1999), John Wiley & Sons, New York.
2. James E. Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley Pub. Co., New York.
3. Chemistry of the elements, N. N. Greenwood and A. Earnshaw, Pergammon.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier.
5. Comprehensive Coordination Chemistry eds., G Wilkinson, R. D. Gillars and J. A. Mc Cleverty. Pergammon.
6. Magneto Chemistry, R. L. Carlin, Springer Verlag.

M.Sc. I

Semester-1

CHE-102 Paper II (4 credits), 100 Marks

Organic Chemistry

Learning Outcomes - After going through the course the students will be able to.

- To understand principles of organic reaction mechanism, substitution, elimination, homo- and hetero bond addition reactions. Stereochemistry of organic compounds, isomerism, different projection formulae withnomenclature and prochirality.
- Conformation and stability of substituted cyclic systems, nomenclature and conformations of fused rings and bridged ring systems.
- Mechanisms and evidences for aromatic electrophilic and nuleophilic substitutions,addition reactions, elimination reactions and rearrangements.
- Effect of substrate structure, leaving group and attacking species in the above reactions.
- The orientation and stereochemistry of the product formed.

UNIT-I:

Nature of bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, Hyperconjugation, bonding in fullerenes. Aromaticity in benzenoid and non-benzenoid Compounds, Huckel's rule, energy level of pi-molecular orbitals, annulenes, antiaromaticity.

UNIT-II

(a) Reaction mechanism, Structure and reactivity Methods of determining mechanism, isotope effect. Generation structure, stability and reactivity of benzynes, carbenes and nitrenes. Effect of structure on reactivity resonance and field effect, steric effect, quantitative treatment.

(b) Stereochemistry Conformational analysis of cycloalkanes, decalines, effect of conformation of reactivity Elements of symmetry, chirality, molecule with more than one chiral center, threo and erythro isomers, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon biphenyl's, alleries.and spiranes

UNIT-III

Aliphatic nucleophilic substitution

The SN_1, SN_2, mixed SN_1 and SN2, neighboring group participation by Pi and Sigma bonds, anchimeric assistance Classical and non classical carbocations. The SNi mechanism nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile. leaving group and reaction medium, ambident nucleophile, regioselectivity.

UNIT-IV

A-Aromatic electrophilic substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The Ortho/Para ratio, ipso attack, orientation in other ring systems. Vilsmeir reaction, Gattemann-Koch reaction.

B-Aromatic nucleophilicsubstitution:

The SN_{Ar}. SN_1, benzyne and SRNi mechanism. Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet Hauser, and Smiles rearrangements.

Assignment-

a -What do you mean by hyper conjugation and aromaticity.

b- Define confirmation and configuration.

c -Define different types of nucleophilic substitution reactions.

d-Discuss the mechanism of SN_1& SN_2

BOOKS SUGGESTED

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R3. Sundberg. Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University press.
5. Organic Chemisty, RT. Morrison and RN. Boyd. Prentice Hall.
6. Modem Organic Reactions H.O. House, Benjamin
7. Principles of Organic Synthesis, R.O.C. Normon and J.M. Coxon, Blackie Academic and professional.
8. Pericyclic Reactions. S.M. Mukherji, Macmillan India.
9. Reaction Mechanism in Organic Chemistry: S.M. Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S Kalsi, New:Age, International.

M.Sc. I

Semester-1

CHE-103 Paper III (4 credits), 100 Marks

Physical Chemistry

Learning Outcomes: After going through the course the students will be able to

- To understand principles and instrumentation of different molecular spectroscopic methods
- Application of quantum mechanics in physical models and experiments of chemical systems. It is also called molecular quantum mechanics.
- Time dependent and time independent Schrödinger equations with solutions in simple systems.
- Matrix representation of quantum mechanics is discussed together with approximate methods..
- Qualitatively predict which signals are to be observed in the rotational, vibrational or Raman spectrum of various materials ranging from single atoms (atomic spectroscopy)
- to molecules.
- The collision model of chemical reactions and how various factors such as temperature and catalyst can affect reaction rate and mechanism of thermal and photochemical hydrogenhalogen reactions.
- Different theories of Unimolecular reactions; Perrin theory, Lindemann-Christiansen
- Hypothesis, Hinshelwood treatment, RRK treatment and RRKM treatment.

UNIT-I: Vibrational 'Spectroscopy

A.Unifying Principles

Electromagnetic radiation, interaction of Electromagnetic with matter-absorption and transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and line width and natural line broadening, selection rules, intensity of spectral lines.

B.Infrared Spectroscopy

Review of linear harmonic oscillator. vibrational energies of diatomic molecules, zero point energy, force constant and bond strength: anharmonicity, P.Q.R. branches, vibrations of polyatomic molecules, Selection rules, normal modes of vibration. Factorsaffecting the band positions and intensities.

C.Raman Spectroscopy Classical and quantum theories of Raman effect Pure rotational, vibrational and vibrational-rotational Raman spectra. selection rules. mutual exclusion principle. Applications of Raman spectroscopy.

UNIT- II:Quantum Chemistry

A.Fundamental Background of Operators,

Postulates of Quantum Mechanics, Hamiltonian for different systems, Angular momentum.

B.Introduction to Exact quantum Mechanical Results:

The Schrodinger equation. Discussion of solutions of the Schrodinger equation to some model system viz. particle in a box,the harmonic oscillator, the rigid rotator, the hydrogen atom.

UNIT- III: Quantum Chemistry.

A .Approximate Methods:

The Variation theorem, linear variation principle. Perturbation theory (First 'o'rder and nondegenerate)\ Application of variation method and perturbation theory to the H_2 molecule and H_2^+ion.

B.Electronic structures of Atoms:
Russel-Saunders terms and coupling schemes, term symbols for the p^n and d^n configurations Spin orbit coupling and Zeeman splitting, introduction to the methods of self-consistent field, Slaters type orbitals.
C.Molecular orbital theory:
Huckel theory of conjugated systems, bond order and charged density calculations. Application to ethylene, butadiene, cyclobutadiene and Benzene molecules.

UNIT- IV: Chemical Dynamics

Methods of determining rate law, collision theory of reaction rates steric factors Activated complex theory, Arrehenius equation and the activated complex theory. Ionic reactions kinetic salt effect, steady state kinetics. Dynamic chain(hydrogen-bromine reaction,pyrolysis of acetaldehyde) photochemical (hydrogenbromine reaction hydrogen-chloride reactions) and oslillakiry reactions (Belousav Zhabotinsky reaction) homogeneous catalysis,kinetics of enzyme reaction General features of fast reaction study of fast reaction by relaxation method flash photolysis and the nuclear mLgnetie resonance method. Dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice -Rampsperger- kassel -marcus (RRKM) theories of unimolecular reactions)

Assignment-
What do you mean by intensity of spectral lines?
Define molecular spectroscopy.
Give the general idea of quantum mechanics.
What are the factors which influencing the rate of reactions.

BOOKS SUGGESTED

1. Modem Spectroscopy.J.M. Hollas,john Wiley.
2. Physical methods in chemistry RS. Drago, Saunders College.
3. Introduction to 'Molecular Spectroscopy G.M.Barrow, Me Graw Hill.
4. Physical Chemistry P.W Atkins PLBS.
5. Introduction to Quantum Chemistry, A.K. Chandi., Tata Me Graw Hill .
6. Quantum Chemistry. Ira N. I.cvinc. Prentice Hall.
7. Coulson's Valence. R.MeWeeny, ELBS.
8. Chemical Kinetics. K.J. Laidler. Mcgraw-Hill.
   Kinetics and Mechanism of Chemical Transformations J. Rajaraman and J.Kuriacosc Mc Milian.

M.Sc. I
Semester-1

CHE-104 Paper IV (2 Credits) 50 Marks
Sec-A: Computers for Chemists (Compulsory for all students)

Learning Outcomes: After going through the course the students will be able to

- The ability to use the power of computers in applications in chemistry.
- The ability to communicate effectively, both orally and in writing.
- Learned how to think critically and analyze chemical problems.
- The ability to read, evaluate, interpret, and present (via oral and written communication) numerical, chemical and general scientific information and literature.
- The ability to work effectively and safely in a laboratory environment.
- This is a theory-cum-laboratory course with more emphasis on laboratory work.

UNIT- I: Introduction to Computer and Computing:

Basic structure and functioning of computers with a PC as an illustrative example Memory,I/O devices, Secondary storage. Computer languages. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS Data Processing principles of programming, algorithms and flowcharts.

UNIT- II: Computer Programming in FORTRAN/C/BASIC:

The language features are listed here with reference to FORTRAN. The instructor my choose another language such as BASIC or C and the features may be replaced appropriately. Elements of the computer language. Constants and variables. operations and symbols, expressions. Arithmeticassignment statement. Input and Output. Format statement. Termination statements. Branching statements such as IF or GO TO statement. LOGICAL variables. Double precision variables. Subscripted variables and DIMENSION. DO statement FUNCTION and SUBROUTINE. COMMON and DATA statements. (Students learn the programming logic and these language features by hands on experience on a personal computer from the very beginning of this topic)

UNIT- III: Programming in Chemistry:

Development of small computer codes involving simple formulae in chemistry such as van der Waals equation, pH titration. kinetics. radioactive decay. Evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory. Elementary structural features such as bond lengths. bond angles, dihedral angles etc. of molecules extracted from a database such as Cambridge data base.

UNIT- IV:

Use of Computer Programmes The students will learn how to operate a PC and how to run standard programmes and packages. Execution of linear regression. X-Y plot. numerical intergration and differentiation as well as differential equation solution programmes. Monte Carlo and Molecular dynamics. Programmes with data preferably from physical chemistry laboratory Futher, the students

will operate one or two of the packages such as MATLAB EASYPLOT LOTUS FOXPRO and Word processing software such as WORDSTAR/MS WORD.

Assignment-

Books Suggested

1. Computers and common Sense, R. Hunt and 1. Shelley. Prentice Hall.
2. Computational Chemistry, A.C. Norris.
3. Microcomputer Quantum mechanics, J.P. Killngbeck. Aoam Eiger.
4. Computer Programming in FORTRAN IV, V. Rajaraman, Prentice Hall.
5. An Introduction to Digital Computer Design. V. Rajaraman and T. Radhakrishana Prentice Hall.

Semester-I

CHE-104 Paper IV (2 credits) 50 Marks

Sec-B: Mathematics for Chemists

(For students without Mathematics in B.Sc.)

Learning Objectives –After going through the course the students will be able to

- The student will understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics, and other disciplines to a wide variety of chemical problems.
- The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
- The student will acquire a foundation in chemistry of sufficient breadth and depth to enable them to understand and critically interpret the primary chemical literature.
- The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

UNIT- I: Vectors and matrix Algebra

Vectors

Vectors, dot, Cross and triple products etc. The gradient, divergence and curl.

Matrix Algebra

Addition and multiplication: inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric Hermitian, skew-Hermitian, unit, diagonal, unitary etc) and their properties Matrix equations: homogeneous, non-homogeneous linear equations and conditions for the solution, matrix eigenvalues diagonalisation determinats (examples from Huckel theory)

UNIT- II: Calculus

Differential Calculus

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels. Bohr's radius and most probable velocity from Maxwell's distribution etc.) exact and inexact differentials with their applications to thermodynamic properties.

B- Integral calculus.

Basic rules for integration, integration by part partial fraction and substitution. Reduction formulae applications of integral calculus. Functions of several variables, partial differentiation. co-ordinate transformations (e.g. cartessian to spherical polar).

UNIT- III: Elementary Differential Equations

Variables-separable and exact first-order differential equations. homogeneous. exact and linear equations. Applications to chemical kinetics. secular equilibria, quantum chemistry etc . Solutions of differential equations by the power series method, Fourier series, solutions of harmonic oscillator and Legendre equation etc, spherical harmonics second order differential equations and their solutions.

UNIT- IV:Permutation and Probability

Permutations and combinations, probability and probability theorems, probability curves, average, root mean square and most probable errors, examples from the Kinetic theory of gases etc.

Assignment-

What are matrix and vectors?

What is use of differential calculus in chemistry?

What is use of integral calculus in chemistry?

What is use of permutation combination in chemistry?

Books Suggested:

1. The chemistry Mathematics Book, E. Steiner, Oxford University Press.
2.Mathematics for Chemistry, Doggett and Sucliffe. Longman.
3. Mathematical preparation for Physical Chemistry. F.Daniels Mc Graw Hill.
4.Chemical Mathematics, D.M. Hurst, Longman.
5.Applied Mathematics for Physical Chemistry. J.R. Barrante. Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt. Wiley.

M.Sc. I
Semester-1

CHE-104 Paper IV (2 credits) 50 Marks
Section - 'C' Biology for Chemists
(For Students without biology in B.Sc.)

Learning Outcomes – After going through the course the students will be able to

- Students will understand the scientific process, in the context of learning the fundamental biological and chemical 'facts' of molecular biology.
- Students will gain skills required to effectively do scientific research. More specifically, students will learn to implement the scientific method by proposing hypotheses to explain biological phenomena, designing and conducting experiments to test these hypotheses, and critically interpreting the resulting data.
- Students will learn to effectively communicate their results, both orally and in writing. In addition, they will be able to critically evaluate scientific literature and the current state of research progress in their area of interest.

UNIT- I:

A- Cell Structure and Functions

Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview biological energy currency. Introduction to biomolecules. building blocks of biomacromolecules.

B-Carbohydrates

Structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides-cellulose and chitin. Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Carbohydrate metabolism, Kerb's cycle, glycolysis, glycogenesis, gluconeogenesis pentose-phosphate pathway.

UNIT- II: Lipids.

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane stucture Lipid metabolism β oxidation of fatty acids.

UNIT- III : Amino-acids, Peptides and proteins

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structure α-helix, β sheets, super secondary structure, triple helix structure of collagen. Tertiary stucture 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).

UNIT- IV: Nucleic Acids

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding structure of ribonucleic acid (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for helding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity

and overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Assignments:

What are the functions of cell?

What do you mean by carbohydrates?

What areproteins?

What are nucleic acids?

Books Suggested

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

M.Sc. I
Semester-1

CHE-105 Fifth Paper (4 credits) 100 Marks
Practical
Time 12 hours in two days

Note:-

A complete records of practical exercises; in Inorganic, Organic and Physical Chemistry done during the session must be produced by the candidates in three separate Record Books at the time of practical examination.

Inorganic Chemistry

1. Qualitative analysis of mixtures 20
   Qualitative analysis of mixture containing trace elements Tl, Mo, W, Zr, Ti, Th, V, U (Two metal ions in cationic/anionic forms) and insoluble oxides, sulphates and halides. The mixture should not contain more than five cations and should be analyzed by semi micro technique.
2. Paper chromatography 05
   Paper chromatography separation of a mixture of the following and measurements of R_f values.
   a) Pb^{+2}, Ag^{+}, Hg^{+2}(b) Co^{+2}, Ni^{2}, Cu^{+2}(c) Ba^{+2}, Ca^{+2}, Sr^{+2}

Organic Chemistry

1. Qualitative Analysis 15
   Separation, purification, and identification of binary mixture. Preparation of derivatives if possible
2. Organic Synthesis 10
   Adipic acid by chromic acid oxidation of cyclohexanol.
   Triphenyl methanol from Benzoic acid. iii.Dibenzal acetone from Benzalehyde.
   p-chlorotolune from p-toludine
   Synthesis of p-nitroaniline and p-bromoaniline.

Physical Chemistry (Any one) **25**

1. Study the adsorption of acetic acid on charcoal and draw the Freundlich isotherm.
2. Show that the order of reaction between acetone and Iodine is zero with respect to Iodine
3. Determination of congruent composition and temperature of a binary mixture e.g. diphenylaminebenzophenone system.
4. Determination of glass transition temperature of a given salt (e.g., $CaCl_2$) conductometrically.
5. Determination of the velocity constant of hydrolysis of an ester / ionic reaction in micellar media.
6. Determination of the velocity Constant of decomposition of Benzene diazonium chloride.
7.

Viva **15**
Records **10**

CHE106: Project I : Credit 04, Marks : 100

M.Sc. I
Semester-II

CHE-201 Paper I(4 credits) 100 Marks
Inorganic chemistry

Learning Outcomes –After going through the course the students will be able to

- Study chemical compounds containing transition metal.
- This paper introduced to M.Sc. classes for detail study of reaction mechanism of transition metals considering substitution, elimination, and addition reaction.
- Mechanisms of Inorganic redox reactions involving coordination compounds.
- Electronic spectroscopy and magnetic properties of coordination compounds.

UNIT- I: Reaction mechanism of Transition Metal Complexes

Energy profile of a reaction, reaction reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reaction, reactions without metal ligands bond cleavage. Substitution reaction in square planar complexes. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions cross- reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT- II: Electronic spectra and Magnetic , Properties of Transition Metal Complexes: Spectroscopic ground states; Orgel energy level and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states); Chary transfer spectra; electronic spectra of octahedral and tetrahedral Co(II) and Ni(II) complexes and calculation of ligand-field parameters.

UNIT- III : Metal π-Complexes

Metal carbonyls, structure and bonding, vibrational spectra of Metal carbonyls for bonding and structural elucidation, important reactions of Metal carbonyls, preparation, bonding. Structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand.

UNIT- IV: A- Metal Clusters

Higher boranes, carboranes, metallocarboranes
Isopoly and heteropoly acids and salts

Assignment:

Define the substitution reactions in inorganic compounds

Introduce the electronic spectra of transition metal complexes.

What do you mean by pi metal complexes?

Draw the structure of different types of metal complexes

Books Recommended

1. F.A. Cotton and G. Wilkinson *Advanced Inorganic Chemistry, 6th Edn.(1999),* John Wiley & Sons, New York.

2. James E. Huheey, *Inorganic Chemistry,* 4th Edn. (1993), Addison-Wesley Pub. Co., New York.
3. Chemistry of the elements, N. N. Greenwood and A. Earnshaw, Pergammon.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier.
5. Comprehensive Coordination Chemistry eds., G Wilkinson, R. D. Gillars and J. A. Mc Cleverty. Pergammon.

M.Sc. I
Semester-II

CHE-202 Paper II (4 credits) 100 Marsk
Organic Chemistry

Learning Outcomes – After going through the course the students will be able to

- Get an idea about the mechanistic pathway of various substitution reactions.
- To study the property and reaction of carbonyl functionality.
- Learn the mechanistic pathway of organic chemistry under the terms of addition and elimination reactions
- The paper of reactions and pericyclic is introduced to M.Sc. classes for the detailed studies of reaction and concerted (pericyclic) reactions.

UNIT- I: Free radical reactions:

Free radical substitution mechanism, mechanism of an aromatic substrate, neighboring group assistance. Reactivity foraliphatic and aromatic substrates at a bridge head. The effect of solvent on reactivity. Arylation of aromatic compounds bydiazonium salt. Hunsdiecker reaction.

UNIT- II: A- Addition to carbon-carbon multiple bond:

Mechanistic and stereochemical aspects of addition reactions involving electrophile, nucleophile and free radicals, regio and chemo selectivity, orientation and reactivity. Hydrogenation of aromatic rings. Hydrobration. Michael reaction. Sharpless asymmetric epoxsidation.

B-Addition to carbon heteroatom multiple bonds:

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles, Witting reaction mechanism of condensation reactions involving enolate, Knoevenagel, Mannich, Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

UNIT- III: Elimination reactions:

The E_1, E_2 and E_1CB mechanism. Orientation of double bond. Reactivity effect of substrate structures. Attacking base, the *leaving* group' and the medium. Mechanism and orientation on Pyrolytic elimination.

UNIT- IV: Pericyclic reactions:

Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann *correlation* diagranls. FMO and PMO approach. *Electrocyclic* reactions- *conrotatory* and disrotatory motions, 4n, 4n+2 and *alyl* systems. Cycloadditions-antarafacial and Suprafacial 'additions, 4n and- 4n+2 system, Sigmatropic

rearrangements-superafacial an antarafacial shift of H,sigmatropic shifts *involving* carbon moieties, 3,-3 and 5, 5 sigmatropic rearrangements. *Claisen,*Cope and Azacope rearrangement. Fluxional tautomerism. Ene reaction.

Assignment:

What are the mechanisms of free radical reactions?

Brief the reactions in which carbon carbon bond formation takes place

Define the types of pericyclic reactions

Explain the mechanism of elimination reactions

BOOKS SUGGESTED:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, *Jerry* March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and RJ. Sundberg. Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and I\.Jechanism in Organic Chemistry, c.K. Irigold, *Cornell* University press.
5. Organic Chemisty, RT. Morrison and RN. Boyd. Prentice Hall.
6. Modem Organic Reactions H.O. House, Benjamin
7. Principles of Organic Synthesis, RO.C. Normon and J.M. Coxon, Blackie Academic and professional.
8. Pericyclic Reactions. S.M. Mukherji, Macmillan India.
9. Reaction Mecnanism in Organic Chemistry S.M.• Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds D. Nasipuri, New Age International.

M.Sc. I

Semester-II

CHE-203 Paper - III (4 credits) 100 Mark

Physical Chemistry

Learning Outcomes –After going through the course the students will be able to

- Get the basic idea about fundamental laws of thermodynamics
- Introduced about non equilibrium thermodynamics
- Impart knowledge on the fundamentals of surface chemistry
- Study the micelle chemistry
- To understand the concept of macromolecules
- Describes concepts and their applications of electrochemistry.

UNIT- I: Thermodynamics

A-Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy and chemical potential. Partial, molar properties partial molar free energy,partial molar volume and its determination, Gibbs Duhem equation, concept of fugacity(by graphical method), Activity and Activity coefficient.

B-Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Canonical, grand canonical and microcanonical ensembles,The Boltzmann distribution lawFermi-Dirac and Bose-Einstein statistics.

. Partition Functions-translational, rotational, vibrational and electronic partition function. Calculation of thermodynamic properties and equilibrium constant in terms of partition function.

C-Non-Equibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, Entropy balance equation for different irreversible processes (e.g heat flow chemical reaction etc. Onsager's reciprocity relation, electro kinetic phenomena.

UNIT- II: Surface chemistry:

A-Adsorption: Gibbs adsorption isotherm estimation of surface area (BET equation), surface films on liquids(Electro kinetic phenomenon), catalytic activity at surfaces.

B-Micelles: Surface active agents,classification of surface = active agents, micellization hydrophobic interactions, Critical micellar concentration(CMC) Factors affecting CMC of surfactants counter ion binding to Micelles,solubilization micro emulsion reverse micelles.

UNIT- III: Macromolecules:

Polymer-definition, types of polymer, electrically conducting fire resistant, liquid crystal polymer, Kinetics of polymerization, Molecular mass, number and mass average molecular mass , molecular mass determination (Osmometry, Viscometry diffusion and light scattering method) sedimentation chain configuration of macromolecules, Calculation of average dimension of various chain structures.

UNIT- IV: Electrochemistry:

Debye- Huckel theory of activity coefficient of electrolytic solutions, applicability and limitations of DebyeHuckel limiting law, ionic strength, stucture of electified interfaces, Helmholtz- perrin, GuoyChapman and stem models.. Over potentials, exchange current density, derivation of Butler-volmer equation, Tafel plot. Electrocatalysis, Influence of various parameters, Hydrogen electrode. Polarography theory, interpretation of a polarographic curve, instrumentation, limiting current, residual and charging current, diffusion current. Supporting electrolytes, Llkovic equation, half wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

Assignment:

What is the scope of thermodynamics?

What do mean by macromolecules.

What are micelles?

What are the applications of electrochemistry?

BOOKS SUGGESTED

1. Kinetics and Mechanism of Chemical Transformations J. Rajaraman and J .Kuriacose Me Millan.
2. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum .
3. Modem Electrochemistry Vol. I and Vol. II J.O.M. Bockris and AK.N. Reddy, Plenum.
4. Introduction to Polymer Science V.R. Gowarikar, N.V. Vishwanathan and J.Sridhar, Wiley Eastern. 5. Physical Chemistry P.W. Atkins, ELBS.

M.Sc. I

Semester-II

CHE-204 Paper IV (4 credits) 100 Marks

Spectroscopy and Diffraction method

Learning Outcomes – After going through the course the students will be able to

- Explain what it means to use spectroscopic method for qualitative and quantitative analysis
- Analyze spectroscopic information to find structural information of molecules
- Assess structure of inorganic compounds using spectroscopy and learn principle of spectroscopy
- Analysis of structure of different structure of crystals.

UNIT- I: Electronic Spectroscopy

A-Atomic Spectroscopy

Energies of atomic orbital, spectra of hydrogen atom and alkali metal atoms.

B-Molecular Spectroscopy

Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and nonradioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

C-Photoelectron Spectroscopy

Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectrion spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectra of simple molecules.

UNIT- II: Nuclear Magnetic Resonance Spectroscopy

A- Magnetic Resonance Spectroscopy

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift deshielding, spin-spin interactions, factors influencing coupling constant 'J' Effect of chemical exchange, spin decoupling, basic ideas about instrument, NMR studies of nuclei other than proton-13C, 19F and 31P. FT NMR, advantages of FT NMR use of NMR in medical diagnostics.

B-Nuclear Quadrupole Resonance Spectroscopy

quadrupole nuclei quadrupole moments, electric field gradient, coupling constant, splittings, Applications.

UNIT- III:

A- Electron Spin Resonance-Spectroscopy

Basic principles, Zero field splitting and Kramer's degeneracy. Factors affecting the 'g' value. Isotropic' and anisotropic hyperfine coupling constants _measurement techniques and applications.

B-Photoacoustic Spectroscopy

Basic principles of photoacoustic spectroscopy (PAS), PAS- gases and condensed systems, chemical and surface applications.

UNIT- IV

A-X-ray Diffraction

Bragg method of X-ray stuctural analysis of crystals, index reflections. Structure of simple lattices and X-ray intensities.

B-ElectronDiffaction

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of Gas phase molecules.

Assignments:

What are principle of electronic spectroscopy
Brief about ^{1}H nmr, ^{13}C nmr ^{19}Fnmr and ^{31}P nmr
What do you mean b zero field splitting
Explain the key point of diffraction methods

BOOK SUGGESTED

1. Modem Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis ed. H. Windawi and F.L. Ho. Wiley interscience.
3. NMR, NQR, EPR and mossbauer Spectroscopy in inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Introduction to Molecular Spectroscopy G.M. Barrow, Mc Graw Hill.
5. Basic principles of Spectroscopy. R. Chang. Mc Graw Hill.
6. Theory and Applications of UV Spectroscopy, H.H. Jaffer and M. Orchin. IBH-oxford.
7. Introduction to Photoelectron Spectroscopy. P.K. Ghosh. John Wiley.
8. Introduction to Magnetic Resonance, A carrington and A.D. maclachalan, Harper &Row.

M.Sc. I

Semester-II

CHE-205 Paper V (4 credits) 100 Marks

Practical

Time 12 hours in two days

Note:-

A complete record of .practical exercise: in Inorganic, Organic and Physical Chemistry done during the session must he produced by the candidates in three separate Record Books at the time of practical examination.

Inorganic Chemistry

I. Either both gravimetric and volumetric estimation of two metal ion from following mixtures: 20

(a) Cu^{+2} and Ni^{+2}(b)Cu^{+2} and Zn^{+2} (c) Ni^{+2} and Zn^{+2} (d) Ba^{+2} and Ag^{+2}

II. Preparation of selective inorganic compounds (any one) 05

(a) $VO(acac)_2$

(b)$Na[Cr(NH_3)_2(SCN)_4]$

(c)$K_3[Fe(C_20_4)_3]$

(d)Prussian Blue

(e)$[Co(Py)_2Cl_2]$

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

Organic Chemistry **25**

Quantitative Synthesis (Any Two)

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

II. Estimation of amine phenols using bromate bromide solution or acetylation method.

III. Determination of iodine and saponifiaction values of an oil sample. IV. Determination of DO, *COD* and BOD of water sample.

Physical Chemistry (Any one) 25

I. Determination of molecular weight of nonvolatile and nonelectrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.

II. Determination of the degree of disskiation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

III. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.

IV. Determination of solubility and solubility product of sparingly soluble salts (e.g PbSO4, BaSO4) conductometrically.

V. Determination of the strength of strong and weak acids in a given mixture conductometrically

Viva **15**

Records **10**

CHE 206: Project II : Credit 04, Marks : 100

M.Sc. II

Semester-III

CHE-301 Paper-I (4 credits) 100 Marks

Applications of Spectroscopy

Learning Outcomes – After going through the course the students will be able tolearn

- Principle of vibrational spectroscopy,Electron spin and Mossbauer spectroscopy and structure elucidation of inorganic compounds
- To get basic idea and application of mass spectroscopy and UV-Visible spectroscopy
- To learn applications of IR spectroscopy in organic molecules
- To be introduced about Continuous wave (CW) and Fourier-Transform (FT) NMR spectroscopy
- To learn applications of IR spectroscopy in organic molecules.

UNIT- I: Applications of Spectroscopy in Inorganic Chemistry

A-Vibrational Spectroscopy

Symmetry and shapes of AB2, AB3 and AB4, mode of bonding of ambidentate ligands such as thiocyanate, nitrate, sulphate and urea, application of Raman spectroscopy particularly for the study of ionic equilibrium in solution.

B-Electron Spin Resonance Spectroscopy

Hyperline coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of tensors, application to transition metal complexes having one unpaired electron and inorganic free radicals such as PH_4, F_2 and BH_3.

C-Mossbauer Spectroscopy

Basic principles, spectral parameters and spectrum display. Application of the techniques to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin and (2) Sn^{2+} and Sn^{4+} compounds nature of M-L bond, coordination Number, structure.

UNIT- II: Applications of Spectroscopy-I in organic Chemistry

A-Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm).Beer Lambert law. Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, ultraviolet spectra of aromatic and heterocyclic compounds.

B-Infrared Spectroscopy

Characteristic vibrational frequencies of aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides and acids), effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonances.

UNIT- III: Applications of Spectroscopy-II in organic Chemistry

A-Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic,

aldehydic and aromatic) and other nuclei (alcohols, phenols, enols and carboxylic acids) chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra).

B-Carbon-13 NMR Spectroscopy

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

UNIT- IV: Applications of Spectroscopy-III in organic Chemistry

Mass Spectrometry : •

Introduction, ion production-. EI, CI, FD and FAB, factors affecting the fragmentation, ion analysis, ion abundance, mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mclafferty rearrangement, Nitrogen rule.

Assignment:

What are the applications of different type spectroscopic techniques?

Books suggested

I. Physical Methods for Chemistry, R.S.Dargo, Saunders Company
2. Structural Methods in Inorganic Chmesis , E.A.V. Ebsworth, Rankin and Cradock- ELBS.
3. Infrared and Raman Spectra Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry, 8 edition, F. A. Cotton
5. Transition Metal Chemistry, ea..L.Carlin, vol. 3, Dekker.
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectrosocpy in Inorganic Chenmsitry, R.V. Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M. L.Martin, J. J. Delpeuch and G. J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein. G.C. Bassler and T.C. Morin John Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fischer and P. Loftus Wiley.
11. Application of Spectroscopy of Organic Compounds J. R. Dyer, Prentice Flail,
12. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata Mc-Graw Hill.

M.Sc. II

Semester-III

CHE-302 Paper-II Total: (4 credits) 100 Marks

Section-A

Bioinorganic Chemistry (2 credits) 50 Marks

Learning Outcomes – After going through the course the students will be able tolearn

- To understand how metal ions interact with biological environment and how these interaction influences the properties of metal centre.
- Bioinorganic chemistry is a field that examines the role of metals in biology.
- Bioinorganic chemistry includes the study of both natural phenomena such as the behavior of metalloproteins as well as artificially introduced metals, including those that are non essential, in medicine and toxicology.
- This paper is introduced to M.Sc. classes for the detailed studies of interdisciplinary area of biology and inorganic chemistry.

UNIT- I Metal Ions in Biological Systems

Essentlallnd trace metals

Na^{+}/ K^{+} Pump

Role of metal ions in biological processes

Bioener etics and ATP cycle

DI\ po ymertniglucose storage, metal complexes in transmission of energy: chlorophylls

Transport and Storage of Dioxygen

Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and hemerythin model synthetic complexes in iron, cobalt and copper

UNIT- IIElectron Transfer in Biology

Structure and function of mefalloproteins in electron transpdrt processes-cytochromes and ion-sulphur proteins.

Nitrogenase

Biological nitrogen fixation, molybdenum nitrogenase

Assignment:what are the ideas about metalloenzymes, bioenergetics, transport and storage of dioxygen, what is the concept of electron transfer,

What are the importance of metal storage and metals in medicine

Books suggested

1. Principle of Bioinorganic Chemistry, S. J. Lippard and J.M. Berg, University Science Books
2. Bioinorganic Chemistry, Bertini H.B. Gray, S.J.Lippard and J.S. Valentine, University Science

Books

3. Inorganic Biochemistry, vols. I and ed. G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols 18 & 38 ed. J.J. Lippard, Wiley.
5.

Section-'B'

Bioorganic Chemistry(2credits) 50 Marks

Learning Outcomes – After going through the course the students will be able tolearn

- To understand interdisciplinary areas of chemistry in a lucid and effective manner.
- To understand vitamins, steroidal hormones and steroids.
- To prepare the students for further research in areas covering Chemistry and Biology.

UNIT- III

Introduction

Basic consideration Proximity effects and molecular adaptation

Enzymes

introduction and historical perspective chemical and biological catalysis, remarkable properties of es like catalytic power, specificity and regulation. Nomenclature and classification, Fisdher's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors. Enzyme kinetics, Michaelis Menten and lineweaver Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action

Transition-state theory, onentation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase-A.

Kinds of Reactions Catalysed by Enzymes

Nucleophilic displacement on a phosphorus atom, multiple displacement reations and the coupling of A TP cleavege to endergonic processes Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions, 13-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carbox_ylation and decarboxylation.

UNIT- IV

Co-Enzyme Chemistry

Cofactor as derived from vitamins coenzyme S, Prosthetic groups, apoenzmes structure +and biological functions of coenzyme A thiamine pyrophosphate, pyridoxal phosphate. NADI, NADP, FMN, FAD, lipoic acid, vitamin B_{12}.

Enzyme Models.

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry crown ethers, cryptates Cyclodextnns. cyclodextrin- based enzme models calixarenes ionophores. micelles. synthetic enzymes or synzymes.

Biotechnological Applications of Enzymes

Large-scale production and purification of enzymes techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy.

Assignments:

What do you understand by bioorganic chemistry?

What is the importance of bioorganic substance?

What are enzymes and coenzymes?

Brief the applications of enzymes

Books Suggested

1.Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny. Springer Verlag. '?.Understanding Enzymes, Trevor Palmer, Prentice Hall.

3.Enzyme Chemistry: Impact and Applications, Ed. Collin J.Suck Chapman and Hall.

4.Enzyme Mechanisms De. M.1. Page and A. Williams. Royal Society of Chemistry

5.Fundamentals of Enzymology. N.C. Price and L. Stevens. Oxford University Press.

6. Immobilized Enzymes: An introduction and application in Biotechnology- Michael D. Trevan- John Wiley.
7. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
8. Biochemistry: The Chemical Reactions of Living,Cells. D.E. Metzler. Academic Press.

M.Sc. II
Semester-III

CHE-303 Paper- III **Total: (4 credits)** **100 Marks**
Section-`A'
Environmental Chemistry **(2 credits)** **50 Marks**

Learning Outcomes – After going through the course the students will be able tolearn

- To understand the role of elements in the environment.
- To understand composition of different region of atmosphere
- What do you mean by soil pollutants and role of fertilizers, insecticides and pesticides on human health?
- To analyze industrial pollutants and their effect on human health

UNIT- I

Environment

Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, veritical stability atmosphere. Biogeochemical cycles of C, N, P, S and 0. Biodiatribution of elements

Hydrosphere

Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle. Aquatic Pollution- inorganic, organic, pesticide, agricultural industrial and sewage, detergents, oil spills and oil pollutants, Water quality parameters-dissolved oxygen biochemical oxygen demand, solids, metals, contemt of chloride, sulfate, phosphate, nitrate and micro-organisms. Water quality standards. Analytical methods for measuring BOD, DO, COD, F, Oils, metals (As, Cd, Cr, Hg, Pb, Se, etc.), residual chloride and chlorine demand. Purification and treatment of water.

Soils

Composition micro and macro nutrients. Pollution-fertilizers, pesticides plastics and metals. Waste treatment.

Atmosphere

Chemical compostion of atmosphere-particles, ions and radicals and their formation Chemical and photochemical reactions in atmosphere, smog formation, oxides of N.C.S-.0. and their effect, pollution by chemicals, petroleum, minerals, chlorofluorohydrocarbons Green house effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air poilution, Continuous monitoring instruments

UNIT- II

Industrial Pollution

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy, polymers, drugs etc. Radionuclide analysis. Disposal of wastes and their management.

Environmental toxicology

Chemical solutions to environmental problems, biodegrade ability, principles of decompostion better industrial processes. Bhopal gas tragedy, Chernobyl, three *mile* istand. Sewozo and Minamata disasters.

Assignment:

What do you mean by BOD, COD and DO

What do you mean by waste treatment?

What are thermal power plant

Explain the environmental problem due to chemical solutions

Books Suggested

1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers
3. Environmental Chemistry, A.K. De, Wiley Eastern. .
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern
5. Standard method of Chemical Analysis, *Fl.* Welcher Vol: **III** Van Nostrand Reinhold Co 6.Environmental Toxicology. *Ed.L* Rose, Gordon and Breach Science Publication.
7. Elemental Analysis of Airborne Particles. Ed. S.Landsberger and M. Creatchman, Gordon and Breach Science Publication.
8. Environmental Chemistry. C. Baird. W.H. Freeman.

ɔection-`B'
Photo Chemistry (2 credits) 50 Marks

Learning Outcomes –After going through the course the students will be able tolearn
To understand different type of chemical reaction

UNIT- III:

Photochemical Reactions

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy actinoimetry.

Determination of Radical Mechanism

Classification rate constants and life times of reactive energy, states-determination of rate constants of reactions.Effect of light intensity on the rate of photochemical actions.

Photochemistry of Alkenes: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclization reactions, rearrangement of 1,4- and 1,5- dienes.

UNIT- IV

Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds- saturated cyclic, acyclic 13, y unsaturated and a,r3 unsaturated compounds, cyclohexadienones.

Intermolecular cycloaddition reactions-dimerization and oxetane formation.

Photochemistry of Aromatic Compounds

Isomerizations, additions and substitutions.

Assignment:

What are the application of photochemistry

Books suggested:

13. Fundamentals of Photochemistry, K.K. Rohtagi Mukherji, Wiley Eastern.
14. Essentials of Molecular Photochemistry, A. Gilbert, BaggotBalckwell Scientific Publications.
15. Introductory Photochemistry, A. Cox and T. Camp, McGraw Hill.
16. Photochemistry, R. P. Kundall and A. Gilbert, Thomson Nelson.
17. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.

M.Sc. II

Semester-III

CHE-304 Paper- IV (4 credits) 100 Marks

Biophysical chemistry and Solid state chemistry

Learning Outcomes –After going through the course the students will be able to learn

- The student will obtain required knowledge for understanding material science problems. Initially, they will study the structure of solids and get introduced with the importance of chemical and physical bonds, crystal disorder and defects for materials properties.
- They will get insight into electronic structure of crystals and compare it with the electronic structure of nonmaterial – to understand the 'nano' prefix.
- The student will understand high temperature phase equilibrium and learn thermodynamic and kinetic treatments of phase transitions.
- They will learn synthesis design and planning, different processing techniques and their chemical-physical fundamentals as well as basic method of characterization of solids.

UNIT- I:

Biological cell and its Constituents

Biological cell, structure and functions of proteins, enzymes. DNA and RNA in living systems. Helix coil transition.

Bioenergetics

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

UNIT- II

Biopolymer Interactions

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

Themodynamics of Bionolymer Solutions

Thermodynamics of biopolymer solutions, osmotic pressure membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

UNIT- III

Cell membrane and Transport of ions

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

Biopolymers and their Molecular Weights

Evaluation of size shape molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibirium, hydrodynamic methods, diffusion, sedimentation velocity viscosity electrophoresis and rotational motions.

UNIT- IV: Solid state chemistry

Solid State Reactions

General Principles for reaction between two solids: Reaction conditions, structural considerations, surface area, reactivity, kinetics of solid state reactions.

Crystal Defects and Non-Stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects- point defects, vacancies- Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, non-stoichiometry and defects.

Electronic Properties and Band Theory

Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties- optical reflectance, photoconduction- photoelectric effects.

Assignment:

Book Suggested

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J.David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistrc, E.E. Conn and f.K. Stumpf, John Wiley.
6. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H.Dugas and C. Penny, SpringerVerlag.
7. Marcomolecules: Structure and Functions, F. Wold, Prentice Hall.
8. Solid sate Chemistry and its Applications, A.R..West, Plenum.
9. Principles of the Solid State, H. V. Keer, Wiley Eastern.
10. Solid State Chemsitry, N. B. Hannay.
11. Solid State Chemistry, D.K. Chakrabarty, New Age International.

M.Sc. II
Semester-III

CHE-305 Paper-V (4 credits) 100 Marks
Practical (Time 12 hours in two days)
Inorganic **25**

1. Preparation of selected inorganic compounds and structural elucidation on the basis of given spectra (IR, ESR and MS) Selection can be made from the following

1- Sodium amide
2- Dichlorophenyl borane $PhBCl_2$
3- Sn(IV) Iodide, Tin (IV) chloride and Tin (II) iodide
4- Ammonium hexachorostannate CNH4h $Snc1_6$,
5- Trichlorodiphenyl antimony (v) hydrate
6- Sodium Tetrathionate, $Na_2S_4O_6$
7- Metal Complexes of dimethyl Sulfoxide, $CuCl_2$, 2DMSO.
8- Metal acetylacetonate.
9- Ion exchange separation of oxidation state of V.
10- Preparation of Fe(II) Chloride.
11- Phosphine Ph3P and its transition metal complexes.
12- Ferrocene
13- Copper glycine Complex

II. Chromatographic Separations: a- Thin layer chromatographic separation of Nickel, Manganese Cobalt and Zinc. Determination of Rf values.
b-Cadmium and Zinc c-Zinc and Magnesium

ORGANIC CHEMISTRY **25**

I. Qualitative Analysis
Separation and identification of components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid). Suitable derivatives to be prepared where possible. Purity of the separated components should also be checked on TLC plates, Chemical analysis. II.Isolation of the following
(i)Caffeine from tea leaves. (ii)Casein from milk (iii)Lactose from milk
(iv)Nicotine dipicrate from tobacco (v)Lycopene from tamtoes.

PHYSICAL CHEMISTRY **25**

Thermodynamics:

I- Determination of partial molar volume of solute (e.g. KCI) I and solvent in a binary mixture.'
II- Determination of the temperature dependence of the solubility of a compound in two solvents having similar inter molecular
interactions (benzoic acid in water and in DMSO water mixture) and to calculate the partial molar heat solution

Spectroscopy
i Determination of pKa of an indicator (e.g. methyl red) 10 (a) aqueous and (b) micellar media.
ii. Determination of stoichiometry and stability constant of inorganic (e.g. ferric-salicyclic acid) and organic (e. g. amine iodine) complexes. Characterization of the complexes by electronic and IR spectral data.

Viva voce **15**
Records **10**

CHE 306: Project III : Credit 04, Marks : 100

M.Sc. II

Semester-IV

CHE-401 Paper -I (4 credits) 100 Marks

Organic Synthesis-I

Learning Outcomes – After going through the course the students will be able to learn

- σ-bonded and π-bonded ligands, metal-carbon bonding, 18- and 16-electron rules, Green rules for nucleophilc addiditon, complexation and decomplexation of organometalliccompounds.
- Transition metal complexes as protecting and stabilizing groups,
- Application of various organometallic compounds in organic synthesis.
- Oxidation and reduction of different functional groups by various reagents
- Synthesis, properties and reactions of heterocycliccompounds.

UNIT- I

Organometallic reagents

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

Group I and II metal organic compounds

Li,Mg,Hg,Cd,Zn compounds.

Transition metals

Cu,Pd,Ni,Fe,Co,Ti compounds.

UNIT- II

Oxidation

Introduction different oxidative processes.

Hydrocarbons-alkenes,aromaticrings,saturated C-Hgroups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acid.

Amines,hydrazines and sulphides.

Oxidation with ruthenium tetraoxide, iodobenzene diacetate and thallium(III) nitrate.

Reduction

Introduction,different reductive processes.

Hydocarbons-alkanes,alkynes and aromatic rings.

Carbonyl compound-aldehydes ,ketones, acids and their derivates.Epoxides.

Nitro, nitroso,azo and oxime groups. Hydrogenolysis.

UNIT- III

Rearrangements

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

Pinacol-pinacolone, wagner-meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Aamdt-Eistert synthesis,

Neber, Beckmann, Curtius, Schmidt,Baeyer-Villiger, Shapiro reaction.

UNIT- IV

Metallocenes, Nonbenzenoid Aromatic and polycyclic aromatic compound General consideration, synthesis and reactions of some representative compounds.

Assignment:

What do you mean by organometalic compounds.

Brief about oxidizing reagents for different functional groups.

Discuss about reducing reagents for different functional groups.

Define aromatic and nonbenzenoid compounds.

Books suggested

1. Modem synthetic reactions,H.O.House, W.A.Benjamin.
2. Some modem methods of organic synthesis, W.Carruthers, Cambridge Univ. Press.
3. Advanced organic chemistry, reactions mechanisms and structure,J.March, John Wiley.
4. Principles of organic synthesis, R.O.C. Norman and J.M.Coxon, Blackie academic and professional.
5. Advanced organic chemistry part B, F.A.Carey and R.J.Sundherg.Plenum Press.
6. Rodd's chemistry of carbon compounds, Ed.S.CoffeyElevier.

M.Sc. II

Semester-IV

CHE-402 Paper II (4 credits) 100 Marks

Polymers Chemistry

Learning Outcomes –After going through the course the students will be able to learn

- Polymer chemistry is a sub-discipline of chemistry that focuses on the chemical synthesis, structure, chemical and physical properties of polymers and macromolecules.
- The principles and methods used within polymer chemistry are also applicable through a wide range of other chemistry sub-disciplines like organic chemistry, analytical chemistry, and physical chemistry and hence introduced in M.Sc. IV semester classes

UNIT- I

Basics

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers, Classification of polymers Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in bomogeneous and heterogeneous systems.

UNIT- II

Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular wights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End group, viscocity. light scattering, .osmotic and ultracentrifugation methods. Analysis and testing of polymers. Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact, tear resistance. Hardness and abrasion resistance.

UNIT- III

Structure and Properties

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

UNIT- IV

A-Polymer Processing

Plastics, elastomers and fibers Compounding Processing techniques Caledering diecasting, rotational casting film casting injection moulding. blow moulding. extrusion mouldingthermolorming, foamian, reinforcing and fibre spinning.

B- Properties of Commerical Polymers

Polyethylene, Polyvinyl chloride polyamides polyesters, phenolic resins. epoxy resins and silicone polymers. Functional polymers, tire retarding polymers and electrically conducting polymers. Biomedical polymers-contact lens, dental polymers, .artificial heart. kindney, skin and blood cells.

Assignment:

What are monomers?

What do you mean by polymerization?

Define characteristics of polymers.

Brief about polymer Processing.

Books Suggested

1. Textbook of Polymer Science, F.W. Billmeyerlr. Wiley.
2. Polymer Science, V.R. Gowarker, N.V. Viswanathan and 1 Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers. K. Takemoto, Y. Inaki and RM. Rttanbrite. **4.**Contemporary Polymer Chamistry, HR. Alcock and F.W. Lambe, Prentice Hall.
5.Physics and Chemistry of Polymer, 1.M.G. Cowie, Blackie Academic and Professional

M.Sc. II

Semester-IV

CHE-403Paper III (4 credits) 100 Marks

Organo Transition Metal Chemistry

Learning Outcomes : After going through the course the students will be able to learn

- Organotransition metal chemistry is the study of chemical compounds containing at least one chemical bond between a carbon atom of an organic molecule and a transition metal.
- This paper is introduced to M.Sc. classes for the detailed studies of transition metal organometallic compounds, organotransition metal catalysts and basic ideas of fluxional organometallic compounds.

Unit-1

Alkyls and Aryls of Transition Metals:

Types, General Synthetic Routes, Stability and Decomposition pathways.

Unit-2

Compounds of Transition Metal - Carbon Multiple Bond: Carbenes and Carbynes:

Low valent carbenes and carbynes ,synthesis, nature of bond and Structural Characteristics.

Unit-3

Transition Metal π- Complexes:

Preparations, Important reactions relating on the ligands, Structural features and bonding of alkenes, alkynes, allyls, diene, dienyl, arene complexes, MO approach of bonding in ferrocene and bis (benzene) chromium.

Ligand behaviour of $C_3Ph_3^+$, $C_7H_7^+$ and $C_8H_8^{2-}$ in different organometallic compounds.

Substitution reactions in metal carbonylsd using σ-donor, σ-donor and **π** -acceptor and **π** -donor ligands.

Unit-4

Catalysis involving organometallic compounds:

Olefin hydrogenation. Oxo reaction. Fischer Tropsch process. Wacker process. Polymerisation of olefins.

Fluxional Organometallic Compounds:

Fluxionality and dynamic equilibria in compounds such as η^3 – allyl and η^1 dienyl complex.

Books Recommended:

1. Comprehensive Organometallic Chemistry, Ed. E.W. Abel, Abel, F.G.A. Stone and G. Wilkinson, Pergamon, 1982.
2. Advnaced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, `Wiley, 1999.
3. The chemistry of elements, N.N. Greenwood and A. Earnshaw, 1997.
4. Inorganic Chemistry, principles of structure and reactivity. J.E. Huheey, Harper, 1983.
5. Organometallic Chemistry (A unified approach), R.C. Mehrotra and A. Singh, Wiley Eastern, 1991

M.Sc. II
Semester-IV

CHE-404 Paper IV (4 credits) 100 Marks
Analytical chemistry

Learning Outcomes –After going through the course the students will be able to learn

- To study concepts and theories behind basic methods and techniques used in analytical chemistry. This theory can be used to solve many rigorous problems of universe.
- To prepare the students for further research in analytical methods of chemistry.

UNIT - I

Introduction

Role of analytical chemistry.Classification of analytical methods-classical and instrumental.Types of instrumental analysis,selecting an analytical method.Neatness and cleanliness, laboratory operations and practices,analytical balance. Techniques of weighing,errors.Volumetric glassware-cleaning and calibration of glassware. Sample preperations, dissolution and decompositions.gravimetric techniques. Selecting and handling of reagents.Laboratory notebooks. Safety in the analytical laboratory.

UNIT- II

Errors and evaluation

Definitionof terms in meamn and median.Precision-standarddeviation, relative standard deviation.Accuracy-absolute error,relative error.Types of error in experimental data determinate (systematic), indeterminate(of random) and gross. Sources of errors and the effects upon the analytical results.Methods for reporting analytical data.Statistical evaluation of data-indeterminte errors.the uses of statistics.

UNIT- III

Food analysis

Moisture, ash, crudeprotein,fat,crude fibre,carbohydrates,calcium,potassium,sodium and phosphate. Food adulteration-common adulterants in food, contamination in foodstuffs.Microscopic examination of food for adulterants.Pesticide analysis infood products.Extraction and purification of sample.HPLC,gas chromatography for organophosphates.Thin: layer chromatography for identification of chlorinated pesticides in food products.

Analysis of water pollution

Origin of waste types water pollutants and effects. Sources of water pollution domestic,industrial,agricultural,soil and radioactive waste as sources of pollution, objectives of analysis-parameter for analysis-colour turbidity total solid conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride ,silica, phosphates and different forms of mifrogen.Heavymetal pollution, public health significance of Cadmium, Chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems. Measurement at Do,BOD,COD.Pesticides as water pollutants and analysis.Water pollution law and standards.

UNIT- IV

Analysis of soil,fuel,bodv fluids and drugs

Analysis of soil:moisture, pH, total nitrogen, phosphorus, silicon, lime, magnesia, manganese, sulphur and alkali salts.

Fuel analysis: solid,liquid and gas,ultimate and proximate analysis-heating and value grading of coal.Liquid fuels-flash point,aniline point,octane number and carbon residue. Gaseous fuels-producer gas and water gas-calorific value.

Chemical chemistry: Composition of blood collection and preservation of samples. Clinical analysis, serum electrolytes, blood glucose, blood urea, :nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphatises. Immunoassay: principles of radioimmunoassay (RIA) and applications. The blood gas analysis trace elements in the body.

Drug analysis: Narcotic and dangerous drugs. Screening by gas and thin layer chromatography and (spectrophotometric) measurements.

Assignment:

Books suggested

1. Analytical chemistry, G.D.Christian,J.Wiley.
2. Fundamentals of analytical chemistry,D.A.Skoog,D.M.WestandF.J.Holler,W.B.Saunders.
3. Analytical chemistry principles,J.S.Kennedy,W.B.Saunders.
4. Analytical chemistry principles and techniques, L.G.Hargis,Prentice Hall.
5. Principles of instrumental analysis,D.A.Skoog,J.L.Loary,W.B.Saunders.
6. Principles of instrumental analysis,D.A.Skoog,W.B.Saunders.
7. Quantitative analysis,R.A.DayJrandA.L.Underwood,Prentice Hall.
8. Environmental solution analysis,S.M.Khopkar,Wiley Eastern.
9. Basic concepts of analytical chemistry, S.M.Khopkar,Wiley Eastern.
10. Handbook of instrumental techniques for analytical chemistry,F.Settle,Prentice Hall.

M.Sc. II

Semester-IV

CHE-405Paper V (4 credits) 100 Marks

Natural Products

Learning Outcomes – After going through the course the students will be able to learn

- .Basic concepts and knowledge of chemistry of natural products are necessary to develop understanding of core organic chemistry i.e. simple to complex organic structures, organic structural determination, semi-synthetic to total synthetic pathways of organic structures etc.

- Natural products can also be prepared by chemical synthesis (both semi synthesis and total synthesis) and have played a central role in the development of the field of organic chemistry by providing challenging synthetic targets.

Unit- 1

Acetogenins : Classification, general method of structure determination of,

a. Flavones- Chrysin
b. Flavonols – quercetin
c. Anthocyanins- Cyanin
d. Anthocyanidins- cyanidin chlorides

Unit-2

Terpenoids : Introduction, isolation and general methods of determining structure of,

a. **Monoterpenoids**
i. Acyclic monoterpenoids: Citral and geraniol
ii. Monocyclic monoterpenoids : α-Terpineol
b. **Diterpenoids**

Abietic acid

Unit-3

Alkaloids: Introduction and general methods of determining structure of,

i. Hemlock alkaloid- Coniine
ii. Pyrrolidine-Pyridine alkaloid- Nicotine
iii. Chincona alkaloids -Quinine
iv. Opium alkaloids : Papaverine and Morphine
v. Rauwolfia alkaloids : Reserpine

Unit-4

Carbohydrates: Structure and functions of,

i. Disaccarides- Lactose, Sucrose

ii. Polysaccarides- Cellulose, starch

Assignment:

What is the importance of natural products?

Define the structure of natural products.

Reference Books:

1. Organic Chemistry, I.L. Finar Vol. I and II, 2000
2. Natural Products, S.M. Chawla, 2018
3. Biochemistry-Lehninger, 2000
4. Biochemistry by L. Stryer, 1995

M.Sc. II

Semester-IV

CHE-406 Paper VI (4 credits) 100 Marks

Medicinal Chemistry

Learning Outcomes – After going through the course the students will be able to learn

- Basic biological and pharmacological interactions of drugs with their targets.
- Process of drug discovery.
- The relation of structure and physical properties of drugs to their pharmacological activity.
- Synthesis and mode of action of the different classes of drugs.
- Development of nanomedicine.
- Contemporary developments in the field of drug discovery.

UNIT-I

Drug design :

Relationship between Chemical structure and biological activity (SAR). Receptor site theory approach to drug design. Introduction to combinatorial synthesis in drug discovery.

Phormacokinetics:

Introduction of drug absorption, desorption, eliminationusing pharmacokinetics, important pharmacokinetics parameters in detining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

UNIT- II

Antineoplastic Agents:

Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Synthesis of mechlorethamine, cyclophosphamide, melphan, mechalorethamine, cyclophosphamide melphalan, uracil, mustards, and 6- mercaptopurine.di

Cardiovascular Drug:

Cardiovascular Drug: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function central intervenation of cardiovascular output. Directacting arteriolar dialators. Synthesis of amyl nitrate sorbitrate, deltizem, quitridine, veramil and atenolal.

UNIT- III

Local Antiinfective Drugs:

Introduction and general mode of action. Synthesis of sulphonamides, turatolidone, ciprofloxacin, norfloxacin, dopone, aminosasalicylic acid, isoniazid, ethionamid, thambutal, fluconatole, ariseofulvin, chlorogenin, primaqion.

Psychoactive Drugs-

The Chemotherapy of mind Introduction, neurotransmitters, CNS depresseant, general anaesthetics, mode of action of hypnotics, sedatives, antianxiety drugs, Antipsychotic drugs- the neuroleptics, antidepressant, butyrophenones, serendipity and drug development. Synthesis of diatepam, oxatepam, chloratepam, alpratalam, phenyloin 2 barbiturates.

UNIT- IV

Antibiotics:

Cellwall biosynthesis inhibitors, β-lactam rings antibiotics inhibiting protein synthesis, synthesis of penicillin, chloramphenicol, cephalosponin and streptomycin.

Assignment:

Define pharmacological interactions of drugs with their targets.

What is relation of structure and physical properties of drugs.

Books Suggested

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

M.Sc. II

Semester-IV

CHE-407

Practicals + Seminar (Credits 3+1=4) 75+25 = 100 Marks

Inorganic chemistry **20**

Time 12 hours in two days

Any two of

(A)Spectrophotometric Determination a-Manganese/Cromium/Vanadium in steel sample. b-Nickel/Molybdenum/Tungsten/Vanadium by extractive spectrophotometric method. c-Floride/Nitrate/Phosphate.

d-Iron- Phenanthroline complex: job Method. (B)Flame photometric determination

a- Sodium and Potasium when present together. b-Lithium/Berium/Calsium/Stransium. c-Cadmium and Magnesium in tap water.

Organic Chemistry **20**

(A)Multistep synthesis of organic compound

Preperation of organic compound involving not more than three stages.

i)Benzanilide from benzene ii)Benzilic acid from benzoin iii)Quinoline from aniline

iv)2-Phenylindole from phenylhydrazine

v)Alkylation of dimethylmalonate with an alkylhalide

(B)Paper Chromatography

Seperation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determation of R_f values. Identification of organic compounds on the basis of given spectral data (UV,IR,PMR,CMR and MS).

Physical Chemistry20 20

A- Polorography

i- Estimation of Pb^{2+} and Cd^{2+}/Zn^{2+} and Ni^{2+} ions from their mixture from polorography.

ii- Determination of desolved oxygen in aqueous solution of organic solvent.

B. E.M.F. measurement

a. Determination of the equilibrium constant of the reaction

$H_2Q + 2Ag+- Q + 2W + 2Ag$

(HydroQuinone) (Quinhydrone)

b. Determination of activity coefficient of electrolytes.

c. Determination of ionic product of water (K_w).

d. Potentiometric titration of a solution of Fe^{2+} charge against $Cr_2O_7^{2-}$ and the determination of the redox potentioal of Fe^{2+}, Fe^{3+} system.

Viva Voce **10**

Records **05**

Seminar **25**

Book Suggested

1- Inorganic experiments. 1. Derek Woolline VCH

2- Microscale Inorganic chemistry, Z Szafrsn R.M. Pike, M.M. Singh. Wiley

3- Practical inorganic chemistry,G.Mar and B W Bookett, Wan Nostrand

CHE 408: Project IV : Credit 04, Marks : 100

Online (Prof. O. P. Pandey)