C. ABDUL HAKEEM COLLEGE (AUTONOMOUS)

(Affiliated to Thiruvalluvar University, Vellore & Re-Accredited by NAAC)

MELVISHARAM – 632 509

PG & RESEARCH DEPARTMENT OF CHEMISTRY
MASTER OF SCIENCE
DEGREE COURSE
M.Sc., CHEMISTRY
UNDER CBCS
(with effect from 2018-2019)

The Course of Study and the Scheme of Examinations

S. NO.	Study Components		Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
	Course Title							
SEMESTER I						CIA	Uni. Exam	Total
1	MAIN	Paper-1	5	4	Stereochemistry & Substitution Reactions	25	75	100
2	MAIN	Paper-2	5	4	Structural & Coordination Chemistry	25	75	100
3	MAIN	Paper-3	5	4	Physical Chemistry - I	25	75	100
4	MAIN PRACTICAL	Paper-1	4	0	Organic Chemistry Practicals - I	-	-	-
5	MAIN PRACTICAL	Paper-2	4	0	Inorganic Chemistry Practicals - I	-	-	-
6	MAIN PRACTICAL	Paper-3	4	0	Physical Chemistry Practicals - I	-	-	-
7	ELECTIVE	Paper-1	3	3	**(to choose 1 out of 3)** A. **Polymer Chemistry** B. Heterocyclic Chemistry C. Inorganic Photochemistry	25	75	100
			30	**15**		**100**	**300**	**400**

SEMESTER II						CIA	Uni. Exam	Total
8	MAIN	Paper-4	4	3	Organic Reaction Mechanisms	25	75	100
9	MAIN	Paper-5	4	3	Solid State & Nuclear Chemistry	25	75	100
10	MAIN	Paper-6	5	4	Physical Chemistry - II	25	75	100
11	MAIN PRACTICAL	Paper-1	4	5	Organic Chemistry Practicals - I	25	75	100
12	MAIN PRACTICAL	Paper-2	4	5	Inorganic Chemistry Practicals - I	25	75	100
13	MAIN PRACTICAL	Paper-3	4	5	Physical Chemistry Practicals - I	25	75	100
14	**Compulsory Paper**		2	2	**Human Rights**	25	75	100
15	ELECTIVE	Paper-2	3	3	**(to choose 1 out of 3)** A. **Green Chemistry** B. Material Science C. Applied Electrochemistry	25	75	100
			30	**30**		**200**	**600**	**800**

SEMESTER III						CIA	Uni. Exam	Total
16	MAIN	Paper-7	5	4	Organic Spectroscopy & Natural products	25	75	100
17	MAIN	Paper-8	5	4	Organometallics & Coordination Chemistry	25	75	100
18	MAIN	Paper-9	5	4	Physical Chemistry - III	25	75	100
19	MAIN PRACTICAL	Paper-4	4	0	Organic Chemistry Practicals - II	-	-	-
20	MAIN PRACTICAL	Paper-5	4	0	Inorganic Chemistry Practicals - II	-	-	-
21	MAIN PRACTICAL	Paper-6	4	0	Physical Chemistry Practicals - II	-	-	-
22	ELECTIVE	Paper-3	3	3	**(to choose 1 out of 3)** A. **Scientific Research Methodology** B. Advanced Chromatographic Techniques. C. Inorganic Biochemistry	25	75	100
			30	**15**		**100**	**300**	**400**

SEMESTER IV						CIA	Uni. Exam	Total
23	MAIN	Paper-10	5	4	Photochemistry & Biorganic Chemistry	25	75	100
24	MAIN	Paper-11	5	4	Inorganic Spectroscopy & Analytical Techniques	25	75	100
25	MAIN	Paper-12	5	4	Physical Chemistry - IV	25	75	100
26	MAIN PRACTICAL	Paper-4	4	5	Organic Chemistry Practicals - II	25	75	100
27	MAIN PRACTICAL	Paper-5	4	5	Inorganic Chemistry Practicals - II	25	75	100
28	MAIN PRACTICAL	Paper-6	4	5	Physical Chemistry Practicals - II	25	75	100
29	ELECTIVE	Paper-4	3	3	**(to choose 1 out of 3)** A. **Environmental Chemistry** B. Drug Design & Analysis C. Supramolecular & Nano Technology	25	75	100
			30	**30**		**175**	**525**	**700**

Subject	Papers	Credit	Total Credits	Marks	Total marks
MAIN	12	3-4	46	100	1200
MAIN PRACTICAL	6	5	30	100	600
ELECTIVE	4	3	12	100	400
COMPULSORY PAPER	1	2	2	100	100
Total	**23**	**-**	**90**	**-**	**2300**

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCH101 Semester: I

Major - 1 Title: **STEREOCHEMISTRY & SUBSTITUTION REACTIONS**

Credits: 4 Max. Marks: 75

OBJECTIVES	To make the students learn and understand the concepts of stereochemistry, conformational analysis and their application in the determination of reaction mechanism. To understand the mechanism of nucleophilic and electrophilic substitution reactions.
COURSE OUTCOMES	
CO1	Recognize and draw stereoisomers, assign the configuration as R or S and E or Z.
CO2	Understand the terminology associated with conformational analysis and determine relative energies for different conformations of a molecule.
CO3	Explain SN reactions & Neighbouring group participation, understand aliphatic Electrophilic substitution reactions.
CO4	Recognize and be able to write the mechanism of electrophilic aromatic substitution
CO5	Explain the methods of generation of Benzyne intermediate and understand the energetics of organic reaction mechanism.

UNIT-I: STEREOCHEMISTRY

Optical activity and chirality, Classification of chiral molecules as asymmetric and dissymmetric. Dissymmetry of allenes, biphenyls, spiro compounds, trans cyclooctane and cyclononene and molecules with helical structures. Absolute configuration - R, S notation of biphenyls and allenes. Fischer projection. Inter conversion of Sawhorse, Newmann and Fischer

projections. Molecules with more than one asymmetric center (restricted to five carbons), erythro and threo compounds. Asymmetric synthesis, Cram's rule.

Geometrical isomerism. E, Z nomenclature of olefins, Geometrical and optical isomerism (if shown) of disubstituted cyclopropane, cyclobutane and cyclopentanes. Stereo specific and stereo selective reactions.

UNIT-II: CONFORMATIONAL ANALYSIS

Conformational analysis of disubstituted cyclohexane and Conformation and reactivity of substituted cyclohexanol (oxidation and acylation), cyclohexanone (reduction) and cyclohexane carboxylic acid derivatives (esterification and hydrolysis). Conformation and stereochemistry of cis and trans decalin and 9 - methyldecalin.

UNIT-III: ALIPHATIC NUCLEOPHILIC AND ELECTROPHILIC SUBSTITUTION REACTIONS

S_N1, S_N2 and S_Ni mechanisms - Neighbouring group participation - reactivity, structural and solvent effects - substitution in norbornyl and bridgehead systems - substitution at allylic and vinylic carbons - substitution by ambident nucleophiles - substitution at carbon doubly bonded to oxygen and nitrogen - alkylation and acylation of amines, halogen exchange, Von-Braun reaction, alkylation and acylation of active methylene carbon compounds, hydrolysis of esters.

S_E1, S_E2 and S_Ei mechanism, double bond shift - Reactivity. Migration of double bond, keto-enol interconversion, HVZ reaction, Stark-Enamine reaction, halogenation of aldehydes and ketones and decarboxylation of aliphatic acids.

UNIT-IV: AROMATIC ELECTROPHILIC SUBSTITUTION REACTIONS

The arenium ion mechanism. Orientation and reactivity. Typical reactions - nitration, sulphonation, halogenation, alkylation, acylation and diazonium coupling, Formylation, Reimer - Tieman reaction, Vilsmeyer - Hack, Gattermann, Gattermann - Koch, Kolbe reaction. Synthesis of 2, 3-dinitrotoluene, 1,2,3-symmetrical tribromobenzene, 2-bromo-6-chlorophenol, m-aminobenzoic acid.

UNIT-V: AROMATIC NUCLEOPHILIC SUBSTITUTION REACTIONS & DETERMINATION OF REACTION MECHANISM

Methods for the generation of benzyne intermediate and reactions of aryne intermediate. Nucleophilic substitution involving diazonium ions. Aromatic Nucleophilic substitution of activated halides. Ziegler alkylaiton. Chichibabin reaction.

Kinetic and non-kinetic methods of determining organic reaction mechanism.

Hammett and Taft equations – Physical significance of ρ and σ.

Recommended Books

1. **Organic Synthesis** by R.O.C. Norman, Chapman and Hall, NY, (1980).
2. **Physical Organic Chemistry** by Niel Isaacs, ELBS Publications (1987).
3. **Organic Reaction Mechanism** by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., Chennai (1990).
4. **Organic Chemistry** IV Edition by Stanley Pines.
5. Structures and Mechanism by E.S. Gould
6. Advanced Organic Chemistry, Part A and B, by Francis A. Carey and Richard J. Sundberg, 3rd Edition (1990), Plenum Press.
7. Aromatic Nucleophilic Substitution by J. Miller
8. Advanced Organic Chemistry III Edition by J. Miller
9. Reactive Molecules, C. Wentrup, John Wiley and Sons, New York (1984)
10. Advanced organic reaction mechanism and structure by J. March, Tata McGraw Hill.
11. Organic Chemistry, Marc London
12. Organic Chemistry, Mc Murray
13. Organic Chemistry, Graham Solomons
14. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
15. Stereochemistry, Conformation analysis and Mechanism by P.S. Kalsi, 2nd Edition (1993), Wiley Eastern Limited, Chennai.

16. Stereochemistry of carbon compounds by Ernest Eliel
17. Stereochemistry and Mechanism through solved problems by P.S. Kalsi. Wiley Eastern Ltd., (1994)
18. Basic principles of Organic Stereochemistry by P. Ramesh - Madurai Kamaraj University.
19. Organic Reaction Mechanism by R.K. Bansal.
20. A Guide book to mechanism in organic chemistry by Longman.
Structure and mechanism in organic chemistry by C.K. Ingold, Cornell University press.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCH102 Semester: I

Major - 2 Title: **Structural & Coordination Chemistry**

Credits: 4 Max. Marks: 75

OBJECTIVES	To learn about the inorganic polymers. To study the concept of Coordination Chemistry, stability and stereochemistry of complexes. To study about structure and bonding of some inorganic compounds.
COURSE OUTCOMES	
CO1	Understand the structure and bonding in poly acids and polysulphur – nitrogen compounds and know their applications.
CO2	Determine the structure of boron cage compounds and metal clusters.
CO3	Discuss HSAB rule and determine stability constant of coordination complexes.
CO4	Explain stereisomers and name chiral complexes, understand various types of macrocyclic ligands
CO5	Discuss the d-orbital splitting pattern in different geometries like octahedral, tetrahedral by strong field and weak field ligands; Discuss terms, state & microstate & orgel diagram and calculate microstate & terms of different configurations

UNIT-I: STRUCTURE & BONDING - I

Polyacids: Isopolyacids and hetereopolyacids of vanadium, molybdenum and Tungsten. Applications of silicates as - Molecular sieves, Feldspar, Zeolites and ultramarines. polysulphur - nitrogen compounds and poly - organophosphazenes.

UNIT-II: STRUCTURE & BONDING - II

Boron hydrides: Polyhedral boranes, Structure prediction of boranes by PSEPT (Wade-Mingos Rule) hydroboration, carboranes and metallo – carboranes.

Metal clusters: Chemistry of di and tri nuclear metal Clusters.

UNIT-III: COORDINATION CHEMISTRY I

Stability of complexes; thermodynamic aspects of complex formation; factors affecting stability, HSAB approach.

Determination of stability constants by spectrophotometric, polarographic and potentiomteric methods.

UNIT-IV: COORDINATION CHEMISTRY II

Stereochemical aspects; Stereoisomerism in inorganic complexes; isomerism arising out of ligand distribuion and ligand conformation; chirality and nomenclature of chiral complexes; optical rotatory dispersion and circular dichroism.

Macrocyclic ligands; types; porphyrins; corrins, Schiff bases; crown ethers.

UNIT-V: COORDINATION CHEMISTRY III

Evidence for metal-ligand orbital overlap, molecular orbital theory and energy level diagrams, concept of weak and strong field ligands, Jahn-Teller distortion, charge - transfer spectra.

Term states for d^2, ground state term symbols for d^n ions - energy diagrams, d-d transitions, Orgel and Sugano - Tanabe diagrams, spin orbit coupling, nephelauxetic effect, spectral and magnetic characteristics of transition metal complexes.

Text Books

1. FA Cotton and G.W. Wilkinson, **Advanced Inorganic Chemistry**– Acomprehensive Text, John Wiley and Sons, (1988).
2. J.E. Huheey, **Inorganic Chemistry**, Harper and Collins, NY, IV Edition, (1993).
3. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry** WB Saunders Co., USA, (1977).
4. M.C. Shrivers, P.W Atkins, CH. Langford, **Inorganic Chemistry**, OUP, (1990).
5. N.N. Greenwood and Earnshaw, **Chemistry of the Elements**, Pergamon Press, New York (1984).

6. NH Ray, **Inorganic Polymers**, Academic Press, (1978)
7. S.F.A. Kettle, **Coordination Chemistry**, ELBS, (1973).

Suggested References

1. A.B.P. Lever, **Inorganic Electronic Spectroscopy**, II Edn., Elsevier, New York, (1984).
2. B.E. Dogulas DH McDaniel's and Alexander, **Concepts and Models of Inorganic Chemistry**, Oxford IBH, (1983).
3. B.N. Figgis, **Introduction to Ligand Fields**, Interscience, (1966).
4. EL. Mutterties, **Polyhedral Boranes**, Academic Press, New York (1975).
5. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., NY, (1974).
6. WU. Mallik, G.D. Tuli, R.D. Madan, **Selected topics in Inorganic Chemistry**, S. Chand and Co., New Delhi, (1992).

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Year: I Year Subject Code: P18MCH103 Semester: I

Major - 3 Title: **Physical Chemistry-I**

Credits: 4 Max. Marks: 75

OBJECTIVES	To study the partial molar property, fugacity and its significance. Theories and basic concepts of chemical kinetics, mechanism of acid – base and enzyme catalysis. Basic co ncepts of rotational spectroscopy and Elements of group theory.
COURSE OUTCOMES	
CO1	Understand the partial molar quantities, concept of fugacity and activity
CO2	Explain ARRT, Hammett and Taft equation
CO3	Discuss catalysis by enzymes and Michelis Menton equation
CO4	Determine moment of inertia and bond lengths, relative intensities of spectral lines, rotational spectra of polyatomic molecules.
CO5	Find point group of molecules using symmetry elements and symmetry operations,

UNIT – I: THERMODYNAMICS

Partial molar quantities – Chemical potential, partial molar volume and partial molar heat content – their significance and determination – variation of chemical potential with temperature and pressure.

Concept of Fugacity – determination of fugacity by graphical method – Variation of fugacity with temperature and pressure.

Concept of activity and activity coefficient – determination of activity coefficient for non-electrolyte - choice of standard state.

UNIT – II: CHEMICAL KINETICS

ARRT – Thermodynamic approach – Eyring equation –Estimation of free energy, enthalpy and entropy of activation and their significance – Statistical treatment of ARRT – Partition function – Transmission coefficient.

Application of ARRT to reaction in solutions – Effect of pressure, dielectric constant and ionic strength on reaction rate in solutions – Jerrum – Bronsted equation - Kinetic isotopic effect – Linear free energy relationships – Hammett and Taft equation.

UNIT – III: CATALYSIS - I

Acid – Base catalysis – mechanism of acid – base catalysis – bronsted catalysis law.

Catalysis by enzymes – rate of enzyme catalysed reaction – Michaelis- Menton Equation and its interpretation - Effect of substrate concentration, pH and temperature on enzyme catalysed reaction – Inhibition of enzyme catalysed reaction – Competitive,
Non-Competitive and Un-Competitive Inhibition

UNIT – IV: SPECTROSCOPY – I

Interaction of radiation with matter – Einstein's transition probabilities – Rotational spectroscopy - Rigid rotor model – Non-rigid rotor – rotational energies of diatomic molecules, determination of moment of inertia and bond lengths - relative intensities of spectral lines, rotational spectra of polyatomic molecules.

UNIT – V: GROUP THEORY – I

Symmetry elements and symmetry operations, Group postulates, Types of groups – sub groups, Abelian and non – abelian groups, order of a group – point groups – Group multiplication table for C_{2v} and C_{3v} point groups, similarity transformation and classes, Representations – reducible and irreducible representation.

Text Books

1. S. Glasstone, Thermodynamics for Chemists, Affiliated East West Press, New Delhi (1950).
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, Lal Nagin Chand, New Delhi (1986).
3. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformations. Mac Millan India Ltd (1993).
4. R.J. Laidler, Chemical Kinetics, Harper and Row, New York (1987).

5. K.V. Ramakrishnan and M.S. Gopinath, Group Theory in Chemistry, Vishal Publications (1998).
6. K.L. Kapoor, A text book of Physical Chemistry, Mac Millan India Ltd.,(2001)
7. K.V.Raman, Goup Theory and its applications to Chemistry, Tata Mc Graw Hill Publishing Company (1990)
8. C.N. Banwell, Fundamentals of Molecular spectroscopy, McGraw Hill (1966)

Suggested References:

1. Raymond charg, Basic Principles of spectroscopy, McGraw Hill ltd, New York (1971)
2. G.M. Barrow, Introduction to molecular spectroscopy, McGraw Hill, New York (1962)
3. W.J. Moore, Physical chemistry, orient Lengman, London (1972)
4. L.K. Nash, Elements of Chemical thermodynamics, Addision Wesley (1962)
5. R.G. Frost and Pearson, Kinetics and mechanism, Wisely, New York (1961)
6. P.K. Bhattacharya, Group theory and its Applications, Himalaya Publishers.

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Year: I Year Subject Code: P18ECH101 Semester: I

Elective – 1A Title: **Polymer Chemistry**

Credits: 3 Max. Marks: 75

OBJECTIVES	To gain the knowledge in the preparation, properties, characterization and uses of polymers.
COURSE OUTCOMES	
CO1	Know the different kind of polymers and techniques of polymerization.
CO2	Categorize polymerization reactions with respect to mechanism of polymerization.
CO3	Acquire knowledge about structure and Concept of Molecular Weight.
CO4	Utility of polymers in industry.

UNIT- I: BASIC CONCEPTS

Classification – Nomenclature and isomerism – functionality – Molecular forces and chemical bonding in polymers – Linear, branched and cross linked polymers. Thermoplastic and thermosetting polymers – Elastomers, Fibers and resins.

Techniques of polymerization–emulsion, bulk, solution and suspension.

UNIT– II: KINETICS AND MECHANISM

Kinetics and Mechanism of polymerization – free radical, cationic, anionic and co-ordination polymerization (Ziegler - Natta Catalyst) – Copolymerisation – Kinetics–Kinetic chain length–degree of polymerization, chain transfer reagents - initiators – inhibitors – retarders. Living polymers – group transfer polymerisation.

UNIT – III

A) **Structure and Properties**

Structure - property relationship – Mechanical properties, Thermal properties – Glass transition temperature – Factors affecting Glass transition temperature- Glass transition temperature of copolymers-Glass transition temperature and melting point- Importance.

B) **Molecular Weight Determination**

Average molecular weight- Number average and Weight average molecular weight- Determination of molecular weight – Ultracentrifuge, Osmometry, Viscosity and light scattering method.

UNIT – IV: INDUSTRIAL NATURAL POLYMERS

Important industrial polymers – preparation and application of polyethylene, poly vinyl chloride, poly urethanes, polytetrafluro ethylene, poly acrylonitrile, Nafion and ion-exchange resins.

Importance of Natural polymers – application and structure of Starch, Cellulose and Chitosan derivatives.

UNIT – V: SPECIALITY POLYMERS

Bio polymers – biodegradable polymers – biomedical polymers – poly electrolytes - conducting polymers – high temperature and fire retardant polymers - polymer blend – polymer composites – polymer nanocomposites – inter penetrating network polymers – Electroluminescent polymers.

Text Books:

1. F. W. Bill Meyer. Text book of polymer science, III Edition, John Wiley and sons, New York.
2. P. J. Flory. Principles of Polymer Chemistry, Cornell Press (recent edition).
3. V. R. Gowarikar, B. Viswanathan, J. Sridhar, Polymer Science – Wiley Eastern, 1986.
4. G. S. Misra – Introduction to Polymer Chemistry, Wiley Eastern Ltd.,
5. P. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.

6. G. Odian, Principles of Polymerization, McGraw Hill Book Company, New York, 1973.

Suggested References

1. Rudin, The Elements of Polymer Science and Engineering. Academic Press, New York, 1973.
2. E. A. Coolins, J. Bares and E. W. Billmeyer, Experiments in Polymer Science, Wiley Interscience, New York, 1973.

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Year: I Year Subject Code: Semester: I

Elective – 1B Title: **HETEROCYCLIC CHEMISTRY**

Credits: 3 Max. Marks: 75

Objectives	To rationalize the reactivity of heteroaromatic compounds. To know the methods to prepare some heterocyclic compounds with Five and Six members, fused rings and heterocyclic compounds two or more heteroatoms. To Improve the students' knowledge of the methods of preparation followed by the Reaction Mechanism. Application for the Synthesis and Design of some biologically active compounds derived from heterocyclic compounds.
Course Outcomes: After the completion of this course, students can be able to	
CO1	Discuss the methods to prepare some heterocyclic compounds with Five and Six members, fused rings and heterocyclic compounds two or more heteroatoms.
CO2	Know the nomenclature, methods of preparation followed by the Reaction Mechanism of heterocyclic compounds
CO3	Gather the knowledge of Synthesis and Design of some biologically active compounds derived from heterocyclic compounds

UNIT-I: NOMENCLATURE OF HETEROCYCLES

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic fused and bridged heterocycles. Aromatic Heterocycles General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations).Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

UNIT-II: NON-AROMATIC HETEROCYCLES

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversino and 1,3-diaxial interaction. Stereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic, ectrophilic interactions. Heterocyclic Synthesis. Principles of heterocyclic synthesis involing cyclization reactions and cycloaddition reactions.

UNIT-III: SMALL RING HETEROCYCLES

Three-membered and four-membered heterocycles-synthesis and reactions of azirodines, oxiranes, thiranes, azetidines, oxetanes and thietanes. Benzo-Fused Five-Membered Heterocycles Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.

UNIT-IV: MESO-IONIC HETEROCYCLES

General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. Six-membered Heterocycles with one Heteroatom. Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromenes.

UNIT-V: HIGHER HETEROCYCLES

Six membered Heterocycles with two or more Heteroatoms. Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-membered Heterocycles. Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.

Suggested References:

1) Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.

2) The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.

3) Heterocyclic chemistry J.A. Joule, K. Mills and g.F. Smith, Chapman and Hall.

4) Heterocyclic Chemistry, T.L. Gilchrist, Longman Scietific Techinal.

5) Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.

6) An Introductiion to the Heterocyclic Compounds, R.M. Acheson, Johnwiely.

Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press

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Year: I Year Subject Code: Semester: I

Elective – 1C Title: **INORGANIC PHOTOCHEMISTRY**

Credits: 3 Max. Marks: 75

Objectives	To know the basics of photochemistry; To describe and explain photochemical and photophysical processes of metal complexes; To know the applications of metal complexes in photochemistry.
Course outcomes: After the completion of the course students can be able to	
CO1	Have a good overview of the core concepts in inorganic photochemistry.
CO2	Understand fundamentals of inorganic photochemistry of metal complexes
CO3	Describe the applications of complexes as sensitizers.

UNIT-I: BASIC OF PHOTOCHEMISTRY

Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times-measurements of the times. Flash photolysis, energy dissipation by radiative and non-radiative processes, absorption spectra, Frank-Condon principle, photochemical stages-primary and secondary processes.

UNIT-II: EXCITED STATES OF METAL COMPLEXES

Excited states of metal complexes: Comparison with organic compounds, electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations.

UNIT-III: LIGAND FIELD PHOTOCHEMISTRY

Photosubstitution, photooxidation and photoreduction, lability and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states.

UNIT-IV: REDOX REACTIONS BY EXCITED METAL COMPLEXES

Energy transfer under conditions of weak interaction and strong interaction-examples formation; condition of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive condidates, (2,2-bipyridine and 1,10-phenanthroline complexes), illustration of reducing and oxidising character of Ruthenium+2 (bipyridal complex, comparsion with Fe (bipy); role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants into high energy products, chemical energy into light.

UNIT-V: METAL COMPLEX SENSITIZERS

Metal complex sensitizer, electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation and carbon dioxidereduction.

Book Suggested:

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

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

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

4) Coordination Chem. Revs. 1981, vol. 39, 121, 1231, 1975, 14, 321,; 1990 97, 313.

5) Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic

6) Press. Elements of Inorganic Photochemistry, G.J. Ferraudi, Wiley.

7) S.Arunachalam,"InorganicPhotochemistry-An Introduction to Photochemical and Photophysical Aspects of Metal Complexes", Kala Publications, Tiruchirappalli, India, 2002.

8) D.M. Roundhill, “Photochemistry and photophysics of Metal complexes”, Springer;Edition, 1994.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCH201 Semester: II

Major - 4 Title: **ORGANIC REACTION MECHANISMS**

Credits: 3 Max. Marks: 75

OBJECTIVES	To learn the various types of reactions, rearrangements and their synthetic utility, Aromaticity, Nitrenes and Carbenes.
COURSE OUTCOMES	
CO1	Discuss the mechanism of organic reactions involving addition to carbon carbon and carbon hetero multiple bonds.
CO2	Know the mechanism orientation of double bond in elimination reactions
CO3	Acquire knowledge about oxidizing agents and their importance in organic synthesis
CO4	Be able to outline the mechanism of important molecular rearrangements.
CO5	Differentiate between aromatic, non-aromatic and anti-aromatic compounds, know about reaction intermediates such as carbenes and nitrenes.

UNIT-I: ADDITION TO CARBON - CARBON AND CARBON – HETERO MULTIPLE BONDS

Electrophilic, nucleophilic and neighbouring group participation mechanisms - addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydroboration, hydroxylation, Michael addition, 1, 3 - dipolar additions, Carbenes and their additions to double bonds -Simon - Smith reaction. Mannich, Stobbe, Darzen, Wittig, Wittig – Horner, Suzuki coupling and Benzoin reactions.

UNIT-II: ELIMINATION REACTIONS

E_1, E_2 and $E_{1C}B$ mechanism - E_1, E_2 and E_1CB spectrum - Orientation of the double bond - Hoffmann and Saytzeff rules - Competition between elimination and substitution. Typical eliminations reactions - dehydration, dehydrohalogenation and dehalogenation. Stereochemistry of E_2 eliminations in cyclohexane systems. Mechanism of pyrolytic eliminations. Chugaev and Cope eliminations.

UNIT-III: OXIDATIONS AND REDUCTIONS

Mechanism - oxidation of alcohols - use of DMSO in combination with DCC and acetic anhydride in oxidising alcohols - oxidation of methylene to carbonyl, oxidation of aryl methenes - allylic oxidation of olefins. Ozonolysis - oxidation of Olefinic double bonds and unsaturated carbonyl compounds-oxidative cleavage of C-C bond. Reduction: Selectivity in reduction of 4-t-butylcyclohexanone using selecterides. Hydride reductions - reduction with $LiAlH_4$, $NaBH_4$, tritertiarybutyloxyaluminium hydride, sodium cyanoborohydride, trialkyltin hydride, hydrazines.

UNIT-IV: MOLECULAR REARRANGEMENTS

A detailed study with suitable examples of the mechanism of the following rearrangements: Pinacol – Pinacolone, Wagner - Meerwein, Demjanov, Dienone - phenol, Favorski, Baeyer - Villiger, Wolf, Stevens (in cyclic systems), Von Richter, Dakin, Benzidine and Lossen rearrangements.

UNIT –V: AROMATICITY, CARBENES & NITRENES

Aromaticity of benzenoid, heterocyclic, and non-benzenoid compounds, Huckel's rule - Aromatic systems - non-aromatic anti aromatic and homo aromatic system - system with more than 10 pi electrons – Azulenes and Annulenes upto C18 (synthesis of all these compounds is not expected).

Carbenes and nitrenes: Methods of generation, structure, addition reactions with alkenes - insertion reactions.

Recommended Books

1. Principles of organic synthesis R.O.C. Norman, Chapman and Hall, London. 1980.
2. Structure and Mechanism by E.S. Gould
3. Advanced Organic Chemistry - Part B by Francis A. Carey and Richard J, Sundberg, 3rd Edition 1990.
4. Organic Reaction Mechanism by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., Chennai - 1990.
5. Organic synthesis by Michael Smith.
6. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
7. Molecular Rearrangements Vol-I and Vol-II by Paul de Mayo.
8. Advanced Organic Chemistry III Edition by J. March.
9. Stereochemistry and Mechanism through solved problems by P.S. Kalsi, Wiley Eastern Ltd., 1994.
10. Some Modern Methods of Organic Synthesis by W Carruthers, III Edition, Cambridge University Press, 1993.
11. Modern Synthetic Reactions by H.O. House, The Benjamin Cummings Publishing Company, London, 1972
12. Advanced organic chemistry, Mc Murray, Thomas Pvt. Ltd.,
13. Organic reaction mechanisms: Parmer and Chawla, S. Chand and Co.,

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCH202 Semester: II

Major - 5 Title: **SOLID STATE & NUCLEAR CHEMISTRY**

Credits: 3 Max. Marks: 75

OBJECTIVES	To study about the theories of coordination complexes, Chemistry of lanthanides, to learn about Nanotechnology and use of Inorganic Compounds in Biological Chemistry.
COURSE OUTCOMES	
CO1	Describe the principles concerning solid state structures
CO2	Identify and define various types of nuclear reactions including fission, fusion and decay reactions.
CO3	Understand the nuclear chemistry applications such as nuclear reactor and radio analytical techniques.
CO4	Acquire knowledge of general properties of lanthanides and actinides & understand the characterization, application of Nanotechnology
CO5	Define the importance of inorganic elements in vital systems.

UNIT-I: THE CHEMISTRY OF SOLID STATE

Structure of Solids; Comparison of X-ray and Neutron Diffraction; structure of Pervoskite, cadmium iodide and nickel arsenide; spinels and reverse spinels; defects in solids, stoichiometric and non-stoichiometric compounds.

Electrical, Magnetic and optical properties of solids.Band theory, semiconductors, superconductors, solid state electrolytes. Types of magnetic behaviour, dia, para, ferro, antiferro and ferrimagnetism: Hysteresis. Solid state lasers, inorganic phosphors, ferrites.

UNIT- II: NUCLEAR CHEMISTRY I

Nuclear properties: Nuclear spin and moments, origin of nuclear forces, salient features of the liquid drop and the shell models of the nucleus.

Modes of Radioactive Decay: orbital electron capture: nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, bubble chamber, G.M, Scintillation and Cherenkov counters.

Nuclear Reactions: Types, reactions, cross section, Q-value, threshold energy, compound nucleus theory: high energy nuclear reactions, nuclear fission and fusion reactions as energy sources; direct reactions; photonuclear and thermo nuclear reactions.

UNIT-III: NUCLEAR CHEMISTRY II

Stellar energy: synthesis of elements, hydrogen burning, carbon burning. Nuclear Reactors: fast breeder reactors, particle accelerators, linear accelerators, cyclotron and synchrotron.

Radio Analytical Methods: Isotope dilution analysis, Radiometric Titrations, Radio Immuno Assay and Neutron Activation Analysis.

UNIT-IV: THE CHEMISTRY OF LANTHANIDES, ACTINIDES AND NANOTECHNOLOGY

Chemistry of lanthanides and actinides, oxidation state spectral, magnetic characteristics, coordination numbers, stereochemistry, nuclear and non-nuclear applications.

Nanotechnology - introduction - preparatory methods, characterization, application as sensors, biomedical applications, application in optics and electronics.

UNIT-V: BIOINORGANIC CHEMISTRY

Transport proteins: oxygen carriers, metalloenzymes, carboxy peptidase, carbonic anhydrase, iron-sulphur proteins, chlorophyll, salient features of the photo synthetic process, vitamin B_{12}. Fixation of nitrogen, nitrogen cycle.

Anti-cancer drugs and their mechanism of action, natural and man-made radio isotopes and their applications in medicine.

Text Books:

1. A.R. West, **Basic solid state chemistry**, John Wiley, (1991).
2. S. Glasstone, **Source Book on Atomic Energy**, Van Nostrand Co., (1969).
3. G. Frielander, J.w. Kennedy and J.M. Miller, **Nuclear and Radiochemistry**, John Wiley and Sons, (1981).
4. Hari Jeevan Arnikar , **Essentials of nuclear chemistry**, New Age International (P) Ltd., (2005).
5. Hari Jeevan Arnikar, **Nuclear Chemistry Through Problems**, New Age International (P) Ltd., (2007).
6. G.T. Seaborg, **Trans uranium elements**, Dowden Hutchinson and Ross, (1978).
7. Nishit Mathur, **Nano chemistry**, RBSA publishers (2010).
8. Patrick Salomon, **A hand book on Nano Chemistry**, Dominant publishers and distributors (2008).
9. G.B. Sergeev , **Nano chemistry** ,Elsevier Science and Technology (2007).
10. U. Saityanarayana, **Essentials of Biochemistry**, Books and Allied (P) Ltd.,

Suggested References:

1. W.E. Addison, **Structural principle in Inorganic chemistry**, Longman (1961).
2. D.M. Adams, **Inorganic solids**, John Wiley Sons (1974).
3. Azaroff, **Solid State Chemistry**, John Wiley.
4. B.E. Douglas DH McDaniel's and Alexander, **Concepts and Models of Inorganic Chemistry**, Oxford IBH, (1983).
5. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., New York (1974).
6. J.E. Huheey, **Inorganic Chemistry - Principles, Structure and Reactivity**, Harper Collins, New York, IV Edition (1993).
7. N. Greenwood and A. Earn Shaw, **Chemistry of Elements**, Pergamon, NY, (1984).
8. F.A. Cotton and G. Wilkinson, **Advanced Inorganic Chemistry** - A Comprehensive Text, John Wiley and Sons, V Edition (1988).
9. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry** - WB Saunders Co., USA (1977)

10. WU. Malik, G.D. Tuli, R.D. Madan, **Selected topics in Inorganic Chemistry**, S. Chand and Co., New Delhi, (1992).
11. M.N. Hughes, **The Inorganic Chemistry of Biological processes**, Wiley London, II Edition (1982).
12. Jonathan W. Stead, David R. Turner andkarl. J. Wallace., Core concepts in **Supramolecular Chemistry and Nano chemistry**, John Wiley sons Ltd (2007).
13. Beoffry A.Ozin, Andre Arsenault, Ludovico & Cademartiri. **Nano chemistry - A chemical approach to nano materials**, Royal Society of chemistry (2009).
14. Kenneth J. Klabunde, **Nano scale materials in Chemistry** A. John Wiley & Sons Publishers (2001).
15. L. Stryer, **Biochemistry** Edition, Freeman & Co., New York (2002) .
16. D. L. Nelson and M.M. Cox, Lehninger, **Principles of Biochemistry**, III edition, McMillan North Publication (2002).
17. W. Kaim and B. Schwederski, **Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, an Introduction and Guide**, Wiley, New York (1995).
18. S. J. Lippard and J. M. Berg, **Principles of Bioinorganic Chemistry**, University Science Books (1994).
19. I. Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine, **Bioinorganic Chemistry**, Viva Books Pvt. Ltd., New Delhi (1998).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCH203 Semester: II

Major - 6 Title: **PHYSICAL CHEMISTRY – II**

Credits: 4 Max. Marks: 75

OBJECTIVES	To study the various types of molecular spectroscopy, basic concepts of electrochemistry, fundamental principles of Quantum Chemistry. Debye-Huckel limiting law – To study kinetics of complex reactions, the applications of Group theory
COURSE OUTCOMES	
CO1	Discuss Debye –Huckel theory and determine of activity coefficient by electrochemical method
CO2	Acquire fundamental knowledge of vibrational, Raman and electronic spectroscopy
CO3	Understand chemical kinetics of complex reactions and fast reactions.
CO4	Describe the concept of adsorption and heterogeneous catalysis
CO5	Apply group theory to determine the structure of simple molecules.

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UNIT – I: ELECTRO CHEMISTRY – I

Mean ionic activity and mean ionic activity coefficient – concept of ionic strength – Debye –Huckel theory of strong electrolytes – activity coefficient of strong electrolytes – Determination of activity coefficient by electrochemical method.

Debye-Huckel limiting law – qualitative and quantitative verification – Debye –Huckel limiting law at appreciable concentrations of electrolytes – Huckel equation – Debye-Huckel Bronsted equation.

UNIT – II: SPECTROSCOPY – II

Vibrational spectroscopy – harmonic oscillator – anharmonicity – vibrational spectra of polyatomic molecules – vibrational frequencies – vibrational coupling – overtones - Fermi resonance.

Raman spectra – Raman effect – rotational and vibrational Raman spectra.

Electronic spectra – Frank-Condon Principle – Types of electronic transitions – Selection Rules – Solvent effects on electronic transitions.

UNIT – III: CHEMICAL KINETICS – II

Kinetics of complex reaction, reversible, consecutive, parallel reactions, chain reactions, general treatment of chain reactions – chain length – Rice Herzfeld mechanism – Thermal decomposition of acetaldehyde - explosion limits.

Study of fast reactions – relaxation methods – temperature and pressure jump method – stopped flow technique – Flash photolysis method.

UNIT – IV: CATALYSIS – II

Concept of Adsorption – Adsorption Isotherms – Langmuir Isotherm, BET Isotherm – Application- Determination of Surface area of Adsorbent.

Heterogeneous Catalysis – Mechanism - Langmuir Hinshelwood and Langmuir Rideal Mechanism - Kinetics of Unimolecular Surface Reactions and Bimolecular Surface Reactions.

UNIT – V: APPLICATIONS OF GROUP THEORY – II

Orthogonality theorem and its consequences – Construction of character table for C_{2v} and C_{3v} – Direct Product Representation - Standard reduction formula – hybrid orbitals in non-linear molecules (CH_4, XeF_4, BF_3, SF_6, and NH_3) Determination of representations of vibrational modes in non-linear molecules (H_2O, PCl_5, BF_3 and NH_3). Symmetry selection Rules for IR and Raman spectra.

Text Book:

1. C.N. Banwell and E.M. McCash, Fundamentals of Molecular spectroscopy, IV - Edition, Tata McGraw Hill (2005).
2. D.N. Sathyanarayana, Vibrational Spectroscopy, New Age International Publishers (2004).
3. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformations. Mac Millan India Ltd (1993).
4. R.J. Laidler, Chemical Kinetics, Harper and Row, New York (1987).
5. K.V. Raman, Group Theory and its Applications to Chemistry, Tata Mc Graw Hill Publishing Co., (1990).
6. K.V. Ramakrishnan and M.S. Gopinath, Group Theory in Chemistry, Vishal Publications (1998).
7. S. Glasstone, Introduction to Electrochemistry, Affiliated East west press, New Delhi (1960)
8. D.R. Crow, Principles and Applications to Electrochemistry, chapman and Hall (1991)

Suggested References:

1. C.N. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill (1966)
2. R.G. Frost and Pearson, Kinetics and mechanism, Wisely, New York (1961)
3. Raymond chang, Basic Principles of spectroscopy, McGraw Hill ltd, New York (1971)
4. C.N. Banwell, Fundamentals of Molecular spectroscopy, McGraw Hill (1966)
5. W.J. Moore, Physical chemistry, orient Lengman, London (1972)
6. John O. M. Bokris, Amulya K.N. Reddy, Modern Electrochemistry2B: Electrodes in Chemistry, Engineering , Biology and Environmental Science.
7. F.A. Cotton, Chemical Applications of Group Theory, John Wiley and Sons inc., New York (1971).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18ECH201 Semester: II

Elective – 2A Title: **GREEN CHEMISTRY**

Credits: 3 Max. Marks: 75

OBJECTIVES	To know eco-friendly methods of synthesis. This helps in planning the synthesis of any type of organic compounds with the revolution of Green Chemistry.
COURSE OUTCOMES	
CO1	Learn the basic principles of green chemistry and understand stoichiometric calculations and relate them to green process metrics.
CO2	Determine the environmental performance using various assessments.
CO3	Review the principles of microwave technology, photochemical reactions and other interesting processes from the viewpoint of green chemistry.
CO4	Learn and understand the mechanism of phase transfer catalyst in green reactions.
CO5	Students get to know the industrial case studies

UNIT - I: PRINCIPLES & CONCEPT OF GREEN CHEMISTRY

Introduction – Need of Green Chemistry - Concept and Principles - Atom economy reactions – rearrangement reactions, addition reactions - atom uneconomic –substitution – elimination - Wittig reactions - toxicity measures – Planning a green synthesis in a chemical laboratory.

UNIT-II: MEASURING AND CONTROLLING ENVIRONMENTAL PERFORMANCE

Importance of measurement – lactic acid production-safer Gasoline – introduction to life cycle assessment-four stages of Life Cycle Assessment (LCA) –Carbon foot printing-green process Matrics-eco labels -Integrated Pollution and Prevention and Control(IPPC)-REACH (Registration, Evaluation, Authorization of Chemicals)

UNIT III: EMERGING GREEN TECHNOLOGY AND ALTERNATIVE ENERGY SOURCES

Design for Energy efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry - Microwave heating –Microwave assisted reactions - Sono chemistry and Green Chemistry – Electrochemical Synthesis - Examples of Electrochemical synthesis - Fuel Cells as renewable energy resources.

UNIT IV: PHASE TRANSFER CATALYSIS IN GREEN SYNTHESIS

Introduction, mechanism of phase transfer catalyst reaction, types and advantages of phase transfer catalyst, types and applications of phase transfer reaction: Nitriles from alkyl or aryl halides, alkyl fluorides, alcohols, azides from alkyl halides, generation of dichlorocarbeens, addition to olefins, elimination reaction, alkylation reactions, Williamson synthesis, Benzoin condensation, Darzon reaction, Michael reaction, Wittig reaction, oxidation under PTC condition and reduction.

UNIT V: INDUSTRIAL CASE STUDIES

Methyl Methacrylate (MMA)-Greening of Acetic acid manufacture-Vitamin C-Leather manufacture –Types of Leather –Difference between Hide and Skin-Tanning –Reverse tanning –Vegetable tanning –Chrome tanning-Fat liquoring –Dyeing –Application-Polyethylene- Ziegler Natta Catalysis- Metallocene Catalysis-Eco friendly Pesticides-Insecticides.

Text Books:

1. New Trends in Green Chemistry, V.K. Ahluwalia, M. Kidwai, II Edn., Anamaya Publishers, New Delhi (2007).
2. Green Chemistry and Introductory text, Mike Lancaster, II Edition.

3. Organic synthesis: Special techniques, V.K. Ahluwalia and R. Agarwal, Narosa Publishers, New Delhi (2003).

References:

1. P.T. Anastas and J.C Warner, Green Chemistry theory and Practice, Oxford University press, Oxford (1988).
2. P. Tundo *et.al.*, Green Chemistry, Wiley –Blackwell, London (2007).
3. Protti D.Dondi *et.al.*, Green Chemistry
4. T.E Graedel, Streamlined Life cycle Assessment, Prentice Hall, New Jersey (1998).
5. V.K. Ahluwalia, Methods and Reagents of Green Chemistry: An Introduction by Green Chemistry.
6. www.clri.org

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: Semester: II

Elective – 2B Title: **MATERIAL SCIENCE**

Credits: 3 Max. Marks: 75

Objectives	To know scientific principles, experimental research, analytical methods and applications in the interdisciplinary fields of nanomaterials and biomaterials
Course outcomes: After the completion of the course students will be able to	
CO1	Understand the crystal system, Bravais lattice and crystal geometry.
CO2	Describe various defects in crystal systems.
CO3	Discuss ionic and organic semiconductors.

UNIT- I: Classification of crystals

Seven crystal systems and fourteen Bravais lattices. Structure and bonding in solids- Cohesive force in crystals, van der waal's interactions, Ionic bonding, covalent bonding and hydrogen bonding in solids. Structure aspects os rock salt, rutile, fluorite, antifluorite, diamond, zinc blende, wurtzite, Crystobalite, spinels, inverse spinels and silicates.

UNIT –II: Crystal geometry

Symmetry elements for solids (including glide planes and screw axis).Introduction to space groups with examples. Techniques of structure determination in solid state – X-ray diffraction, electron

and neutron diffractions and electron microscopy – principle, instrumentation and applications; Calculation of structure factor.

UNIT- III: Theories of metallic state

Free electron theory, (Brillouin) and Band models. Defects in crystals – Frenkel and Schotky defects, F-centres, effect of defects on the electrical, optical, magnetic, thermal and mechanical properties of crystals. Smart metals- binary and ternary – examples and applications.

UNIT –IV: Ionic conductors

Optimised ionic conductors-silver ion, copper ion, alumina and related electrolytes, alkali metalion, fluoride ion and proton conductors; super conductors – principle and applications. Models of ionic motion- simple hopping motion – cooperative motion models. Photo conducting materials – principle, examples and applications.

UNIT V: Organic semiconductors

Organic semiconductors – photo physical processes, thermal and photo generation of carriers;Aromatic hydrocarbons, phthalocynins- anthracene mechanisms; excitons and polarons.Change transfer complexes – characterization and their electrical properties.Conduction polymers- polyacetylenes, polyanilines and polyvinylidenes- preparation and Applications.Carbon Nano particles- fullerenes- preparation and potential applications. liquid crystals- classification- thermotropic and lyptropic- nemetic, smectic and cholestric and their applications.

References:

1) Materials science by Raghavan

2) Materials Science Vol I and II by Manas Chanda

3) Structural Inorganic chemistry by A.F . Wells

4) Introduction to solid state physics by McCrey et al.

5) Solid state chemistry and applications byAntony West

6) Solid state chemistry by Hannay

7) Chemistry of Nanomaterials, Vol.I & II, by C.N.R. Rao.

8) Muller and A. K. Cheetham, Wiley VCH Verlag, 2002.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: Semester: II

Elective – 2C Title: **APPLIED ELECTROCHEMISTRY**

Credits: 3 Max. Marks: 75

Objectives	To know basics of the electrode kinetics and some relevant thermodynamic aspects; Understand the conversion of electrochemical energy - Knowledge of corrosion and potential sweep methods.
Course outcomes: After the completion of the course students can be able to	
CO1	Understand the basics of electrode kinetics and relevant thermodynamics
CO2	Understand the conversion of electrochemical energy
CO3	Know about corrosion and potential sweep methods.

UNIT-I: CONVERSION AND STORAGE OF ELECTROCHEMICAL ENERGY

Pollution problem. History of fuel cells, Direct energy conversion by electrochemical means. Maximum intrinsic efficiency of an electrochemical converter. Physical interpretation of the Carnot efficiency factor in electrochemical energy converters. Power outputs. Electrochemical Generators (Fuel Cells) : Hydrogen oxygen cells, Hydrogen Air cell, Hydrocarbon air cell, Alkaline fuel cell, Phosphoric and fuel cell, direct NaOH fuel cells, applications of fuel cells.

UNIT-II: ELECTROCHEMICAL ENERGY STORAGE

Properties of Electrochemical energy storers: Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density. Classical Batteries :

(i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc manganese dioxide. Modern Batteries : (i) Zinc-Air (ii) Nickel-Metal Hydride, (iii) Lithium Battery, Future Electricity storers : Storage in (i) Hydrogen, (ii) Alkali Metals, (iii) Non aqueous solutions.

UNIT-III: CORROSION AND STABILITY OF METALS

Civilization and Surface mechanism of the corrosion of the metals; Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diaphragms; uses and abuses, Corrosion current and corrosion potential -Evans diagrams. Measurement of corrosion rate: (i0 Weight Loss method, (ii) Electrochemical Method. Inhibiting Corrosion:Cathodic and Anodic Protection. (i) Inhibition by addition of substrates to the electrolyte environment, (ii) by charging the corroding method from external source, anodic Protection, Organic inhibitors, The fuller Story Green inhibitors. Passivation :Structure of Passivation films, Mechanism of Passivation, Spontaneous Passivation Nature's method for stabilizing surfaces.

UNIT-IV: KINETIC OF ELECTRODE PROCESS

Essentials of Electrode reaction. Current Density, Overpotential, Tafel Equation, Butler Volmer equation.Standard rate constant (K0) and Transfer coefficient (a), Exchange Current.Irreversible Electrode processes :Criteria of irreversibility, information from irreversible wave.Methods of determining kinetic parameters for quasi-reversible and irreversible waves: Koutecky's methods, Meits Israel Method, Gellingsmethod.Electrocatalysis:Chemical catalysts and Electrochemical catalysts with special reference to porphyrin oxides of rare earths. Electrocatalysis in simple redox reactions, in reaction involving adsorbed species. Influence of various parameters.

UNIT-V:POTENTIAL SWEEP METHODS

Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications. Diagnostic criteria of cycli voltammetry.Controlled current microelectrode techniques: comparison with controlled potentials methods, chronopotentiometry, theory ad applications.Bulk Electrolysis Methods : Controlled potential coulometry, Controlled Coulometry, Electroorganic synthesis and its important applications. Stripping analysis: anodic and cathodic modes, Pre electrolysis and

Stripping steps, applications of Stripping Analysis. Bioelectrochemistry :bioelectrodics, Membrane Potentials, Simplistic theory, Modern theory, Electrical conductance in biological organism: Electronic, Protonic electrochemical mechanism of nervous systems, enzymes as electrodes.

References :

1) Modern Electrochemistry Vol. I, IIa, Vol. IIB, J'OM Bockris and A.K.N. Reddy, Plenum Publication, New York.

2) Polarographic Techniques by L. Meites, Interscience.

3) "Fuel Cells : Their electrochemistry". McGraw Hill Book Company, New York. Modern

4) Polarographic Methods by A.M. Bond, Marcell Dekker.

5) Polarography and allied techniques by K. Zutshi, New age International publicatin. New Delhi.

6) "Electroaalytical Chemistry by Basil H. Vessor & Galen W. ; Wiley Interscience.

7) Electroanalytical Chemistry by Basil H. Vessor & alen w. ; Wiley Interscience.

8) Topics in pure and Applied Chemistry, Ed. S. K. Rangrajan, SAEST Publication, Karaikudi

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18CHR201 Semester: II

Compulsory Paper Title: **HUMAN RIGHTS**

Credits: 2 Max. Marks: 75

OBJECTIVES	To study and understand various human rights violation in the present society. To assess the human rights issues in the context of globalization. To know the various International and National human rights documents.

COURSE OUTCOMES	
CO1	Acquire the basic knowledge of human rights.
CO2	Learn about human right declarations and amnesty international
CO3	Know the rights of children, labours and womens

UNIT I

Definition of Human Rights - Nature ,Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights

UNIT II

International Human Rights - Prescription and Enforcement till World War II - Human Rights and the U.N.O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner

UNIT IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts

UNIT V

Contemporary Issues on Human Rights: Childrens' Rights - Womens' Rights - Dalits' Rights - Bonded Labour and Wages - Refugees - Capital Punishment - Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission

Books for Reference:

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982
3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.
7. Human Rights, A Selected Bibliography, USIS.
8. J.C. Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C. Sinha & - International Encyclopedia of Peace, Security
12. K. Cheous (Ed) Social Justice and Human Rights (Vols 1-7).
13. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay
2. Human Rights Today, Columbia University
3. International Instruments of Human Rights, UN Publication
4. Human Rights Quarterly, John Hopkins Unversity, U.S.A.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCHP21 Semester: II

Major Practical- 1 Title: **ORGANIC CHEMISTRY PRACTICAL- I**

Credits: 5 Max. Marks: 75

OBJECTIVES	To know about separation and qualitative estimation of organic compounds containing two functional groups and characterization with a derivative and to synthesize simple organic compounds.
COURSE OUTCOMES	
CO1	Learnt the separation and identification of binary organic mixtures
CO2	Get to know the methods of qualitative analysis of organic compounds
CO3	Students learnt about the derivative of the organic functional groups
CO4	Understand the single stage preparation of organic compounds

A) Identification of components in a two component mixture and preparation of their derivatives. Determination of b.p. / m.p. for components and m.p. for the derivatives.

B) Any Six preparations from the following:

1. Preparation of o-benzoyl benzoic acid (Fridel Crafts Reaction)
2. p-Nitrobenzoic acid from p-nitrotoluene (Oxidation)
3. Anthroquinone from anthracene (Oxidation)
4. Glucose pentaacetate from Glucose (Acetylation)
5. m-Nitroaniline from m-dinitrobenzene (Reduction)
6. Benzophenone oxime from benzophenone (Addition reaction)
7. p-Chlorotoluene from p-toluidine (Sandmeyers' Reaction)
8. 2,3 - Dimethylindole from phenyl hydrazine and 2 - butanone (Fisher Indole Synthesis)

9. 1,2,3,4 - Tetrahydrocarbazole from cyclohexanone (Fisher Indole Synthesis)

10. Methyl orange from sulphanilic acid (Diazo Reaction)

Marks distribution:

Semester Examination	Marks
Qualitative Organic Analysis	40
Preparation	20
Viva voce	10
Record	05
Total	**75**

CONTINUOUS INTERNAL ASSESSMENT MARKS (CIA MARK)
MAX. MARKS = 25

Evaluation method for practical paper:

Distribution of Marks

Internal assessment	Marks
Two Tests	**10**
Results accuracy	**10**
Attendance/ Regularity	**5**
Total	**25**

References:

1. Arthur I. Vogel, "A Textbook of Practical Organic Chemistry", ELBS.

2. N.S. Gnanapragasam and B. Ramamoorthy, "Organic Chemistry Lab Manual" (2006),

S. Visvanathan Printers & Publishers.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCHP22 Semester: II

Major Practical- 2 Title: **INORGANIC CHEMISTRY PRACTICAL- I**

Credits: 5 Max. Marks: 75

OBJECTIVES	To learn about Semimicro qualitative analysis of mixture of inorganic substances and preparation of some inorganic substances.
COURSE OUTCOMES	
CO1	Learnt about Qualitative analysis of common metal ions.
CO2	Learnt about Qualitative analysis of rare metal ions.
CO3	Understand the complexometric titrations.
CO4	Experimental conditions and setup for the general methods of preparation of complexes

UNIT-I

Semimicro qualitative analysis of mixture containing two common and two rare cations. The following are the rare cations to be included. W, Te, Se, Ti, Ce, Th, Zr, V, U, Mo, Be and Li.

UNIT-II

a) Complexometric titrations (EDTA) - Estimation of Ca, Mg and Zn.

b) Preparation of the following:

(i) Potassium tris (oxalate) aluminate (III) trihydrate

(ii) Tris (thiourea) copper (I) chloride

(iii) Potassium tris (oxalato) chromate (III) trihydrate

(iv) Sodium bi (thiosulphato) cuprate (I)

(v) Tris (thiourea) copper (I) sulphate

(vi) Sodium hexanitrocobaltate (III)

(vii) Chloropentammine cobalt (III) chloride

(viii) Bis (acetylacetonato) copper (II)

(ix) Hexamminenickel (II) chloride

(x) Bis (thiocyanato) pyridine manganese (II)

c) Separation of zinc and magnesium on an ion exchange

Marks distribution:

Semester Examination	Marks
Qualitative Inorganic Analysis (Semimicro) Mixture of 4 cations (2 rare + 2 common)	25
EDTA complexometric Titration	20
Preparation	15
Viva voce	10
Record	5
Total	**75**

CONTINUOUS INTERNAL ASSESSMENT MARKS (CIA MARK)
MAX. MARKS = 25

Evaluation method for practical paper:

Distribution of Marks

Internal assessment	Marks
Two Tests	**10**
Results accuracy	**10**
Attendance/ Regularity	**5**
Total	**25**

C.Abdul Hakeem College (Autonomous), Melvisharam.

Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: I Year Subject Code: P18MCHP23 Semester: II

Major Practical- 3 Title: **PHYSICAL CHEMISTRY PRACTICAL- I**

Credits: 5 Max. Marks: 75

OBJECTIVES	To know about colligative properties, phase rule, chemical kinetics, and chemical equilibrium experiments.
COURSE OUTCOMES	
CO1	Students get to know the concepts of kinetics of chemical reaction
CO2	Learnt the Phase rule and its applications and experimented
CO3	The concept of adsorption isotherm is understood.
CO4	Learnt the concept of Polarimeter.

Experiments in Thermodynamics, colligative properties, phase rule, chemical equilibrium and chemical kinetics. Typical examples are given and a list of experiments is also provided from which suitable experiments can be selected as convenient.

1. Heat of solution from Solubility measurements
2. Determination of molecular weight
3. Determination of activity and activity coefficient
4. Phase diagram construction involving two/three component systems
5. Determination of partial molar quantities
6. Adsorption isotherm
7. Reaction rate and evaluation of other kinetic parameters using polarimetry, analytical techniques, conductometry and dilatometry
8. Verification of Beer Lambert law.

Detailed list of Experiments for Physical Chemistry Practical I

- Typical list of possible experiments are given.
- Experiments of similar nature and other experiments may also be given.
- The list given is only a guideline.
- Any 15 experiments have to be performed in a year.

1. Determine the temperature coefficient and energy activation of hydrolysis of ethyl acetate.
2. Study the kinetics of the reaction between acetone in iodine and - acidic medium by half life method and determine the order with respect to iodine and acetone.
3. Study the effect of solvent (DSMO-water, acetone-water system).On the rate of acid catalysed hydrolysis of acetal by dilatometry.
4. Study the Saponification of ethyl acetate by sodium hydroxide conductometrically and determine the order of the reaction.
5. Study the inversion of cane sugar in the presence of acid using Polarimeter
6. Determine the rate constant and order of the reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
7. Study the effect of ionic strength on the rate constant for the saponification of an ester.
8. Study the salt effect on the reaction between acetone and iodine.
9. Study the kinetics of the decomposition of sodium thiosulphate by mineral acid (0.5M HCl).
10. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion).
11. Study the kinetics of enzyme catalysed reactions (Activity of tyrosinase upon tyrosine spectro photo metrically).
12. Study the salt effect, the solvent effect on the rate law of alkaline hydrolysis of crystal violet.
13. Study the reduction of aqueous solution of ferric chloride by stannous chloride.
14. Determine the molecular weight of benzoic acid in benzene and find the degree of association.
15. Determine the activity coefficient of an electrolyte by freeing point depression method.
16. Study the phase diagram form-toluidine and glycerine system.
17. Construct the phase diagram for a simple binary system naphthalene - phenantherene and benzophenone-diphenyl amine.

18. Construct the boiling point composition diagram for a mixture having maximum boiling point and minimum boiling point.
19. Study the complex formation between copper sulphate and ammonia solution by partition method.
20. Study the simultaneous equilibria in benzoic acid - benzene water system.
21. Determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride by partition method.
22. Determine the molecular weight of a polymer by viscosity method.
23. Determine the viscosities of mixtures of different compositions of liquids and find the composition of a given mixture.
24. Determine the partial molal volume of glycine/methanol/formic acid/sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.
25. Study 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 calculate the partial molar heat of solution.
26. Determine the polar molar volume of glycine/methanol/formic acid /sulphuric acid by graphical method and by determining the densities of solutions of different concentrations.
27. Construct the phase diagram of the three component of partially immiscible liquid system (DMSO-water-benzene; acetone-chloroform -water; chloroform-acetic acid-water)
28. Construct the phase diagram of a ternary aqueous system of glucose -potassium chloride and water
29. Study the surface tension - concentration relationship for solutions(Gibb's equation)
30. Study the absorption of acetic acid by charcoal(Fruendlich isotherm)
31. Study the complex formation and find the formula of silver-ammonia complex by distribution method.
32. Determine the dissociation constant of picric acid using distribution law.
33. Construct a chemical actinometry and determine the quantum yield and calibrate the lamp intensity.

Marks distribution:

Semester Examination	Marks
Procedure	10 Marks
Manipulation	25 Marks
Result	25 Marks
Viva voce	10 Marks
Record	05 Marks
Total	**75 Marks**

CONTINUOUS INTERNAL ASSESSMENT MARKS (CIA MARK)
MAX. MARKS = 25

Evaluation method for practical paper:

Distribution of Marks

Internal assessment	Marks
Two Tests	**10**
Results accuracy	**10**
Attendance/ Regularity	**5**
Total	**25**

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCH301 Semester: III

Major - 7 Title: **ORGANIC SPECTROSCOPY & NATURAL PRODUCTS**

Credits: 4 Max. Marks: 75

OBJECTIVES	To understand the concepts of spectral techniques and to apply these techniques for the quantitative and structural analysis of organic compounds. To understand Terpenes, Alkaloids, Heterocycles, Steroids and their importance.
COURSE OUTCOMES	
CO1	Know the principles of spectroscopy. To understand the various concept of UV Visible and IR spectroscopy. To learn their importance in functional groups identification.
CO2	Acquire knowledge about various principle of ^{1}H-NMR and ^{13}C-NMR. To know the spectroscopic techniques of structural determination of organic molecules.
CO3	Learn the basic principle of mass spectroscopy and the structural characteristics of organic molecules.
CO4	Understand the chemistry of natural products and their classification and the systematic methods of structural elucidation of natural products.
CO5	Know the significance of natural products and heterocyclic, steroids and their synthesis.

UNIT-I: UV AND IR SPECTROSCOPY AND ITS APPLICATIONS

Ultraviolet - Visible spectroscopy - types of electronic transitions - chromophores and auxochromes - factors influencing position and intensity of absorption bands - absorption spectra of dienes, polyenes and unsaturated carbonyl compounds - Woodward - Fieser rules.

IR Spectroscopy - vibrational frequencies and factors affecting them - identification of following functional groups (hydrocarbons, alcohol, aldehyde, ketone, amine, ester and nitro) - intra and inter molecular hydrogen bonding - finger print region - Far IR region - metal ligand stretching vibrations.

UNIT-II: NMR SPECTRA AND ITS APPLICATIONS

Nuclear spin - magnetic moment of a nucleus - nuclear energy levels in the presence of magnetic field relative populations of energy levels - basic principles of NMR experiments - CW and FT NMR - ^{1}H NMR - chemical shift and coupling constant - factors influencing proton chemical shift and vicinal proton - proton coupling constant - ^{1}H NMR spectra of simple organic molecules such as CH_3CH_2Cl, CH_3CHO etc. AB, AX and ABX spin system - spin decoupling - nuclear overhauser effect- chemical exchange- chemical shift reagents.

^{13}C NMR - proton decoupled and off - resonance ^{13}C NMR spectra - factors affecting ^{13}C NMR chemical shift - ^{13}C NMR spectra of simple organic molecules. Problem solving (for molecules with a maximum number of C_{10}). Elementary concept of COSY and NOESY.

UNIT-III: PHYSICAL METHODS OF STRUCTURAL DETERMINATION

Mass Spectroscopy - Principles - measurement techniques - (El, Cl, FD, FAB, SIMS) - presentation of spectral data - molecular ions - isotope ions - fragment ions of odd and even electron types - rearrangement ions - factors affecting cleavage patterns - simple and multicentre fragmentation - McLafferty rearrangement. Mass spectra of hydrocarbons, alcohols, phenols, aldehydes and ketones. ORD, octant rule, cotton effect, axial halo ketone rule and their applications.

UNIT-IV: CHEMISTRY OF NATURAL PRODUCTS - I

Terpenes: Introduction- classification- isoprene rule- structural determination of citral, Geraniol, Farnesol, α-pinene and camphor.

Alkaloids: Introduction – classification - isolation of alkaloids - total synthesis of quinine, morphine and reserpine.

UNIT-V: CHEMISTRY OF NATURAL PRODUCTS - II

Nomenclature and classification of heterocyclic compounds - Syntheses of imidazole, oxazole, thiazole, pyrimidines (cytocine and Uaracil only) and purines (adenine, guanine only).

Natural pigments - Synthesis of flavones, isoflavones and anthocyanins,

Steroids - Conversion of cholesterol to progesterone, estrone and testosterone.

Recommended Books

1. J. Dyer, Applicaton of absorption spectroscopy of organic compounds, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. R.M. Silverstein, C.G. Bassler and Monsil, Spectrometric identification of organic compounds, 6th Edn., John Wiley & Sons, New York, 2004.
3. Introduction to the spectroscopic methods for the identification organic compounds - 2 volumes, Schiemann Pergamman Press.
4. I.L. Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)
5. S. Kalsi, Spectroscopy of organic compounds, 5th Edn., Wiley Eastern Ltd., Madras, 2002.
6. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons (1992)
7. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc., 1996.
8. Physical organic chemistry by Neil S. Issac, ELBS publication 1987.
9. Organic reaction mechanism, Macmillan India, 1999.
10. William Kemp, Organic Spectroscopy, ELBS, New Delhi, 1982.
11. Y.R. Sharma, Elementary Organic Spectroscopy, I Edn, S.Chand & Company Ltd, New Delhi, 1980.
12. O.P. Agarwal, Chemistry of Organic Natural Products, Vol I & II, Goel Publishing House, 2014.
13. Terpene Chemistry - James verghese.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCH302 Semester: III

Major - 8 Title: **ORGANOMETALLICS & COORDINATION CHEMISTRY**

Credits: 4 Max. Marks: 75

OBJECTIVES:	To study Coordination complexes, Substitution in Coordination complexes and to study Organometallic chemistry and Inorganic photochemistry
COURSE OUTCOME(S)	
CO1	State and show the peculiarities of metal – carbon bond and their structural chemistry.
CO2	Chemical Industry based on the catalytic combination of small molecules like C_2H_4, CO, H_2, H_2O and NH_3 to give larger molecules using organo metallic catalysts revealed.
CO3	Demonstrate reactivity displayed by Co ordination compounds and integrate the usefulness of this reactivity in the synthesis of co ordination compounds
CO4	Describe the importance of Electron transfer Reactions.
CO5	Define the significance of Inorganic photochemistry and apply metal complexes in solar energy conversions.

UNIT-I: ORGANOMETALLIC CHEMISTRY - I

Synthesis, structure and Bonding – Carbon σ donors, synthesis of metal alkyls and Aryls, structure and bonding in metal alkyls and Aryls, metal carbonyls – properties and structure, bonding in carbonyls, carbon π Allyl complexes, structure and bonding in Ferrocene.

Reaction pathways – Association, Substitution addition and elimination reactions – ligand protonation Electrophilic and Nucleophilic attack on Ligands carbonylation and decarbonylation, oxidative addition and fluxional isomerism.

UNIT-II: ORGANOMETALLIC CHEMISTRY - II

Catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (Oxo process), oxidation of olefins to aldehydes and ketones (Wacker process) polymerization (Zeigler - Natta Catalyst); cyclooligomerisation of acetylene using nickel catalyst (Reppe's catalyst).

UNIT-III: COORDINATION CHEMISTRY - IV

Mechanism of Electron Transfer reaction, key ideas concerning electron transfer, outer sphere and inner sphere electron transfer reactions, two electron transfer, formation of precursor complexes, the role of bridging Ligand, Marcus theory- applications.

UNIT-IV: COORDINATION CHEMISTRY - V

Substitution Reactions: Substitution in square planar complexes, reactivity of platinum complexes, influences of entering, leaving and other groups, the trans effect and its theories.

UNIT-V: COORDINATION CHEMISTRY - VI

Substitution Reactions: Substitution of octahedral complexes of cobalt and chromium, replacement of coordinated water, solvolytic (acids and bases) reaction, SN^1, SN^2 & SN^1CB mechanism, applications in synthesis (platinum and cobalt complexes only).

Inorganic Photochemistry: Photo-substitution, Photoredox and isomerisation process, application of metal complexes in solar energy conversion.

TEXT BOOKS

1. R.C. Mehrothra, A. Singh, **Organo Metallic Chemistry**, Wiley Eastern Co., (1992).

2. F. Basolo and R.G. Pearson, **Mechanism of Inorganic Reaction**, Wiley NY (1967).
3. J. Huheey, **Inorganic Chemistry**, Harper and Collins, NY IV Edition, (2009).
4. K.F. Purcell and J.C. Kotz, **Inorganic Chemistry**, W. Saunders Co., (1977).
5. S. FA Kettle, **Coordination Chemistry**, ELBS, (1973).
6. F.A. Cotton and G. Wilkinson, **Advanced Inorganic Chemistry**, John Wiley and Sons, V Edition (1988).
7. D.F. Shrivers, Pw. Atkins and C.H. Langford, **Inorganic Chemistry**, OUP (1990).
8. Guillermo J. Ferraudi, **Elements of inorganic photochemistry**, Wiley (1988).
9. Arthur W. Adamson, Paul D. Fleischauer, **Concepts of inorganic photochemistry**, Wiley(1975).

SUGGESTED REFERENCES

1. G. Coates M.l. Green and K. Wade. **Principles of Organometallic chemistry**, Methven Co., London (1988).
2. P. Powell, **Principles of Organometallic chemistry**, Chappman and Hall. (1998).
3. G.S. Manku, **Theoretical Principles of Inorganic Chemistry**, McGraw-Hill Education, (1984).
4. M.C. Day and J. Selbin, **Theoretical Inorganic Chemistry**, Van Nostrand Co., New York (1974).
5. R.B. Heslop and K. Jones, **Inorganic Chemistry**, Elsevier Scientific Publ., (1976).
6. F. Basolo and R.G. Pearson, **Mechanism of Inorganic Reaction**, Wiley NY (1967).
7. B.E. Dogulas DH McDaniel's and Alexander, **Concepts and Models of Inorganic Chemistry**, Oxford IBH (1983).
8. WU. Mallik, G.D. Tuli, R.D. Madan, **Selected topics in Inorganic Chemistry**, S. Chand and Co., New Delhi (2006).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCH303 Semester: III

Major - 9 Title: **PHYSICAL CHEMISTRY – III**

Credits: 4 Max. Marks: 75

OBJECTIVES:	To study the principle and applications of NMR spectroscopy, the fundamental principles and applications of Quantum chemistry, study of electrode-electrolyte interface and introductory statistical thermodynamics.
COURSE OUTCOME(S)	
CO1	Learn foundations of quantum mechanics and to study the various operators used in Quantum mechanics.
CO2	Study the applications of wave equation to problems like SHO, Rigid Rotator and Hydrogen atom and application of approximation methods.
CO3	Know the basics of Statistical thermodynamics and its applications .To learn about the Maxwell-Boltzmann Statistics and partition function.
CO4	Discuss the electrode-electrolyte interface, structure of electrical double layers and diffusion.
CO5	Acquire the fundamental knowledge of NMR spectroscopy and to determine the compound structure using NMR spectra.

UNIT – I: QUANTUM CHEMISTRY – I

Photoelectric effect – Compton Effect – wave-particle duality – uncertainty principle

Theory of wave motion – Wave equation for electrons – Wave function Ψ and its physical significance – condition for acceptable wave function – condition for normalization and orthogonality.

Operator Algebra – Commutative property – linear operator – Eigen values and eigen functions – Hermitian property of operators – Basic postulates of quantum mechanics.

UNIT – II: QUANTUM CHEMISTRY – II

Elementary applications of schrodinger wave equation – Particle in one and three dimensional box – Quantum mechanical results for harmonic oscillator and rigid rotor – Schrodinger equation for hydrogen (No derivation) and the solution – Approximation methods – Variation and Perturbation methods – Application to hydrogen and helium atoms.

UNIT – III: STATISTICAL THERMODYNAMICS – I

Objectives of statistical thermodynamics – Micro states and macro states – Concept of mathematical and thermodynamic probability – Distribution of distinguishable and non-distinguishable particles.

Derivation of Maxwell-Boltzmann distribution law – Partition function – Evaluation of translational, vibrational, rotational and electronic partition function. Expressions for thermodynamic functions in terms of partition function – Applications of partition function to heat-capacity of ideal gases.

UNIT – IV: ELECTROCHEMISTRY – II

Electrode – Electrolyte interface – Adsorption at electrified interface – Electrical double layer – electrocapillary phenomenon – Lippmann equation – Structure of double layers – Helmholtz Perrin; Guoy – Chapmann and stern model of electrical double layers.

Diffusion – Fick's law of diffusion – Effect of ion association on conductance – Electro kinetic phenomena – Membrane potential.

UNIT – V: MAGNETIC RESONANCE SPECTROSCOPY

Resonance spectroscopy – Zeeman effect – Equations of motion of spin in magnetic fields – Chemical shift – Factors affecting chemical shift – Spin – Spin coupling and coupling constant – NMR of simple AX and AMX type molecules – Chemical exchange in NMR –

Relaxation process – NMR and Restricted Rotation – C^{13}, ^{19}F, ^{31}P NMR spectra applications – Brief discussion of FT NMR spectroscopy.

TEXT BOOKS

1. S. Glasstone, Introduction to electrochemistry, Affiliated East West Press, New Delhi (1977).
2. P.H. Reiger, Electrochemistry, Chapman and Hall, New York (1994).
3. M.C. Gupta, Statistical thermodynamics, Wiley Easter, New Delhi (1990).
4. S. Glasstone, Text book of physical chemistry (2006).
5. R.K. Prasad, Quantum chemistry, Wiley Eastern, New Delhi (2001).
6. M.W. Hanna, Quantum mechanics, W.A. Benjamin Inc. London (1965).
7. Raymond Chang, Basic principles of spectroscopy, McGraw Hill Ltd., New York (1971).
8. W. Kemp, NMR in chemistry, McMillan Ltd., (3^{rd} Edition, 2008).

SUGGESTED REFERENCES

1. C.N. Banwell, Fundamentals of Molecular spectroscopy, McGraw Hill (4^{th} Edition, 2017).
2. A.K. Chandra, Introductory quantum chemistry, Tata McGraw Hill.
3. D.A. McQuarrie, Quantum chemistry, university science books, Mill valley, California (2^{nd} edition, 2008).
4. J.O.M. Bokris and A.K.N. Reddy, Electrochemistry, Vol. 1 and 2, Plenum, Now York (2^{nd} Edition, 1998).
5. B.J. Meclelland, Statistical thermodynamics, chapman and Hall, London (1973).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18ECH301 Semester: III

Elective – 3A Title: **SCIENTIFIC RESEARCH METHODOLOGY**

Credits: 3 Max. Marks: 75

OBJECTIVES:	To study the importance of research, literature survey, error analysis, statistical treatment and to study about the conventions of writing thesis.
COURSE OUTCOME(S)	
CO1	Survey of scientific literature using modern tools explained.
CO2	Separation techniques constitute an important aspect of experimental chemistry and the importance & modern techniques are introduced
CO3	Awareness about the causes of uncertainties in the evaluation of data.
CO4	Scientific data are subjected to mathematical and statistical methods. Elementary treatment of these tests are given
CO5	Set up Skills required to write the thesis report explained.

UNIT-I: SURVEY OF LITERATURE

Nature and importance of Research - Need for Literature Survey – Primary Sources – Secondary Sources – Selection of Research Topic – Selection of Research and Instrumental facilities – Aids of computer devices in literature survey.

UNIT-II: CONDUCT OF RESEARCH WORK

Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure.

Chemistry of working with hazardous materials - acid / water sensitive, corrosive, toxic, explosive and radioactive materials.

UNIT-III: EVALUATION OF ANALYTICAL DATA

Precision and accuracy - Reliability - determinate and random errors - distribution of random errors - normal distribution curve.

UNIT-IV: STATISTICAL ANALYSIS OF DATA

Elimination of outlying Results - Q-Test - T-Test - Statistical Analysis of the T-Test (Null Hypothesis) – The F-Test – Linear Regression – Minimum sum-of-squares – Slope and intercept.

UNIT-V: THESIS WRITING

Components of a thesis – Style and Conventions in writing thesis - The general format – Organization, Title, Summary, Introduction, Experimental procedures, Results and Discussion, Footnotes, Tables, Figures, Chemical and Mathematical usage and References – Write up steps in drafting report.

REFERENCES

1. Douglas A. Skoog and Donald, M. West, Fundamental of analytical chemistry, Halt Saundersons International Edition.
2. J. Anderson,H.M. Durstonand M.Poole, Thesis and assignment writing - Wiley Eastern Ltd., (1970).
3. J. March, Advanced organic chemistry - reactions, Mechanism & Structure. McGraw Hill Student Edition.
4. Vogel's Textbook of quantitative chemical analysis, ELBS edition.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: Semester: III

Elective – 3B Title: **ADVANCED CHROMATOGRAPHIC TECHNIQUES**

Credits: 3 Max. Marks: 75

Objective	To learn the basic concept of chromatography. To understand the different chromatographic techniques. To study the applications of chromatography. To know the separation and purification methods.
Course Outcome: On successful completion of the course, students will be able to	
CO1	Acquire fundamental knowledge of chromatography.
CO2	Understand the principle, instrumentation and working techniques of gas chromatography.
CO3	Explore the knowledge of column efficiency of HPLC.
CO4	Learn thoroughly the importance of ion exchange chromatography.
CO5	Gain knowledge about the superiority of chromatographic techniques over crystallization, distillation and sublimation.

UNIT-I: BASIC CONCEPTS OF CHROMATOGRAPHY

General description: Definitions, terms and parameters used in chromatography. Classification of chromatographic methods. Elution chromatography on columns. Migration rates of solutes, zone broadening, column efficiency and optimization of column performance.

UNIT-II INSTRUMENTATION TECHNIQUES OF GAS CHROMATOGRAPHY(GC)

Principles of gas-liquid chromatography, instrumentation, carrier gas, sample injection, column configuration and detection system (FID, TCD, ECD). Gas

chromatographic columns (open tubular columns and packed columns) and stationary phases. Interfacing GC/MS.

UNIT-III: HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

Column efficiency. Instrumentation: pumping system, sample injection system. Liquid chromatographic columns - types of column packing. Detectors: Absorbance detector and electrochemical detectors.

UNIT-IV: ION-EXCHANGE CHROMATOGRAPHY (IEC)

Definition, requirements for ion exchange resin. Synthesis and types of ion-exchange resins. Principle and basic features of ion - exchange reactions. Exclusion chromatography: Theory and principle of size exclusion chromatography. Experimental techniques of gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC). Materials for packing-factors governing column efficiency. Methodology and applications. Separation of rare earth metal ions. Separation of Zn & Cd, Cl^- & Br^- ions using IEC.

UNIT-V: PURIFICATION AND EXTRACTION TECHNIQUES

Distillation: fractional, steam, azeotropic, vacuum distillations. Recrystalization and sublimation.

Solvent extraction: Principle and techniques. Factors affecting the extraction efficiency: Ion association complexes, chelation, synergistic extraction and pH. Role of chelating ligands in solvent extraction. Introduction to solid phase extraction (SPE) and microwave assisted extraction (MAE) and applications.

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th Edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, prentice Hall, Inc. New Delhi.

4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Inidan Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Introduction to Chromatography Theory and practice, V.K.Srivastava, K.K.Srivastava, Chand &.Company Ltd , New Delhi
7. Principles of Instrumental Analysis, D.A. Skoog,,F.James
8. Holler, Timothy.A.Nieman ,Harcourt Asia (P) Ltd
9. Principles of Instrumental Analysis, D.A. Skoog, , Saunders College Pub. Co, III Edn., 1985.
10. Text Book of Quantitative Organic Analysis A.I Vogel, , ELBS III Edn, 1987.
11. Fundamentals of Analytical Chemistry, D.A. Skoog and D. M. West, Holt Rinehart and Winston Publications, IV Edn, 2004.
12. Instrumental Methods of Analysis, Willard, Merit, Dean and Settle, , CBS Publishers and Distributors, IV Edn.,1989
13. G. D. Christian and J. E. O. Reilly, Instrumental Analysis, Allyn and Bacon Inc, II Edn., 1988.
14. R. M. Upadhyay , Instrumental & Analytical Chemistry Principles & Procedure Kalyani Publishers(2002).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: Semester: III

Elective – 3C Title: **INORGANIC BIOCHEMISTRY**

Credits: 3 Max. Marks: 75

Objective	To learn the importance of Bioinorganic Chemistry. To learn the role of metal ions in the biologically important complexes. To learn mechanism of photosynthesis.
Course Outcome: On successful completion of the course, students will be able to	
CO1	Understanding the scope, complex formation, evolution and essentiality of trace elements.
CO2	Acquire knowledge about proteins through structure and mechanism.
CO3	Explain the enzymes of copper, zinc and cobalt enzymes.
CO4	Learn thoroughly the importance of metals in medicine and toxicity of some heavy metals.
CO5	Know the importance of nitrogenase enzyme in nitrogen cycle and photosynthesis.

UNIT - I: SCOPE OF BIOINORGANIC CHEMISTRY

Introduction: Trace elements, complex formation- Amino acids and proteins - structure of proteins, peptide bond- enzymes - nucleic acid - carbohydrates - blood - plasma.

Concepts of essentiality - evolution of essential trace elements - future essential trace elements- role of minerals - working of essential trace elements - essential ultra trace elements - essential ultra trace nonmetals.

UNIT - II: METALLOPORPHYRINS

Respiratory proteins: Hemoglobin and Myoglobin - structure and functions - oxygenation reactions - structural models for dioxygen binding - synthetic models for oxygen binding - models for Hemoproteins – Hemerythrin - Hemocyanin. Non-redox metalloenzymes: Peroxidase, Catalayse and Alcohol Dehydrogenase (Structure, mechanism of action and model compound).

UNIT - III: METALLOENZYMES

Copper enzymes: Superoxide dismutase, cytochrome oxidase and ceruplasmin - Molybdenum enzymes: Pyridoxyal oxidase and xanthine oxidase. Zinc enzymes: Carbonic anhydrase and carboxy peptidase. Cobalt enzyme: Vitamin B_{12}.

UNIT - IV: METALS IN MEDICINE

Metal deficiency and disease - toxicity of mercury, cadmium, lead, beryllium, selenium and arsenic - biological defence mechanism - meaning and example of chelation therapy- Metals used for diagnosis (Tc, Fe and Co) - Metals in medicine: platinum complexes as anticancer drugs, Pt-DNA binding, complexes of gold, copper and zinc as drugs.

UNIT - V: NITROGEN FIXATION AND PHOTOSYNTHESIS

Nitrogenase enzyme: Reactivity, reduction involving nitride / diazene intermediate, dinitrogen complexes and their reactivity in vitro nitrogen fixation. Photosynthesis: Structure of chlorophyll in green plants (Z- Scheme) - ATP synthesis - Role of manganese complex in oxygen evolution - dark reaction (Calvin cycle).

TEXT BOOKS

1. K. Hussain Reddy, Bioinorganic Chemistry, New Age international publishers (2007)

2. S. J. Lippard & J. M. Berg. Principles of Bioorganic Chemistry, Panima Publ. Corpn. (2005). 3. E. I. Ochiai. Bioinorganic Chemistry – An Introduction, Allyn and Bacon Inc. (1977).

4. M.N. Hughes, Inorganic Chemistry of Biological Processes, John Wiley &Sons, 2nd Edition, 1985

5. R.P. Hanzlik. Inorganic Aspects of Biological and Organic Chemistry, Academic Press (1976)

REFERENCE BOOKS

1. H. Kraatz & N. Metzler-Nolte (Eds.). Concepts and Models in Bioinorganic Chemistry, Wiley (2006).

2. I. Bertini, H. B. Gray, S. J. Dippard & J. S. Valentine, Bioinorganic Chemistry, Viva Books Pvt. Ltd. (2004).

3. A.W. Addison, W.R. Cullen, D. Dolphin & B.R. James (eds.). Biological Aspects of Inorganic Chemistry, John Wiley (1977).

4. R.J.P. Williams & J.R.R.F. Dasilva. New Trends in Bioinorganic Chemistry, Academic Press (1978).

5. A. E. Martel. Inorganic Chemistry in Biology and Medicine, ACS Symp. Series, ACS (1980).

6. S. J. Lippard. Progress in Inorganic Chemistry: Bioinorganic Chemistry, Vol. 38, John Wiley (1990).

7. N. Kaim & B. Schwederski. Bioinorganic Chemistry: Inorganic Elements in the Chenistry of Life, John Wiley (1994).

8. Advanced Inorganic Chemistry, F.A. Cotton and G. W. Wilkinson. John Wiley &Sons, 5th Ed. 1988.

9. Inorganic Chemistry, Principles of Structure and Reactivity, J. E. Huheey,E.A. Keiter 4th Ed. Harper Collins, 1993.

10. Bioinorganic chemistry, R. W. Hay, Halsted Press, 1984.

11. Principles of Bioinorganic Chemistry, S. J. Lippard and J.M. Berg, Panima Publishing Corporation, 2nd Ed., 1995

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCH401 Semester: IV

Major – 10 Title: **PHOTOCHEMISTRY & BIOORGANIC CHEMISTRY**

Credits: 4 Max. Marks: 75

OBJECTIVES	To understand the concepts of Photochemical Pericyclic Reactions. To learn free radicals reactions, Applications and Techniques of Dyeing, Proteins, Nucleic acids, Antibiotics and Vitamins.
COURSE OUTCOMES	
CO1	Know the principles of photochemistry and pericyclic reactions
CO2	Acquire knowledge about proteins and importance of nucleic acids
CO3	Learn importance and structural elucidation of antibiotics and the structural characteristics vitamins.
CO4	Understand the chemistry of free radicals and the synthetic methods of dyes.
CO5	Know the significance of modern synthetic methods and the chemistry of reactions and reagents.

UNIT-I: PHOTOCHEMISTRY & PERICYCLIC REACTIONS

Photochemical excitation - Fate of the excited molecules - Jablonski diagram - study of photochemical reactions of ketone - photoreduction - photocyclo addition - Paterno - Buchi reaction - di pi-methane rearrangement. Structure of bulvalene, a fluxional molecule - Cope and Claisen rearrangement.

Pericyclic reactions – classification – orbital symmetry – Woodword Hoffman rules - Analysis of electrocyclic, cyclo addition and sigmatropic reactions - correlation diagrams for butadiene – cyclobutene system, hexatriene to cyclohexadiene system, dimerisation of ethylene and Diels-Alder reaction.

UNIT-II PROTEINS AND NUCLEIC ACIDS

Proteins: Peptides and their synthesis – synthesis of tripeptide. Merrifield synthesis, Determination of tertiary, quaternary structure of Protein, Bio-Synthesis of Proteins.

Nucleic Acids: Types of Nucleic Acids-DNA & RNA polynucleotide chain. Components-biological functions. Structure and role of DNA and RNA (Nucleotides only)

Biosynthesis of Cholesterol.

UNIT-III: ANTIBIOTICS & VITAMINS:

Introduction, structural elucidation and synthesis of pencillin, streptomycin and chloromycetin.

Introduction, structural elucidation and synthesis of vitamin A1, vitamin B1 and vitamin B6.

UNIT-IV: FREE RADICALS & DYES

Long and short-lived free radicals, methods of generation of free radicals. Addition of free radicals to olefinic double bonds. The following aromatic radical substitutions are to be studied: decomposition of diazocompounds, phenol - coupling - Sandmeyer reaction Gomberg reaction, Pschorr reaction, Ulmann reaction, mechanism of Hunsdiecker reaction Detection of free radicals by ESR.

Introduction, various methods of dyeing, concept of Chromophore and Auxochrome, classification of dyes, nitroso dyes, Azodyes, - Fast green, Methyl Orange, Methyl Red, Fast Red, tripheylmethane dyes - Malachite green, Rosaniline, Aniline blue, Crystal violet, Xanthene dyes - Fluorescein, Rhodamine B, Anthraquinone dyes – Alizarin – Preparation and uses.

UNIT – V: MODERN SYNTHETIC METHODS, REACTIONS AND REAGENTS

Synthesis of simple organic molecules using standard reaction like acetylation, alkylation of enamines and active methylene compounds, Grignard reactions, Phosphorus and sulphur ylides Robinson annulation, Diels Alder reactions. Basic principles and terminology of retrosynthesis, 1,2 and 1,3-disconnection approach. Protection and deprotection of functional groups (R-OH, R-CHO, RCO-R, R-NH_2 and R-COOH). Uses of the following reagents: DCC, DDQ, LDA, 1, 3-Dithiane (umpolung) and diisobutylaluminiumhydride (DIBAL).

RECOMMENDED BOOKS

1. Molecular Reaction and Photochemistry by Charles H. Depuy and Orville, L. Champman, Prentice Hall of India Pvt., Ltd., New Delhi.
2. I.L. Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)
3. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons (1992)
4. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc., 1996.
5. Chemistry of organic Natural Products by Dr. O.P. Agarwal, Goel Publishing House, Meerut. (2014).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCH402 Semester: IV

Major – 11 Title: **INORGANIC SPECTROSCOPY & ANALYTICAL TECHNIQUES**

Credits: 4 Max. Marks: 75

OBJECTIVES:	To study about the Inorganic Spectroscopy and Analytical techniques.
COURSE OUTCOME(S)	
CO1	UV-Visible, IR, Raman spectral properties of metal complexes, magnetic properties and its measurement methods revealed
CO2	Spectral applications of inorganic systems using NMR, NQR and Massbauer spectroscopy knowledge gained.
CO3	Study about the spectroscopic principles and the properties of ESR and PES
CO4	Learning the spectroscopic analytical techniques of AAS, AES and ICP.
CO5	Gaining knowledge related to analytical techniques of chromatographic and electron microscopic instrumentations.

UNIT-I: INORGANIC SPECTROSCOPY - I AND MAGNETIC PROPERTIES

Applications to inorganic systems of the following: ultra violet, visible, infra-red and Raman spectra of metal complexes, organometallic and simple inorganic compounds.

Magnetic Susceptibility and measurements - Guoy method, Faraday method; applications.

UNIT-II: INORGANIC SPECTROSCOPY – II

Application to Inorganic systems of the followings - NMR, NQR and Mossbauer spectra: NMR spectra of ^{31}P, ^{19}F, NMR shift reagents.

NQR – structural information.

Mossbauer spectra of Fe and Sn systems.

UNIT-III: INORGANIC SPECTROSCOPY – III

ESR Introduction - Zeeman equation, g-value, nuclear hyperfine splitting, interpretations of the spectrum, simple carbon centered free radicals. Anisotropy - g-value and hyperfine splitting constant. McConnell's equation, Kramer's theorem. ESR of transition metal complexes of copper, manganese and vanadyl complexes.

Photoelectron spectroscopy (UV and X-ray) - photo electron spectra - Koopman's theorem, time structure in PES, chemical shift and correlation with electronic charges.

UNIT-IV: INSTRUMENTAL ANALYSIS – I

Atomic Spectroscopic methods: Introduction – classification of spectral methods

AAS and AES – Principle, instrumentation, spectral and chemical interferences, applications.

Differences between AAS and AES; advantages of AAS over AES.

ICP: Pinciple, instrumentation, interferences and applications.

UNIT-V: INSTRUMENTAL ANALYSIS – II

Chromatography: GLC and HPLC – Principle, instrumentation, working, types of detectors and applications.

Electron Microscopy: SEM, TEM and AFM –Principle, instrumentation and applications.

Text books

1. A. Earnshaw, **Introduction to Magneto Chemistry**, Academic Press, London, (1968).
2. C.N.R. Rao, I.R. Ferraro, **Spectroscopy in Inorganic Chemistry**, Vol. I and Vol. II, Academic Press, (1970).
3. D. A. Skoog and D.M.West, **Principles of Instrumental Methods of analysis**, Saunder's College Publ. III Edition, (1985).
4. E. A. V. Ebsworth, D. W. H. Rankin and S. Cradock, **Structural Methods in Inorganic Chemistry**, II Edition, Blackwell Scientific Publications, Oxford, London (1991).

5. G.D. Christian and J.E.G. Reily, **Instrumental Analysis**, AllegnBecon, II Edition, (1986).
6. H.A. Strobel, **Chemical Instrumentation**, Addison - Wesley Pub. Co., (1976).
7. R. S. Drago, **Physical Methods for Chemists,**Saunders College Publishing, Philadelphia (1992).
8. Willard Merrit, Dean and Settle, **Instrumental methods of analysis**, CBS Publ. VI edition, (1986).

Suggested References

1. AI Vogel, **Text book of Qualitative Analysis** - IV Edition (1985).
2. C. N. Banwell and E.M. Mc Cash, **Fundamentals of Molecular Spectroscopy**. IV edition, Tata McGraw Hill, New Delhi (1994).
3. D.A. Skoog D.M. West, Holt Reinhert and Winston, **Fundamental of Analytical Chemistry**, Publication, IV Edition (1982).
4. D.N. Sathyanarayana, **Electronic Absorption Spectroscopy and Related Techniques,** Universities Press (India) Ltd., Hyderabad (2001).
5. FA Cotton and G Wilkinson, **Advanced Inorganic Chemistry**, John Wiley and Sons, V Edition (1988).
6. G. Aruldhas, **Molecular Structure and spectroscopy**, Prentice Hall of India Pvt. Ltd., New Delhi (2001).
7. J. Huheey, **Inorganic Chemistry**, Harper and Collins, NY, IV Edition, (1993).
8. M.C. Shrivers, P.W Atkins, CH. Langford, **Inorganic Chemistry**, OUP (1999).
9. Nakamoto, **Infrared and Raman Spectra of Inorganic and Coordination Compounds**, IIIEdn., John Wiley and Sons, New York, (1986).
10. O. Khan, **Molecular Magnetism**, New York, VCH (1993).

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Year: II Year Subject Code: P18MCH403 Semester: IV

Major – 12 Title: **PHYSICAL CHEMISTRY – IV**

Credits: 4 Max. Marks: 75

OBJECTIVES:	To study the applications of quantum chemistry and chemical bonding, types of photophysical processes in chemistry, the mechanism of electrochemical reactions, over potential, corrosion, heat capacity of solids and quantum statistics.
COURSE OUTCOME(S)	
CO1	Explain VB and MOT of diatomic and polyatomic molecules, application of HMO to organic molecules.
CO2	Derive Butler-Volmer equation for electron transfer reactions and to know the concept of corrosion and passivation.
CO3	Discuss the quantum statistics and their application, models of heat capacity of solids.
CO4	Learn about the various photochemical and photophysical processes and to study the kinetics of quenching.
CO5	Understand the various types of photochemical reactions, concept of quantum yield and kinetics of photochemical reactions.

UNIT – I QUANTUM CHEMISTRY – III

Born-oppenheimer approximation – Valence bond theory for hydrogen molecule and hydrogen molecule ion – LCAO – MO theory for diatomic molecules.

Concept of Hybridization - Huckel theory for conjugated molecules (Ethylene, butadiene and benzene) – Semi-empirical methods – Slater orbitals.

UNIT – II ELECTRO CHEMISTRY – III

Mechanism of electrode reaction –Polarisation and over potential – Butler-Volmer equation for one step and multistep electron transfer reactions – Significance of electron exchange current density and symmetry factors – Transfer coefficient and its significance – Mechanism of hydrogen and oxygen evolution reaction.

Corrosion and passivation of metals –Pourbaix diagram – Evan's diagram – Fuel cells.

UNIT – III STATISTICAL THERMODYNAMICS – II

Heat capacity of solids – Einstein and Debye models.

Quantum statistics: Fermi-Dirac and Bose-Einstein statistics and their corresponding distribution functions –Comparison of quantum and classical statistics – Applications of quantum statistics to electron gas in metals and Planck's radiation law.

UNIT – IV PHOTOCHEMISTRY – I

Absorption and emission of radiation – Franck – Condon principle – Decay of electronically excited states –Jablonski diagram – Radiative and non-radiative transitions– Flourescence and phosphorescence

Photophysical kinetics of unimolecular processes – Kinetics of biomolecular process – Static and dynamic quenching – Stern-Volmer equation – Concentration dependence of quenching –Excimer formation.

UNIT – V PHOTOCHEMISTRY – II

Experimental methods – Quantum yield and life time measurements – Steady state principle – Quantum yield and chemical Actinometry.

Kinetics of Photochemical reactions – Hydrogen and halogen reactions,Photolysis of acetaldehyde and dimerization of anthracene.

Photo isomerization, Photo rearrangement, Photo reduction, Photo redox, Photosubstitution and Photosensitized reactions – Aspects of solar energy conversion and storage.

Text Books

1. R.K. Prasad, Quantum chemistry, New age International Publishers, New Delhi (2009).
2. D.A. McQuarrie, Quantum chemistry, university science books, Mill valley, California (1983).
3. N.J. Turro, Modern Molecular Photochemistry, Benjamin, Cumming Mento Park, Univ Science Books; New Ed edition (1991)
4. K.K. Rohatgi, Mukherjee, Fundamentals of Photo chemistry (Revised Edition), Wiley Eastern Ltd. (1992).
5. S. Glasstone, Introduction to electrochemistry, Affiliated East West Press, New Delhi (2006).
6. D.R. Crow, Principles and applications of electrochemistry, Chapman and Hall (1991).
7. M.C. Gupta, Statistical thermodynamics, Wiley Easter, New Delhi (1990).

SUGGESTED REFERENCES

1. J.O.M. Bokris and A.K.N. Reddy, Electrochemistry, Vol. 1 and 2, Plenum, Now York (1977).
2. B.J. Meclelland, Statistical thermodynamics, chapman and Hall, London (1973).
3. A.K. Chandra Introductory quantum chemistry, Tata McGraw Hill.
4. P.W. Atkins, Quantum Mechanics, Oxford university press, Oxford (1983).
5. R.P.Wayne, Photochemistry,Butterworths, London (1970)
6. Francis W Sears and Gerhard L Salinger, Thermodynamics, Kinetic theory and Statistical thermodynamics.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18ECH401 Semester: IV

Elective – 4 A Title: **ENVIRONMENTAL CEMISTRY**

Credits: 3 Max. Marks: 75

OBJECTIVES:	To study the Atmosphere, Lithosphere, Hydrosphere, and Biosphere - interactions – causes and control of pollution.
COURSE OUTCOME(S)	
CO1	Understand the Environmental issues related to air pollution, classify pollutants, their chemistry and apply abatement methods.
CO2	Recognize the significance of mineral resources and the importance of water as an irreplaceable resource.
CO3	Explain how human activities affect the earth's bio diversity and the impact of ecological disruption on human health.
CO4	State the prospects of Agriculture, describe Agricultural pollution and the significance of carbon and nitrogen cycle.
CO5	Analyze different pollutants and demonstrate the importance of pollution control.

UNIT - I: ATMOSPHERIC CHEMISTRY

The chemistry of air pollution- oxides of nitrogen- hydrogen sulphide and oxides of sulphur- Aerosols – ozone depletion and consequences- dioxins burning plastics- other atmospheric chemicals- smog- radio activity and fallout- air pollution abatement. Green house effect- Global warming, oxides of carbon.

UNIT - II: THE EARTH

The lithosphere- Composition of Lithosphere - Earth resources – Wastes and pollutants in soil and conservation steps.

The hydrosphere: Water pollution– mercury pollution. The chemical constituents of sea water- organic matter and suspended material- ocean dumping- oil pollution. The role of water in our total environment.

UNIT - III: THE BIOSPHERE

The structure of the biosphere, Man's perturbation of the biosphere – Man as a chemical factory – material use and waste – energy use and thermal pollution – ecological disruption – chemical sensation, hormonal imbalance and mutagens.

UNIT IV: INTERACTIONS

Lithosphere- biosphere interaction: soil chemistry – the prospects of agriculture- agricultural pollution – pesticides and other persistent pollutants – the deposition of coal and petroleum –the nitrogen cycle – the carbon cycle – air – sea interactions.

UNIT - V: POLLUTION CONTROL

Pollution control in the following: Fertilizer, petroleum, pulp and paper, tanning, sugar, alcohol, electroplating and nuclear reactors.

Analysis of pollutants: Sum, specific and group parameters BOD, COD, Fe, Cr, Cu, Pb, and Ni-$SO_2$and NOx.

REFERENCES

1. R.A. Horne, Chemistry of our environment, Wiley Interscience Publications, New York (1978).
2. A.K. De, Environmental chemistry, New Age International Private Ltd. (2017)
3. Jain L, Marr and Malcom S. Cresser Environmental chemical analysis, Bishopbriggs, Glassgow International Textbook Co., NewYork (1983).
4. S.P. Mahajan, Pollution control in process industries, Tata Mcgraw – Hill Education (1985).

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: Semester: IV

Elective – 4B Title: **DRUG DESIGN & ANALYSIS**

Credits: 3 Max. Marks: 75

Objective	Students shall be able to understand concepts of drug design and mechanism of drug action of different drugs. Students will be aware of metabolism and delivery methods of different classes of drugs.
Course Outcome: On successful completion of the course, students will be able to	
CO1	Develop skills required for new drug designing.
CO2	Explore the knowledge, importance and mode of actions of antibiotics, antimalerials, antileprotic, anaesthetic and tranquilizer drugs .
CO3	Learning thoroughly the physical properties and biological importance of drugs.
CO4	Describe the classification of drugs.
CO5	Develop skills required for quantitative analysis of drugs.

UNIT-I: DRUG DESIGN & THEIR PARAMETERS

Development of new drugs, concepts of pro-drugs and soft drugs, Principles of drug design, Quantitative structure activity relationships. History and development of QSAR (Quantitative Structure Activity Relationships) - Concepts of drug parameters. High throughput Screening.

UNIT-II: IMPORTANCE AND MECHANISM OF DRUG ACTION

Mechanism, mode and action of Antibiotics: Drug action of penicillin, erythromycin, tetracycline chloramphenicol (no synthesis). Antimalerials: Trimethoprim- NSAIDS: Paracetamol, Meperidine, Aminopyrine-Ibuprofen, Oxyphenylbutazone, Diclophenac sodium, Indomethacin-Antitubercular and antileprotic: Ethambutol, Isoniazide and Daspone - Antihistamines: Phenobarbital, Diphenylhydramine- Anti AIDS agents: Acylovir, Ganciclovir.

UNIT-III: PHYSICO-CHEMICAL FACTORS AND BIOLOGICAL ACTIVITIES

Physical properties - Features governing drug action - Structurally specific - nonspecific drugs -Thermodynamic activity - Theories - Cut-off point - Factors governing ability of drugs -Absorption - Distribution - Excretion - Biotransformation - Intramolecular distances -Dissociation constants - Isosterism and Bioisosterism.

UNIT-IV: CLASSIFICATION OF DRUGS

Central Nervous system acting drugs – (General and Local anaesthetics, Sedatives and Hypnotics, Anticonvulsants, Narcotic and Non-narcotic analgesics, Anti- Parkinsonian agents, Anti-depressants, Tranquilizers, Psychomimetics) - Pharmacodynamic agents (Anti-arrythmics, Anti-anginals, Vasodialators, Anti-hypertensives, Diuretics, Antihistamines) - Chemotherapeutic Agents (Antivirals, Antifungals) - Drugs for metabolic and endocrine disorders (Anti-thyroid drugs, Anti-diabatic drugs, anticancer drugs biosynthetic insulin) – Therapeutic Index (Definitions with examples)

UNIT-V: ANALYSIS OF DRUGS

Principles of quantitative analysis of the following drugs in formulations: Aspirin - benzyl penicillin - ascorbic acid - isoniazid - codeine - chloramphenical - riboflavin and folic acid.

Reference Books

1. Burger's Medicinal Chemistry & Drug discovery, Vol 1-3, 5th Ed, 1995.
2. Wilson, Gisvold & Dorque: Text book of Organic Medical and Pharmaceutical Chemistry, 10th Ed, Lippincoh pover publishers, 1998.
3. David A Williams, William O. Foye & Thomas L. Lemke, Foye's Principles of medicinal Chemistry, 6th Edition, Lippincott Williams & Wilkins, 2002.
4. Zubay G, Biochemistry, Maxwell Macmillan International Editions, second edition, 1987.
5. R. L. Foster, The Nature of Enzymology, Croom Helm, 1980.
6. D. L. Purich, (Ed), Contemporary Enzyme kinetics and Mechanisms, Academic Press, 1983.
7. Dugas H, Bio-organic Chemistry, A chemical approach to enzyme action, Springer 2003.
8. Chemistry of drug design and drug action-. R. B. Silverman (2004) Acad. press
9. Graham Patrick, An Introduction to Medicinal Chemistry- 2nd Edn. Qxford, 2010
10. N. K. Jain, Advances in Controlled and Novel Drug Delivery, CBS, 2001.
11. Lednicer, The Organic Chemistry of Drug Synthesis, Vol. 1, 5th Edition, John Wiley & Sons, 2001.
12. Foye's Principles of Medicinal Chemistry, Sixth Edition, Wolters Kluwer, 2008
13. G.R. Chatwal, Medicinal Chemistry, Himalaya Publishing House.

14. V.K. Ahluwalia and M. Chopra, Medicinal Chemistry, Ane Book Pvt. Ltd., 2008.
15. J. B. Taylor and P . D. Kenewell., Introductory medicinal chemistry.
16. D. C. Garratt., Quantitative analysis of drugs.
17. G. L. Patrick., An introduction to medicinal chemistry.
18. Beckett and Stenlake., Practical pharmaceutical chemistry. Vol 1 and 2.

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: Semester: IV

Elective – 4C Title: **SUPRAMOLECULAR AND NANOTECHNOLOGY**

Credits: 3 Max. Marks: 75

Objective	To know the student the basis of supramolecular chemistry, metal-organic framework solids, nano materials and their applications. To understand the various techniques available to characterize the advanced nano materials. To identify the applications of nanotechnology.
Course Outcome: On successful completion of the course, students will be able to	
CO1	Understand the basic concept of ion interactions, dipole moment, bonding and vanderwaals forces of supramolecules.
CO2	Know about porous materials such as zeolites, metal-organic frameworks and their applications.
CO3	Gain the knowledge of synthesis and structure of supramolecules
CO4	Learn the basics of nanochemistry and synthesis of nanoparticles
CO5	Describe the characterization and applications of nanoparticles.

UNIT-I: SUPRAMOLECULAR CHEMISTRY

Definition of supramolecular chemistry. Nature of binding interactions in supramolecular structures: ion-ion, ion-dipole, dipole-dipole, H-bonding, cation-p, anion-p, p-p, and vander Waals interactions. Supramolecular synthons.

Self-assembly molecules: Design, synthesis and properties of the molecules, self-assembling by H-bonding, metal-ligand interactions and other weak interactions, metallomacrocycles, catenanes, rotaxanes, helicates and knots.

UNIT-II: FRAMEWORK SOLIDS

Introduction-definition of porosity, pore size, pore volume, pore density-zeolites-synthesis and applications-metal organic frame work solids-definition-classifications- uses of different types of organic ligands- tuning of structure and properties - synthetic methods-advantage of MOF solids over zeolites- cracking of petroleum products

UNIT-III: SYNTHESIS OF SUPRAMOLECULES

Synthesis and structure of crown ethers, lariat ethers, podands, spherands, cyclophanes, cryptophanes, carcerands and hemicarcerands., Host-Guest interactions, lock and key analogy. Binding of cationic, anionic, ion pair and neutral guest molecules.

Molecular devices: molecular electronic devices, molecular wires, molecular rectifiers, molecular switches and molecular logic.

UNIT-IV: NANOTECHNOLOGY

Introduction and definition of nanoparticles and nanomaterials, emergence of nanotechnology, challenges of nanotechnology. Synthesis of nanoparticles of ZnO_2, TiO_2, silver, gold, rhodium, palladium and platinum; carbon materials- fullerene- porous nano carbon (PNC).

Techniques of synthesis: Electroplating and electrophoretic deposition, conversion through chemicalreactions and lithography; Thin films: Chemical vapor deposition and atomic layer deposition techniques; Carbon fullerenes and nanotubes.

UNIT-V: ANALYTICAL CHARACTERIZATION AND APPLICATIONS

X-rays, Infrared, UV-Vis, Laser Raman, Electron microscopic techniques (SEM and TEM) - Thermal analysis (TG/DTA/DSC) methods.

Application of nanotechnology: modern technology in electronic, biological, consumer and domestic applications. Energy related application: photo-voltaic cells, energy storage nanomaterial. Drug delivery, drug targeting. Sensors and biosensors.

Reference Books

1. C.N.R. Rao, A. Muller, A.K. Cheetam (Eds), The Chemistry of Nanomaterials, Vol.1, 2, Wiley – VCH, Weinheim, 2004

2. Nanochemistry, Kenneth J. Klabunde and G.B.Sergeev
3. G.Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004)
4. Metal-Organic Frameworks Applications from Catalysis to Gas Storage. Cejka, J, ed. (2011). Wiley-VCH. ISBN 978-3-527-32870-3
5. Zeolites and Catalysis: Synthesis, Reactions and Applications. Jiri Cejka; Avelino Corma; Stacey Zones (2010). John Wiley & Sons. ISBN 978-3-527-63030-1.
6. J.-M. Lehn; Supramolecular Chemistry-Concepts and Perspectives (Wiley-VCH, 1995)
7. P. D. Beer, P. A. Gale, D. K. Smith; Supramolecular Chemistry (Oxford University Press, 1999)
8. J. W. Steed and J. L. Atwood; Supramolecular Chemistry (Wiley, 2000).
9. C. P. Poole Jr, F. J. Owens, Introduction to nanotechnology, 2nd edition, Wiley-India, Delhi, 2008.
10. C. C. Kouch, Nanostructures materials: Processing, properties and applications, William Andrew publications, Newyork, 2002.
11. T. Pradeep, Nano: The essentials., McGrew Hill Education.(2007)

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Year: II Year Subject Code: P18MCHP41 Semester: IV

Major Practical- 4 Title: **ORGANIC CHEMISTRY PRACTICAL – II**

Credits: 5 Max. Marks: 75

OBJECTIVES	To know about quantitative estimation of organic compounds and to synthesize simple organic compounds.
COURSE OUTCOMES	
CO1	Acquire the skills of doing quantitative estimations in organic chemistry.
CO2	Understand the double stage organic preparations
CO3	Know the spectral methods of identifying the structure of organic compounds.

I. Any six preparations from the following involving two stages

1. sym-Tribromo benzene from aniline.
2. Benzanilide from benzophenone
3. m-Nitro benzoic acid from methyl benzoate
4. 2,4- Dinitrobenzoic acid from p-nitrotoluene
5. m-Nitro benzoic acid from benzaldehyde
6. Benzil form benzaldehyde
7. Anthraquinone from phthalic anhydride
8. Anthranilic acid from phthalic acid
9. 2-Phenyl indole from phenyl hydrazine
10. 2, 4-dinitrophenyl hydrazine from p-nitrochlorobenzene

II. Any two exercises in the extraction of natural products (Not for examination)

1. Caffeine from tea leaves
2. Lactose from milk
3. Citric acid from lemon

4. Piperine from black pepper

III. Chromatographic separations (Not for examination)

1. Column chromatography: Separation of anthracene and picric acid from anthracene picrate.
2. Thin layer chromatography: Separation of green leaf pigments.
3. Paper chromatography: Identification of amino acids.

IV. Any five estimations

1. Estimation of aniline
2. Estimation of phenol
3. Estimation of ethyl methyl ketone
4. Estimation of glucose
5. Estimation of amino group
6. Estimation of amide group
7. Saponification of fat or an oil
8. Iodine value of an oil

V. Special interpretation of organic compounds UV, IR, PMR and mass spectra of the following 15 compounds

1. 1,3,5- Trimethyl benzene
2. Pinacolane
3. n-Propylamine
4. p-Methoxy benzyl alcohol
5. Benzyl bromide
6. Phenyl acetone
7. 2-Methoxyethyl acetate
8. Acetone
9. Isoopropyl alcohol
10. Acetaldehyde diacetate
11. N,N-Dimethylamino ethanol
12. Pyridine
13. 4-Picoline
14. 1,3-dibromo - 1, 1- dichloropropene
15. Cinnamaldehyde

Recommended Books

1. Arthur I.Vogel, A text book of Practical Organic Chemistry, ELBS

2. Raj K. Bansal, Laboratory Manual of Organic Chemistry, Wiley Eastern limited.
3. N.N. Greenwood and A. Earnshaw, Chemistry of the Elements, Vol.II, Pergamon Press (1997).

TOTAL MARKS FOR PRACTICAL PAPER = 100 MARKS

University Examination	**Marks**	**Internal Assessment**	**Marks**
Estimation	30	Two Tests	10
Preparation	20	Attendance / Regularity	10
Interpretation of spectra	10	Results accuracy	05
Record	05	**Total**	**25**
Viva voce	10		
Total	**75**		

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Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCHP42 Semester: IV

Major Practical- 5 Title: **INORGANIC CHEMISTRY PRACTICALS – II**
QUANTITATIVE ANALYSIS OF COMPLEX MATERIALS

Credits: 5 Max. Marks: 75

OBJECTIVES	To know about quantitative estimation of metals and to synthesize simple inorganic complexes.
COURSE OUTCOMES	
CO1	Acquire the skills of doing quantitative estimations in organic chemistry.
CO2	Learnt about Colorimetric analysis of some common metals
CO3	Know the spectral methods of identifying the structure of organic compounds.

a) ANALYSIS OF ORES

1. Determination of percentage of calcium and Magnesium in dolomite.
2. Determination of percentage of MnO_2 in pyrolusite.
3. Determination of percentage of lead in galena.

b) ANALYSIS OF ALLOYS

1. Estimation of tin and lead in solder.
2. Estimation of copper and zinc in brass.
3. Estimation of chromium and nickel in stainless steel.

c) ANALYSIS OF INORGANIC COMPLEX COMPOUNDS

1. Preparation of cis and trans potassium bis (oxalato) diaquochromate(III) and analysis of each of these for chromium.
2. Preparation of potassium tris (oxalato) ferrate (III) and analysis for iron and oxalate.

d) QUANTITATIVE ANALYSIS

Quantitative analysis of mixtures of iron-magnesium; iron - nickel; copper - nickel and copper - zinc.

e) COLORIMETRIC ANALYSIS

(Using) Photoelectric method: Estimation of iron, nickel, manganese and copper.

f) BIAMPEROMETRIC TITRATIONS

(With dead stop endpoint) thiosulpate - iodine system and Iron (II) - cerium (IV) systems.

g) LIST OF SPECTRA TO BE GIVEN FOR INTERPRETATION.

1. ^{31}p NMR Spectra of methylphosphate
2. ^{31}p NMR Spectra of HPF_2
3. ^{19}F NMR Spectra of CIF_3
4. ^{1}H NMR Spectra of Tris (ethylthioacetanato) cobalt (III)
5. Explain high resolution ^{1}H NMR spectra of (N-propylisonitrosoacetylacetoneuninato) (acetylacetonato) Nickel (II)
6. ESR Spectra of the aqueous $ON(SO_3)^{2-}$ ion.
7. ESR Spectra of the H atoms in CaF_2.
8. ESR Spectra of the $[Mn (H_2O)_6]^{2+}$.
9. ESR Spectra of the bis (salicylaldiminato) copper (II)
10. IR Spectra of the sulphato ligand.
11. IR Spectra of the dimethylglyoxime ligand and its Nickel (II) complex.
12. IR Spectra of carbonyls
13. Mossbauer spectra of $FeSO_4$ $7H_2O$
14. Mossbauer spectra of $FeCl^{3.}$
15. Mossbauer spectra of$[Fe(CN)_6]^{3-}$
16. Mossbauer spectra of $[Fe (CN)_6]^{4-}$

TOTAL MARKS FOR PRACTICAL PAPER = 100 MARKS

SEMESTER EXAMINATION	Marks
I. Estimation of mixture containing two metal ions	
Volumetric	15
Gravimetric	10

Procedure	5(3+2)
II. Colorimetric estimation / amperometric titration	
Estimation	15
Procedure	05
III. Interpretation of Spectra	10
Record	05
viva-voce	10
Total	**75**

INTERNAL ASSESSMENT	**Marks**
Two Tests	10
Attendance / Regularity	10
Results accuracy	05
Total	**25**

C.Abdul Hakeem College (Autonomous), Melvisharam.

Syllabus for M.Sc., Chemistry effective from the year 2018-2019

Year: II Year Subject Code: P18MCHP43 Semester: IV

Major Practical- 6 Title: **I PHYSICAL CHEMISTRY PRACTICAL- II**

Credits: 5 Max. Marks: 75

OBJECTIVES	To know about experiments in electrochemisty.
COURSE OUTCOMES	
CO1	Students learn and understand the concept Electrode potential
CO2	Students learn and understand the concepts of Conductometric titrations
CO3	Students learn and understand the concepts of Potentiometric titrations
CO4	Know the spectral methods of identifying the structure of organic compounds.

Experiments in electrochemistry: conductometry, potentiometry, pH metry and spectroscopy.

CONDUCTIVITY MEASUREMENTS

Determination of equivalent conductance of a strong electrolyte and verification of Debye - Huckel - Onsager Equation

Verification of Debye-Huckel limiting law

Verification of Ostwald's Dilution law for a weak electrolyte. Determination of PK values of weak acids and weak bases.

Conductometric titrations between acid (simple and mixture of strong and weak acids) - base, precipitation titrations including mixture of halides.

E.M.F MEASUREMENTS

Determination of standard potentials (Copper & Zinc)

Determination of thermodynamic quantities from EMF measurements - potentiometric titrations.

Determination of pH and calculation of pKa.

Determination of stability constant of a complex.

Determination of solubility product of a sparingly soluble salt. Redox titrations.
Precipitation titration of mixture of halides by EMF measurements.

SPECTROSCOPY

Experiments given only to familiarize the interpretation of spectra provided. Interpretation of simple UV-Visible spectra of simple molecules for the calculation of molecular data and identification of functional groups (5 typical spectra will be provided).
IR and NMR spectral calculations of force constant - identification and interpretation of a spectra (5 each in IR and NMR will be provided).

LIST OF EXPERIMENTS SUGGESTED FOR PHYSICAL CHEMISTRY PRACTICAL II

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. Any 15 experiments have to be performed in a year.

1. Determination of the equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculate the dissociation constant of the acid.
2. Determination of equivalent conductance of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
3. Determination of the activity co-efficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye-Huckel limiting law.
4. Determination of the solubility product of silver bromate and calculate its solubility in water and in 0.01 M KBrO3 using Debye-Huckel limiting law.
5. Conductometric titrations of a mixture of HCl, CH_3COOH and $CuSO_4$ and NaOH.
6. Determination of the dissociation constant of an acid at different dilution.
7. Determination of the solubility of the lead iodide in water , 0.04 M KI and 0.04 M Pb(NO3)2 at 298 K

8. Determination of the solubility product of leadiodide at 298 K and 308 K and calculate the molar heat of solution of lead iodide.
9. Compare the relative strength of acetic acid and mono chloroacetic acid by conductance method.
10. Determine the basicity of organic acids (oxalic /benzoic).
11. Study the effect of solvent on the conductivity of $AgNO_3$/acetic acid and determine the degree of dissociation and equilibrium constant in different degree of dissociation and mixtures (DMSO, DMF, dioxane, acetone, water) and test the validity of Debye-Huckel Onsager's equation.
12. Determine the solubility of $Ca(TiO_3)_2$ in deionised water and in dilute solution of KCl at 298 K. Determine the solubility product graphically.
13. Determine the equivalent conductivity of a Ca electrolyte and dissociation constant of the electrolyte.
14. Determine the equivalent dissociation constant of a polybasic acid.
15. Determine the electrode potentials of Zn and Ag electrodes in 0.1M and 0.001M solutions at 298 K and fine the standard potentials for these electrodes and test the validity of Nernst equation.
16. Determine the activity co-efficient of an electrolyte at different molalities by EMF measurements.
17. Determine the dissociation constant of acetic acid titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
18. Study of the electrolytic separation of metals (Ag, Cu, Cd and Zn)
19. Determine the strength of a given solution of KCl using differential potentiometric titration technique.
20. Determine the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
21. Determine the transport number of cadmium ions and sulphate ions by measuring emf of concentration cells with and without transference.
22. Determine the dissociation constant of monobasic or dibasic acid by all the Alber-Serjeant method.
23. Determine the transport number of Ag ions and nitrate ions by Hittorf's method.

24. Calculate the $ZnSO_4 + H_2$ by emf method and thermodynamic parameters for the reaction $Zn + H_2SO_4$
25. Determine the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
26. Determine the pH of the given solution with the help of indicators using buffer solutions and by colorimetric method.
27. Perform acid-base titration in a non aqueous medium.
28. Determine pH value of an acid-base indicator (methyl red) by colorimetry.
29. Determine the composition and instability constant of a complex by mole ratio method.
30. By colorimetry determine simultaneously Mn and Cr.
31. Determine lead ion by amperometric titrations with potassium dichromate.
32. Determine ferric ion by amperometric titration.
33. Determine the stability constant of a complex by polarographic method.
34. Estimate the concentration of cadmium and lead ions by successive reduction in polarography. Verify Illkovic equation.
35. Determine the g value from a given ESR spectrum.

Quantum of marks in respect of Practical Examinations

University Examination	**Marks**	**Internal Assessment**	**Marks**
Procedure	10	Two Tests	10
Manipulation	25	Attendance / Regularity	10
Result	15	Results accuracy	05
Interpretation of spectra	10	**Total**	**25**
Record	05		
Viva voce	10		
Total	**75**		