Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: CHEMISTRY

Name of the Course: M.Sc. I (Sem.– I & II)

(Syllabus to be Implemented from w.e.f. June 2020)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M. Sc. I Chemistry Syllabus
(w.e.f. academic year 2020-21)

School of Chemical Sciences offer following P.G. courses

1. **M.Sc. (Chemistry)(Polymer Chemistry)**
2. **M.Sc. (Chemistry)(Industrial Chemistry)**
3. **M.Sc. (Chemistry)(Organic Chemistry)**
4. **M.Sc. (Chemistry)(Medicinal Chemistry)**

Following P.G. courses are offered at the colleges affiliated to Solapur University, Solapur

5. **M.Sc. (Chemistry)(Physical Chemistry**), DBF Dayanand College of Arts and Science, Solapur
6. **M.Sc. (Chemistry)(Pharmaceutical Chemistry**), DBF Dayanand College of Arts and Science, Solapur
7. **M.Sc. (Chemistry)(Analytical Chemistry**), Shri Shivaji Mahavidyalaya, Barshi
8. **M.Sc. (Chemistry)(Inorganic Chemistry**), Walchand College of Arts and Science, Solapur

The above courses are of two year duration consisting of four Semesters (First year: Semester I and II, second year: Semester III and IV). **First year is common to all above referred courses (1 to 8).**

Course structure of first year

Semester	Paper Code	Title of the Paper	Semester exam			L	T	P	Credits
I		**Hard core**	**Theory**	**IA**	**Total**				
	HCT-101	Inorganic Chemistry -I	80	20	100	4	--	-	4
	HCT-102	Organic Chemistry -I	80	20	100	4		-	4
	HCT-103	Physical Chemistry -I	80	20	100	4		-	4
		Soft Core (Any one)							
	SCT-104	Analytical Chemistry -I	80	20	100	4		0	4
	SCT-105	Chemistry in Life Sciences	80	20	100	4		0	
		Practicals							
	HCP-106	Inorganic Chemistry	40	10	50	-	-	2	6
	HCP-107	Organic Chemistry	40	10	50	-	-	2	
	HCP-108	Physical Chemistry	40	10	50	-	-	2	
		Soft core (Any one)							
	SCP-109	Analytical Chemistry	40	10	50	-	-	2	2
	SCP-110	Analytical Chemistry	40	10	50	-	-	2	
	T-I	Tutorial					25		1
		Total for 1st semester	**480**	**120**	**600**		**625**		**25**
II		**Hard core**							
	HCT-201	Inorganic Chemistry -II	80	20	100	4	--	-	4
	HCT-202	Organic Chemistry -II	80	20	100	4		-	4
		Soft core (Any one)							
	SCT-203	Physical Chemistry -II	80	20	100	4		-	4
	SCT-204	Green Chemistry	80	20	100	4		-	
		Open elective (Any one)							
	OET-205	Analytical Chemistry-II	80	20	100	4		-	4

	OET-206	Medicinal Chemistry -I	80	20	100	4		-	
	Other								
		Practicals							
	HCP- 207	Inorganic Chemistry	40	10	50	-	-	2	4
	HCP- 208	Organic Chemistry	40	10	50	-	-	2	
		Soft core (Any one)							
	SCP- 209	Physical Chemistry	40	10	50	-	-	2	2
	SCP- 210	Physical Chemistry	40	10	50	-	-	2	
		Open elective (Any one)							
	OEP- 211	Analytical Chemistry	40	10	50	-	-	2	2
	OEP -212	Medicinal Chemistry	40	10	50	-	-	2	
	Other								
	T-II	Tutorial					25		1
		Total for 2nd semester	**480**	**120**	**600**		**625**		**25**

L = Lecture T = Tutorials P = Practical

4 Credits of Theory = 4 Hours of teaching per week
2 Credit of Practical = 4 hours per week
HCT = Hard core theory,
SCT = Soft core theory,
HCP = Hard core practical
SCP = Soft core practical,
OET = Open elective theory,
OEP = Open elective practical,
HCMP = Hard core main project

M. Sc. Part-I (Semester-I)
Inorganic Chemistry– I
Paper No. HCT-101

Unit I: Chemistry of Transition Elements (15)

General characteristic properties of transition elements, co-ordination chemistry oftransition metal ions, ligand field theory, ligand field energy parameters(Racahparameters B and C, Slater Condon Parameters, Slater Condon Shortley Parameters), splitting of d orbitals in low symmetry environment, Janh-Teller effect, interpretationof electronic spectra including charge transfer spectra, spectrochemical series, nephelauxetic effect and nephelauxetic series. Dia-para-ferro and antiferromagnetism, quenching of orbital angular moments, spin orbit coupling.

Unit-II: A) Stereochemistry and Bonding (08)

VSEPR theory, Walsh diagrams (tri and penta-atomic molecules) dπ – pπ bonds, Bent`s rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

Unit-II: B) Inorganic Materials, (07)

Insulators and semiconductors, electronic structure of solids, band theory, intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, semiconductor devices, rectifiers, transistors, photoconductors, photovoltaic cell.

Unit-III: Nuclear Chemistry (15)

Radioactive decay and equilibrium, Nuclear reactions, Q values, cross sections, types of reactions. Chemical effects of nuclear transformations, fission and fusion, fission products and fission yields. Radio active techniques, tracer techniques, neutron activation analysis, counting techniques such as G.M., ionization and proportional counters.

Unit- IV Metal Cluster and Metal Carbonyls (15)

Metal Cluster: Introduction, Classification of metal clusters, Structures of Carbonyl Clusters (LNCC and HNCC), Structural aspects of Halide type Clusters (Di, tri, tetra & hexanuclear clusters)

Metal Carbonyls: Introduction, Classification of carbonyl complexes, Formation of CO molecule, Coulson's modification and explanation of strong field effect of Co ligand, Bonding in metal carbonyl complexes (mono, di & trinuclear carbonyl complexes, synergic relationship between metal and CO ligands), Preparation, properties & structures of mono, di & trinuclear carbonyl complexes [V(CO)6, Cr(CO)6, Ni(CO)4, Fe(CO)5, Mn2(CO)10, Co2(CO)8, Fe2(CO)9, Fe3(CO)12], EAN rules for metal carbonyls and problems based on EAN, 18 electron rule for metal carbonyls and problems based on 18 electron rule.

RECOMMENDED BOOKS

1. A. F. Wells, Structural Inorganic Chemistry – 5th Edition (1984), Oxford Science Publication
2. James H. Huheey, Inorganic Chemistry- Principle, Structure and Reactivity,
3. J. D. Lee, Concise Inorganic Chemistry, ELBS with Chapman and Hall, London
4. A.R. West, Solid State Chemistry and its applications, Plenum-John Wiley and Sons
5. N.B. Hanny, Solid State Physics
6. H.V. Keer, Solid State Chemistry
7. S.O. Pillai, Solid State Physics, New Age International Publication
8. W.D. Callister, Material Science and Engineering: An Introduction, John Wiley and Sons
9. R. Raghwan, First Course in Material Science
10. R.W. Cahan, The coming of Material Science
11. A.R. West, Basic Solid State Chemistry, 2nd Edition, John Wiley and Sons
12. U. Schubest and H. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000)
13. M.C. Day and Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
14. A.H. Hanny, Solid State Chemistry, A.H. Publication
15. John Wullf, The Structure and Properties of Materials, Vol. 4, Electronic properties, Willey Estern
16. L.V. Azoroff and J.J. Brophy, Elecronic Processes in Materials, McGraw Hill –I
17. Prakash G. More, Comprehensive Industrial Chemistry, PragatiPrakashan,Meerut
18. F.A. Cotton and R.G. Wilkinson, Advanced Inorganic Chemistry, Wiley Students Edition
19. Williams and L. Jooly, Modern Inorganic Chemistry, McGraw-Hill International Edition
20. ManasChanda, Atomic Structure and Bonding, TMH Publication
21. N.N. Greenwood and A. Earnshaw, Chemistry of Elements, Pergamon
22. Chakrabarty, Solid State Chemistry, New Age International Publication
23. J.J. Lipard, Progress in Inorganic Chemistry, Vol 18 and 38, Wiley
24. E. Konig, Structure and Bonding, Vol 9, 1971, 175
25. H.J. Arnikar, Essentials of Nuclear Chemistry, New Age International Publication
26. Friendlander, Kennedy and Miller, Nuclear and Radiochemistry, Wiley and Sons

M. Sc.-I (Semester-I)
Organic Chemistry-I
Paper No. HCT-102

Unit I: Nature of Bonding in Organic Molecules (15)

Delocalized chemical bonding conjugation, Resonance, Hyperconjugation, Bonding in fullerenes, Tautomerism, Aromaticity in benzenoid and non–benzenoid compounds, Alternant and non–alternant compounds, Huckel rule, Annulenes, Aromaticity, homo–aromaticity, ψ–aromaticity, PMO approach, Crown ethers complexes and cryptands, Inclusion compounds.

Unit II: Reaction Mechanism: Structure and Reactivity (15)

Types of Mechanisms, Types of reactions, Thermodynamic and Kinetic requirements, Kinetic and Thermodynamic control, Hammonds postulates, Curtin–Hammett principle, Potential energy diagrams, Transition states and intermediates, Methods of determining mechanisms, Isotope effects, Hard and soft acids and bases, Generation, structure, stability and reactivity of carbocations, Carbanions, Free radicals, Carbenes and Nitrenes. Effect of structure on reactivity, Resonance and field effect, Steric effect, Quantitative treatment, The Hammett equation, Linear free energy relationship, Substituents and reaction constants, Taft equation.

Unit III: Aliphatic Nucleophilic & Electrophilic Substitution reactions (15)

The SN^2, SN^1, mixed SN^1 & SN^2, and SET mechanisms, Neighboring group participation by π and 6–bonds, anchimeric assistance. Nucleophilic at an allylic aliphatic trigonal and a vinylic carbon.

Reactivity: Effect of substrate structure, attacking nucleophile, leaving group and reaction medium. Ambident nucleophiles, regioselectivity. Bimolecular mechanisms –SE^2 and SE^i The SE^1 mechanisms. Electrophilic substitution accompanied by double bond shifts.

Unit IV: Stereochemistry (15)

Elements of symmery, Chirality, Enantiomeric and diastereomeric Relationships, R and S, E and Z nomenclature, Molecules with more than one chiral center, Threo and Erythro isomers, Prochiral relationships, groups and faces, stereospecific and stereoselective reactions. Optical activity in the absence of Chiral carbon (Biphenyls, allenes and Spiranes), Chirality due to helical shape, Methods of resolution, optical purity, stereochemistry of the compounds containing Nitrogen, Sulphur and phosphorous, Conformations analysis of cycloalkanes, Mono and disubstituted cyclohexanes, decalins, Effect of conformation on reactivity.

RECOMMENDED BOOKS

1. Advanced Organic Chemistry, IV Edn –J. March
2. Stereochemistry of carbon Compounds: E. L. Eliel
3. Advanced organic chemistry: F. A. Carey and R. J. Sundberg
4. A guide book to mechanism in organic chemistry: Peter Sykes.
5. Mechanism and Structure in organic Chemisry, E.S.Gould
6. Principle of Organic Synthesis: R.O.C. Norman.
7. Modern Methods of Organic Synthesis: W. Carruthers
8. Organic Chemistry: Clayden, Greeves, Warren and Wothers
9. Stereochemistry of Organic Compounds: D. Nasipuri
10. Stereochemistry: P. S. Kalsi
11. Basic Stereochemistry of Organic Molecules: Subrata Sen Gupta

M. Sc.-I (Semester-I)
Physical Chemistry-I
Paper No. HCT-103

Unit-I: Wave Mechanics (15)

Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, matter waves, wave nature of the electron, Heisenberg's uncertainty principle, Schrodinger wave equation, particle in one dimensional box, the particle in three dimensional box, the hydrogen atom, transformations of coordinates, separation of variables and their significance, the Φ equation, the Θ equation and the Radial equation.

Unit-II: Chemical Thermodynamics (15)

Review of Thermodynamics laws, Derivations of Maxwells Relations, Thermodynamic equation of state, Entropy and Third law of thermodynamics, residual entropy. Concept of fugacity and determination of fugacity, Activity and activity coefficients of solute and solvent, their determination by freezing point depression and vapour pressure measurement, criteria for equilibrium between phases, Derivation of phase rule, application of phase rule to three component system.

Unit-III:Thermodynamics of Solutions [15]

Thermodynamics of ideal solutions, Raoult's and Henrey's law, Deviations, partial molar quantities, Gibbs-Duhem equation, Duhem-Margules equation, Excess and mixing thermodynamic properties of Non- ideal solutions and their determination.

Unit-IV: Statistical Thermodynamics: [15]

Weights and configurations, the most probable configuration, thermodynamic probability and entropy: Boltzmann – Planck equation. Ensembles, ensemble average and time average of property. Maxwell-Boltzmann (MB) distribution law and its application to viscosity and diffusion of gases. Physical significance of distribution Law.

RECOMMENDED BOOKS

1. Quantum Chemistry- R. K. Prasad
2. Quantum Chemistry – Donald A. MacQuarrie
3. Physical Chemistry- P.W. Atkins
4. Text book of Physical Chemistry- S.Glasstone
5. Principles of Physical Chemistry – Marron and Prutton
6. Physical Chemistry- G.M.Barrow
7. Thermodynamics for Chemists – S.Glasstone
8. Thermodynamics – Lewis and Randall, revised by Pitzer
9. An introduction to Chemical Thermodynamics- R. R. Mishra and R. P. Rastogi
10. Kinetics and Mechanism – Frost and Pearson
11. Chemical and Kinetics by K. J. Laidler
12. An Introduction to Statistical Thermodynamics – T.L. Hill, Addison-Wesley. 1960.
13. Statistical Mechanics – Donald A. McQuarrie, 2000.
14. Elements of statistical thermodynamics - L. K. Nash, 2nd Ed. Addison Wesley. 1974.

M. Sc.- I (Semester-I)
Analytical Chemistry-I
Paper No. SCT-104

Unit-1: Statistical data analysis (15)

Errors, Types of Errors: Determinate, constant, proportional and indeterminate; Significant figures and computation rules, Accuracy and precision, Distribution of random errors, Average deviation and Standard deviation, Variance and Confidence Limit, Least Square method. Methods of Sampling, Sample Size, Techniques of Sampling gases and Solids.

Unit: II A: Atomic absorption spectroscopy (8)

Introduction, principle, difference between AAS and FES. Advantages of AAS over FES, Disadvantages of AAS, Instrumentation, Single and double beam AAS, Detection limits and sensitivity, Interference, Applications.

Unit II B: Inductively coupled plasma spectroscopy (7)

Introduction, nebulization, torch, plasma, instrumentation, interferences, Applications

Unit-III: Electroanalytical Techniques: (15)

Polarography: - Introduction, Instrumentation, Ilkovic equation and its application in quantitative analysis. Half wave potential. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications Amperometry: - Principles, instrumentation, nature of titration curves, analytical applications.

Unit-IV: Computer for Chemists: (15)

Introduction: Software: Overview of the key elements of basic programme structure, Operating with softwares such as Origin, CHEM DRAW, CHEM SKETCH, word processing, use of MSWORD, powerpoint and EXCEL in chemistry, Linear regression, X-Y plots, numerical integration and differentiation and use of internet for searching research data.

RECOMMENDED BOOKS

1. Analytical Chemistry (J.W.)-G. D. Christian.
2. Introduction to Chromatography.1) Bobbit,2) Srivastva.
3. Instrumental Methods of Analysis (CBS)-H. H. Willard, L. L. Merrit, J. A. Dean & F. A. Settle.
4. Instrumental Methods of Analysis: Chatwal and Anand.
5. Instrumental Methods of Inorganic Analysis(ELBS):A. I. Vogel.
6. Chemical Instrumentation: A. Systematic approach-H. A. Strobel.
7. Physical Chemistry-P. W. Atkins.
8. Principles of Instrumental Analysis- D. Skoog and D. West.
9. Treatise on Analytical Chemistry: Vol. I to Vol. II-I .M. Kolthoff.
10. Computer, Fundamentals-P. K. Sinha.
11. Programming in BASIC-E. Balaguruswamy.
12. Computer programming made simple: J. Maynard.
13. The principles of ion selective electrodes and membrane transport.-W.E Mort
14. Computational Chemistry- G. Grant and W. Richards, Oxford University Press.
15. Computer for chemists by S. K. Pundir and A. Ban

M. Sc.- I (Semester-I)
Chemistry in Life Sciences
Paper No. SCT-105

Unit I: Introduction to cell biology and Structure of different cell organelles (15)

Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models. Structure of nuclear envelope, nuclear pore complex. ER structure. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Zellweger syndrome.

Unit II: Amino acids and Nucleic acids (15)

Structure and classification, physical, chemical and optical properties of amino acids
Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA.
Structure of major species of RNA - mRNA, tRNA and rRNA.
Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers

Unit : III: Protein Chemistry (15)

Polypeptide backbone, covalent and non-covalent interactions, end-group analysis by chemical and enzymatic methods, Conformation, Configuration, Details of primary, secondary, tertiary and quaternary structures, problems based on determination of primary structure, Ramchandran Plot, structure- function relation of protein (Ex. Haemoglobin) Chemical modification and cross-linking in proteins, dynamic properties and mechanisms of protein folding

Unit IV: Introduction to bioenergetics (15)

Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

RECOMMENDED BOOKS

1. Principles of Biochemistry, Lehninger C Rs. Publ. (1982).
2. Biochemistry, L. Stryer, W.H. Freeman, San Francisco.
3. Schaum's Outline Series of Theory and Problems of Biochemistry, Philip W. Kuchel and G.B. Ralston. Int. Ed., McGraw-Hill Book Co.
4. Molecular Biology of the cell – Bruce Alberts – J.D. Watson et al Garland publishing Inc., N.Y. (1983).
5. Cell and Molecular Biology – DeRobertis and Saunders (1980).
6. The cell – C.P. Swanson, Prentice Hall (1989)
7. Cell Biology – C.J. Avers, Addision Wesley Co. (1986).
8. Metabolic Pathways - Greenberg.
9. Biochemistry – G. Zubay, Addision Wesley Publ. (1983).
10. Biochemistry – Stryer (1988) 3rd Edition W.H. Freeman and Co.

M. Sc.-I (Semester-II)
Inorganic Chemistry – II
Paper No. HCT - 201

Unit-I: Chemistry of Non- transition Elements (15)

General discussion of the properties of non- transition elements, special features of the individual elements, synthesis, properties and structure of their halides and oxides, polymorphism of carbon, phosphorous, sulphur. Synthesis, structure and properties of boranes, carboranes, borazines, silicates, carbides, silicones, phosphazenes, sulphur nitrogen compounds, oxyacids of nitrogen, phosphorous, sulphur and halogen, interhalogens, pseudohalides and noble gas compounds.

Unit-II: Organometallic Chemistry of Transition Elements (15)

Synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogenous catalytic reactions (hydrogenation, hydroformylation, isomerization,Monsanto acetic acid process, synthesis gas, Wacker Process), Ziegler and Natta catalysis, pi-metal complexes, activation of small molecules by coordination.

Unit-III: A) Metal- Ligand Equillibria in Solution (07)

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

Unit-III: B) Chemistry of Lanthanides and Actinides (08)

Lanthanides: Introduction, spectral and magnetic properties. Classical methods of separation of lanthanides: (i) precipitation (ii) thermal reaction, (iii) fractional crystallization, (iv) complex formation, (v) solvent extraction and (vi) ion exchange. Use of lanthide compounds as shift reagent. Applications of lanthanides.

Actinides: Introduction, spectral and magnetic properties. Methods of separation of actinides. Preparation of trans-uranic elements. Applications of actinides. Further extension of periodic table.

Unit-IV: A) Metallurgy (08)

Occurance, extraction, properties and applications of copper, silver, gold, zinc, tin and lead.

Unit-IV: B) Bioinorganic Chemistry (07)

Role of metal ions in biological processes, molecular mechanism of ion transport across membranes, ionophores, photosynthesis PS I and PS II, nitrogen fixation, oxygen uptake proteins, cytochromes and ferrodoxines.

RECOMMENDED BOOKS

1. A. F. Wells, Structural Inorganic Chemistry – 5th Edition (1984), Oxford Science Edition
2. James H. Huheey, Inorganic Chemistry- Principle, Structure and Reactivity, Harper and Row Publisher Inc., New York
3. J. D. Lee, Concise Inorganic Chemistry, ELBS with Chapman and Hall, London
4. M.C. Day and Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
5. Jones, Elementary Coordination Chemistry
6. Morttel, Coordination Chemistry
7. T.S. Swain and D.S.T. Black, Organometallic Chemistry
8. Prakash G. More, Comprehensive Industrial Chemistry, PragatiPrakashan, Meerut
9. John Wullf, The Structure and Properties of Materials, Vol. 4, Electronic properties, Willey Eastern
10. L.V. Azoroff and J.J. Brophy, Elecronic Processes in Materials, McGraw Hill –I
11. F.A. Cotton and R.G. Wilkinson, Advanced Inorganic Chemistry, Wiley Student Edition
12. Williams and L. Jooly, Modern Inorganic Chemistry, McGraw Hill International Edition
13. ManasChanda, Atomic Structure and Bonding,TMH Publication
14. P.L. Pausan, Organometallic Chemistry
15. Cullen, Dolphin and James, Biological Aspects of Inorganic Chemistry
16. Williams, An Introduction to Bioinorganic Chemistry
17. M.N. Hughes, Inorganic Chemistry of Biological Processes
18. Ochi, Bioinorganic Chemistry
19. O.A. Phiops, Metals and Metabolism
20. S.J. Lipard and J.M. Berg, Principles of Bioinorganic Chemistry, University Science Books
21. G.L. Eichhron, Inorganic Bichemistry, Vol I and II, Elsevier

M. Sc. - I (Semester-II)
Organic Chemistry-II
Paper No. HCT - 202

Unit I: Aromatic Electrophilic & Nucleophilic Substitution reactions (**15)**

The arenium ion mechanism, orientation and reactivity, energy profile diagram, orto/para ratio, IPSO substitution, orientation in other ring system, recapitulation of halogenations, nitration, sulphonation and friedel craft's reactions, Diazonium coupling.

The SN^{Ar}, SN^1, SN^2 and benzyne mechanism, Effect of substrate structure, leaving group and attacking nucleophilic on reactivity

Unit IIA: Addition to Carbon–Carbon and Carbon –Hetero multiple bond (10)

Mechanism and streochemical aspects of addition reaction involving electrophile, nucleophile and free radical, Regioselectivity and chemo selectivity, orientation and reactivity, Michael addition, Sharpless asymmetric epoxidation.

Mechanism of Metal hydride reduction of saturated and unsaturated carbonyl compound, acid, ester and nitriles, Addition of Grignard reagent, Organo zinc and organo lithium reagent to carbonyl and unsaturated carbonyl compounds, Witting reaction, Mechanism of condensation reaction involving enolates : Aldol, Knovenagel, claisen, Mannich, Benzoin, Perkin, Stobbe reaction, Hydrolysis of ester and amides.

Unit II B: Elimination Reactions (**05)**

The E1, E2 and E1cb mechanism. Orientation of double bond, reactivity: Effect of substrate substance, attacking base, the leaving group and the medium, pyrolytic elimination.

Unit III: Oxidation reactions (15)

Introduction, different oxidative process, hydrocarbons (alkanes and alkenes), aromatic rings, alcohol, diols, aldehyde, ketones, Ketal and carboxylic acids, amine, hydramine and sulphide, Oxidation with Ruthenium tetraoxide, Iodobenzene diaacetate and Thallium (III) nitrate.

Unit IV: Reduction reactions (15)

Introduction, different reductive process, alkenes, alkynes and aromatic ring carbonyl compounds, aldehydes, ketones,acids and their derivatives, epoxides, nitroso, azo and oxime groups, hydrogenolysis.

RECOMMENDED BOOKS

1. Advanced Organic Chemistry: IV Edn. J. March
2. Stereochemistry of carbon Compounds: E. L. Eliel
3. Advanced organic chemistry: F. A. Carey and R. J. Sundberg
4. A guide book to mechanism in organic chemistry: Peter Sykes.
5. Mechanism and Structure in organic Chemisry: E. S.Gould
6. Principle of Organic Synthesis: R.O.C. Norman.
7. Modern Methods of Organic Synthesis: W. Carruthers
8. Organic Chemistry: Clayden, Greeves, Warren and Wothers
9. Stereochemistry of Organic Compounds: D. Nasipuri
10. Stereochemistry: P. S. Kalsi
11. Basic Stereochemistry of Organic Molecules: Subrata Sen Gupta

M.Sc.- I (Semester-II)
Physical Chemistry-II
Paper No. SCT – 203

Unit-I: Photochemistry-I **[15]**

Introduction, Absorption of light and nature of absorption spectra, electronic transitions, Franck–Condon principle, electronic excitation, photo-dissociation and Pre-dissociation, photo-reduction, photo-oxidation, role of photochemistry in environment (Green house effect, ozone depletion).

Unit-II: Photochemistry-II **[15]**

Photophysical phenomenon. Jablonskidigram. Kasha's rule, fluorescence, phosphorescence, delayed fluorescence, differences between phosphorescence and delayed fluorescence. Inter & intra molecular excitation energy transfer (EET) processes. Quenching of fluorescence and kinetics of biomolecluar quenching processes, Stern-Volmer equation, formation of photodimer, (with suitable examples) excimer and exciplex.

Unit-III: Electrochemistry **[15]**

Electrical double layer and its significance (Helmholtz, Gouy-Chapmann and Stern model), evaluation of mean activity coefficients of ions from e.m.f. data, determination of dissociation constant of monobasic acid by e.m.f. method. Debye Huckel theory (without derivation) and limiting law. Storage batteries: acid and alkali storage cells.

Unit-IV: Chemical Kinetics **[15]**

Rate determining step, steady state approximation. fractional order kinetics, Higher order kinetics and their examples.

Reaction mechanism: Thermal decomposition of acetaldehyde, ethane, reaction between hydrogen and halogens, reaction between NO_2 and F_2, Decomposition of Ozone. Ionic reactions: Primary and secondary salt effect, Effect of ionic strength and dielectric constant of medium on the rate of ionic reactions in solution.

RECOMMENDED BOOKS

1. Photo chemistry- J.G.Calverts&J.N.Pits
2. Fundamentals of Photochemistry- K.K.Rohatgi, Mukharji
3. Photochemistry of Solutions – C. A. Parker
4. Chemical Kinetics – K.J.Laidler
5. Kinetics and Machanism - R. A. Frost and R. G. Pearson
6. Electrochemistry – S.Glasstone
7. Modern electrochemistry – Bockris& Reddy
8. Physical Chemistry – P. W. Atkins
9. Physical Chemistry – G. M. Barrow
10. Physical Chemistry: A molecular Approach – Donald A. McQuarrie and John D. Simon, Viva Books, New Delhi, 1998.
11. Introduction to Photochemistry-Wells
12. Electrolytic Solutions by R. A. Robinson and R. H. Strokes, 1959
13. Basic chemical Kinetics- G. L. Agarwal, Tata-McGraw Hill

M.Sc.- I (Semester-II)

Green Chemistry-I

Paper No. SCT – 204

UNIT I: **Green chemistry:** **(15)**

History, need, and goals. Green chemistry and Sustainability. Dimensions of sustainability, Limitations/Obstacles in pursuit of the goals of Green Chemistry. Opportunities for the next generation of materials designers to create a safer future. Hazard assessment and mitigation in chemical industry

UNIT II: Basic principles of Green Chemistry and their illustrations with examples. **(15)**

Prevention of waste/byproducts, Maximum Incorporation of the materials used in the process into the final product (Atom Economy): Green metrics,Prevention/Minimization of hazardous/toxic products,Designing safer chemicals - different basic approaches,Selection of appropriate auxiliary substances (solvents, separation agents etc),Energy requirements for reactions—use of microwave, ultrasonic energy,Selection of starting materials—use of renewable starting materials,avoidance of unnecessary derivatization—careful use of blocking/protection groups, Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents, Designing biodegradable products, Prevention of chemical accidents**.**

UNIT III: Examples of green synthesis/reaction and development of analytical technique **(15)**

Green starting materials,2 Green reagents, Green solvents and reaction conditions,Green catalysis, Green synthesis- Real world cases (Traditional processes and green ones) Synthesis of Ibuprofen, Adipic acid.

Strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Development of accurate and reliable sensors and monitors for real time in process monitoring.

UNIT IV: Future Trends in Green Chemistry: (15)

Oxidation-reduction reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Noncovalentderivatization. Biomass conversion, emission control. Biocatalysis.

RECOMMENDED BOOKS

1. Green Chemistry: Theory and Practice. P.T. Anastas and J.C. Warner. Oxford University Press.

2. Green Chemistry: Introductory Text. M. Lancaster Royal Society of Chemistry (London).

3. Introduction to Green Chemistry. M.A. Ryan and M.Tinnesand, American Chemical Society (Washington).

4. Real world cases in Green Chemistry, M.C. Cann and M.E. Connelly. American Chemical Society (Washington).

5. Real world cases in Green Chemistry (Vol 2) M.C. Cann and T.P.Umile. American Chemical Society (Washington**)**

M. Sc.-I (Semester-II)
Analytical Chemistry-II
Paper No. OET-205

Unit I: Infrared Spectroscopy (15)

Instrumentation and sample handling, Various vibrational transitions, Characteristic vibrationl frequencies of alkenes, alkynes, aromatic compounds, Carbonyl compounds, hydroxyl compound and amines. Factors affecting IR group frequencies, overtone, combination bands and Fermi resonance. Applications

Unit II: Nuclear Magnetic Resonance Spectroscopy (15)

Elementary Ideas, Chemical Shifts, Factors affecting chemical shifts, Spin–Spin coupling constants (J) Instrumentations, Different types of coupling, Factors affecting coupling constant, Karplus equation, Spin system (AB, AX, ABX, AMX, etc), Rate processes, Spin decoupling, Shift reagents, Nuclear over Hauser effect (NOE).

Unit III A: C^{13}-NMR Spectroscopy (10)

Elementary ideas, instrumental difficulties, FT technique advantages and disadvantages. Proton Noise Decoupling technique advantages and disadvantages, off-resonance technique, factors affecting chemical shifts, analogy with 1H NMR, calculations of chemical shift of hydrocarbons, different types of carbons (alkene, alkyne, allene, carbonyl, nitrile, oxime and aromatic carbons and effect of substituent on chemical shifts of carbons. Chemical shifts of solvents.

Unit III B: 2D- NMR Spectroscopy (05)

Two Dimensional (2D) NMR techniques: COSY, NOESY, DEPT, APT, INEPT & INADQUATE

Unit IVA: Mass Spectrometry (10)

Introduction, Ion production (EI, CI, FD & FAB), Ion analysis, Ion abundance, Factors affecting fragmentation, Fragmentation of different functional groups, Molecular ion peaks, Metastable peaks Nitrogen rule, McLafferty rearrangement, Retro-Diels Alder reaction.

Unit IV B: Problems based on joint application of IR, NMR & Mass spectroscopy (05)

RECOMMENDED BOOKS

1. Instrumental Methods of Analysis (CBS, Delhi)-Willard, Merritt, Dean & Settle.
2. Spectroscopic identification of Organic Compound (J.W.)R. M. Silverstein and G. C. Bassler.
3. Spectroscopic methods in Organic Chemistry (T. M .Hill)-D .H.Williams and I.Fleming.
4. Absorption Spectroscopy of Organic molecules (Addison-Wesley) V.M.Parikh.
5. Applications of Spectroscopy techniques in Organic Chemistry – (Wiley Eastern)-P.S.Kalsi.
6. Physical methods in Inorganic chemistry (DWAR)-R.Drago
7. Chemical Spectroscopy (Elsevier) Dudd.
8. Instrumental methods of analysis – Chatwal&Anand
9. Introduction to EPR (Hilger)-Assenliein.
10. Fundamentals of Analytical Chemistry by D.A. Skoog& D. M. West (Holt Rinehart & Winston Inc).
11. Introduction to Spectroscopy, D.L. Pavia, G.M. Lampman, G.L. Nelson.
12. Mass Spectroscopy, K.G. Das & James.

M. Sc.-I (Semester-II)

Medicinal Chemistry

Paper No. OET-206

Unit –I **(15)**

a) **Drugs:** Essential Drugs, Nomenclature of Drugs, Routes of Drug Administration, Adverse effects of Drugs, IUPAC Naming of Drugs.
b) **Drug Design:** Development of New Drugs, Factors Affecting Development of New Drugs. Sources of lead compounds, Concept of prodrugs and soft drugs, Drug Receptors, Theories of Drug Action.

Unit –II **(15)**

a) **Pharmacokinetics:** Introductions, Drug Absorption, Distribution and Disposition of Drugs, Excretion and Elimination, Pharmacokinetics of Elimination.
b) **Pharmacodynamics:** Introduction, Enzyme Stimulation, Enzyme Inhibition, Membrane Active Drugs, Drugs Metabolism, Biotransformation, Toxicology, Types of Interactions.

Unit-III **(15)**

a) **Cardiovascular Drugs:** Introductions, Classification, Cardiovascular Diseases, Synthesis of Diltiazem, Verapamil, Methyldopa, Atenolol.
b) **Non Steroidal Anti-inflammatory Drugs (NSAIDs):** Introductions, Classification, Synthesis, Mechanism of action of Indomethacin, Ibuprophen, Dichlorophenac, Naproxen, Allorpurinol.

Unit –IV **(15)**

a) Antibiotics: Introductions, Classification, β-Lactum antibiotics, Cephalosporins, Anticancer Antibiotics. Synthesis of Penicillin-G, Penicillin-V, Ampicillin, Amoxycillin, Chloramphenicol, Cephalophalosporin, Tetracyclin and Strectomycin.
b) General anaesthetics and local anaesthetics: Introduction, Classification, Mode of Action and mechanism of action of general and local anaesthetics.

Reference books:

1. Medicinal Chemistry by AshutoshKar, New Age International Publishers.
2. Medicinal Chemistry by Alka L. Gupta.

M. Sc. Part – I
Inorganic Chemistry Practicals
Semester-I

Ore Analysis:

1. Iron Ore
2. Dolomite Ore

Alloy Analysis: (any one)

1. Brass alloy
2. Bronze alloy

Preparation and determination of purity: (any two)

1. Potassium trioxalatochromate(III)
2. Nitritopentacyano ferrate (III) monohydrate
3. Copper acetate
4. Prussian blue
5. Manganese acetate

Note: Any other relevant experiment be added

Semester-II

Ore analysis: (any one)

1. Pyrolusite ore
2. Boxite ore

Alloy analysis: (any two)

1. Type metal alloy
2. Solder alloy
3. Cupro-nickel alloy

Preparation and determination of purity: (any two)

1. Sodium tetrathiocyanatodiamminechromate(III)
2. Potassium hexathiocyanatochromate(III)
3. Hexathioureaplumbus nitrate
4. Hexamine cobalt nitrate
5. Manganous ammonium phosphate

Note: Any other relevant experiments may be added

RECOMMENDED BOOKS

1. Vogel's Text Book of Quantitative Inorganic Analysis.
2. W. G. Palmer, Experimental Inorganic Chemistry, Cambridge at the University Press, 1965.
3. M. A. Malati, Experimental Inorganic/Physical Chemistry, Harwood publishingChichester.
4. A.J.E.Welch, Inorganic Preparations, George Allen & Unwin Ltd.

ORAGNIC CHEMISTY PRACTICALS

Semester–I

Qualitative analysis:

1. Separation and identification of the two component mixtures using Chemical and physical methods.(Minimum Five Mixtures)

Demonstrative Experiments:

1. Thin layer chromatography (TLC).
2. Vacuum and steam distillation techniques.
3 Extraction by Soxhlet Method

Semester–II

Preparations:

1) One stage preparations involving various types of reactions (minimum Two)

1. Aldol condensation: Dibenzal acetone from benzaldehyde.
2. Sandmeyer reaction: p- Chlorotoulene from p-toluidine.
3. Cannizzaro reaction: 4-Chlorobenzaldehyde as a substrate.

2) Two stage preparations involving various types of reactions (minimum Four)

1. Aceotophenone- Oxime- Acetanilide
2. Phthalic anhydride- o-Benzoyl benzoic acid- anthraquinone
3. Chloroenzene-2,4-dintrochlorobenzene-2,4-dinitrophenol
4. Benzoin-benzil-benzilic acid
5. Acetanilide-p-bromoacetanilide-p-bromoaniline
6. Acetanilide-p-nitroacetanilide-p-nitroaniline

3) Estimations: (minimum Two)

1) Estimation of amine by acetylation method.
2) Estimation of hydroxyl group by acetylation method
3) Estimation of an iodine value of an oil or fat.
4) Determination of percentage of Keto-enol form.

(Any other suitable experiments may be added)**.**

RECOMMENDED BOOKS

1. A text book of practical Organic Chemistry- A. I. Vogel.
2. Practical organic Chemistry- Mann and Saunders.
3. A handbook of quantitative and qualitative analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.
5. Systematic Lab Experiments in Organic Chemistry by ArunSethi
6. Advanced practical chemistry by Jagdamba Singh

M.Sc.- I Semester-I
Physical Chemistry Practicals

NON-INSTRUMENTAL

Kinetics

1. To investigate the auto-catalytic reaction between potassium permanganate and oxalic acid.
2. Iodonation of acetone
3. Determination of energy of activation of acid catalyzed hydrolysis of an ester.

Viscosity

1. Determine the molecular weight of PVA by viscosity measurements.

Adsorption

1. Acetic acid on activated animal charcoal

Phase Equilibria :-

1. Three component system: Acetic acid, chloroform, water
2. To determine the CST of phenol-water system in presence of 1% NaCl

Surface Tension:

1. To determine the surface tension of a liquid by stalagmometer (drop number method)

INSTRUMENTAL

Refractometry

1. To determine the structure of given Organic Liquids

2. **pHmetry:**

1. Determination of pKa of dibasic acid (Oxalic acid)
2. Determination of hydrolysis constant of aniline hydrochloride

Conductometry

1. Titration of $ZnSO_4$ / $MgSO_4$ against $BaCl_2$ and $Ba(CH_3COO)_2$ and calculation of amount of Sulphate Present .
2. Conductometric estimation of NH_4Cl with NaOH solution.

Potentiometry

1. To determine the basicity and pKa value of organic acids by potentimetric method. (Orthophosphoric acid)
2. Determine the solubility and solubility product of sparingly soluble salts.

Semester-II

NON-INSTRUMENTAL

Kinetics

1. Determination of order of reaction by differential method
2. Comparison of acid strength by hydrolysis of ester

Viscosity

1. To determine the radius of molecule by viscosity measurements. (glycerol / sucrose)

Adsorption

1. Oxalic acid on activated animal charcoal

Phase Equilibria :-

1. Three component system: Benzene, ethyl alcohol and water
2. To determine the CST of phenol-water system in presence of 0.5% naphthalene (or 1% succinic acid)

Surface Tension:

1. To determine the atomic parachor of C, H and Cl by surface tension measurements.

INSTRUMENTAL

Refractometry

1. To determine the electron polarization and electron polarizability of a liquid.

2. **pHmetry:**

1. Determination of pKa of acid (Succinic acid)
2. Determination of hydrolysis constant of aniline hydrochloride

Conductometry

1. Solubility and solubility product of spranigly soluble salts.
2. Titration of a mixture of HCl, CH_3COOH and $CuSO_4$ against alkali.

Potentiometer

1. Estimate the amount of halides present in the given mixture by titrating with $AgNO_3$ solution.
2. Titration of mixture of acids with base.

Polarimetry

1. To determine the percentage of two optically active substances (d-sucrose and d-tartaric acid) in a given solution.

Each candidate has to perform minimum 12 experiments (at least one from each technique) in each semester. Any other relevant experiments may be added.

RECOMMENDED BOOKS

1. Findlay's Practical Physical Chemistry by J.A. Kitchnar
2. Text-book of Quantitative Inorganic Analysis including elementary

Instrumental Analysis- A.I.Vogel, Revised by J.Bassott, R.C.Banney

3. Experimental Physical Chemistry – F.Daniels&J.Williams
4. Experimental Physical Chemistry – R.C.Das&B.Behra
5. Systematic experimental Physical Chemistry by- Rajbhoj and Chondhekar.
6. Experimental physical Chemistry- V.D. Athawale and P. Mathur
7. Advanced practical physical Chemistry- J. B. Yadav
8. Advanced physical Chemistry Experiments- Gurtu and Gurtu

Analytical Chemistry Practicals

Semester I

A) Inorganic Analytical Chemistry

1. Determination of calcium from given drug sample.
2. Determination of hardness, alkalinity and salinity of water.
3. Separation and estimation of chloride and bromide on anion exchanger
4 To determine the amount of Cu in brass metal alloy titrimetrically
5 Separation and estimation of Fe and Al on cation exchanger

B) Organic Analytical Chemistry

1. Analysis of Pharmaceutical tablets.
2. To verify the Beer-Lambert's Law and determine the concentration of given dye solutioncolorimetrically.
3. To determine the acid value of given oil.
4. Separation of mixture of o-and p-nitroanilines on an alumina column..
5. Determination of uric acid / createmins in urine.
6. Analysis of pharmaceutical tablet lbrufen
7. Estimate amount of endosulphon.

C) Analytical Physical Chemistry

1. To Verify Beer –Lambert's Law for solution of $KMnO_4$ in water and in acid medium Colorimetrically
2. To determine the solubility of calcium Oxalate in presence of KCI (Ionic Strength Effect)
3. To determine the solubility of calcium Oxalate in presence of HCI (H^+ ion Effect)
4. To determine the pKa value of dibasic acid (malonic) by pHmetery.
5. To determine the amount of carbonate & bicarbonate by potentiometrically.
6. Estimate the concentration of H_2SO_4, CH_3COOH and $CuSO_4$ by conductometric titration with NaOH solution.

Semester II

A) Inorganic Analytical Chemistry

1. Determination of sodium from the fertilizer sample using cation exchange chromatography.
2. Determination of Zn and Cd from the given solution by using anion exchanger resin
3. Separation and estimation of Ni and Co on anion exchanger
4. Estimation of Pb and Sn in solder alloy
5. Determination of Mo, Fe, by solvent extraction using isopropyl alcohol as solvent.

B) Organic Analytical Chemistry

1. To estimate the amount of D-glucose colorimetrically
2. To separate a mixture of 2,4-dinitrophenyl hydrazones by adsorption chromatographic technique.
3. Analysis of pharmaceutical tablet Analgin.
4. Caffeine in Tea Powder.
5. Determination of percentage purity of given olefinic compound by bromination method.
6. Colorimetric estimation of drugs.

C) Analytical Physical Chemistry

1. To Verify Beer –Lambert's Law for $K_2Cr_2O_7$ in water and in acid medium colorimetrically
2 .To determine the solubility of lead iodide in different concentrations of KCI (Ionic Strength Effect)
3. To determine the solubility of lead iodide in different concentrations of KNO_3 (Ionic Strength Effect)
4. To determine the amount of carbonate & bicarbonate by pHmetry
5. To determine the concentration of vinegar conductometrically.
6. To estimate the amount of D-glucose in given solution polarimetrically.

Minimum three experiments from each section may be conducted during each semester. However, the total number of experiments conducted should be commensurate with the facilities and time available.

Any other relevant experiments may be added.

RECOMMENDED BOOKS

1. A text book of quantitative inorganic analysis, A.I. Vogel
2. Standard methods of chemical analysis, F. J. Welcher
3. Experimental Inorganic Chemistry, W. G. Palmer
4. Manual on water and waste-water analysis, NEERI, Nagpur; D.S. Ramteke and C.A. Moghe
5 .Inorganic synthesis, King
6. Synthetic inorganic chemistry, W. L. Jolly
7. EDTA titrations, F. Laschka
8. Experimental physical Chemistry- V.D. Athawale and P. Mathur
9. Advanced practical physical Chemistry- J. B. Yadav
10. Advanced physical Chemistry Experiments- Gurtu and Gurtu
11. Practical organic Chemistry by F. G. Mann, B. C. Saunders
12. Quantitative organic analysis, A.I. Vogel