Solapur University, Solapur
School of Chemical Sciences
M. Sc. I
(w.e.f. June 2016)

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)**

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

4. **M.Sc. (Chemistry)(Physical Chemistry**), DBF Dayanand College of Arts and Science, Solapur
5. **M.Sc. (Chemistry)(Analytical Chemistry**), KBP College, Pandharpur
6. **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 6).**

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	70	30	100	4	--	-	4
	HCT-102	Organic Chemistry -I	70	30	100	4		-	4
	HCT-103	Physical Chemistry -I	70	30	100	4		-	4
		Soft Core (Any one)							
	SCT-104A	Analytical Chemistry -I	70	30	100	4		0	4
	SCT-104B	Chemistry in Life Sciences	70	30	100	4		0	
		Practicals							
	HCP-I	Inorganic Chemistry	35	15	50	-	-	2	6
	HCP-I	Organic Chemistry	35	15	50	-	-	2	
	HCP-II	Physical Chemistry	35	15	50	-	-	2	
		Soft core (Any one)							
	SCP-IIA	Analytical Chemistry	35	15	50	-	-	2	2
	SCP-IIB	Analytical Chemistry	35	15	50	-	-	2	
	T-1	Tutorial					25		1
		Total for 1st semester	**420**	**180**	**600**		**25**		**25**
II		**Hard core**							
	HCT-201	Inorganic Chemistry -II	70	30	100	4	--	-	4
	HCT-202	Organic Chemistry -II	70	30	100	4		-	4
		Soft core (Any one)							
	SCT-203A	Physical Chemistry -II	70	30	100	4		-	4
	SCT-203B	Green Chemistry	70	30	100	4		-	
		Open elective (Any one)							
	OET-204A	Instrumental Methods of	70	30	100	4		-	4

		Analysis							
	OET-204B	Medicinal Chemistry -I	70	30	100	4		-	
		Practicals							
	HCP III	Inorganic Chemistry	35	15	50	-	-	2	4
	HCP III	Organic Chemistry	35	15	50	-	-	2	
		Soft core (Any one)							
	SCP IVA	Physical Chemistry	35	15	50	-	-	2	2
	SCP IVB	Physical Chemistry	35	15	50	-	-	2	
		Open elective (Any one)							
	OEP IVC	Analytical Chemistry	35	15	50	-	-	2	2
	OEP IVD	Medicinal Chemistry	35	15	50	-	-	2	
	T-2	Tutorial					25		1
		Total for 2nd semester	**420**	**180**	**600**		**25**		**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

Nature of question paper (M. Sc. I):

Time: 2.5 hours Maxi Marks 70

Instructions

1. Attempt 05 questions.
2. Section I (question 1) is compulsory
3. Attempt any two questions from section II and any two questions from section III.
4. Answers to all 05 questions (from section I, II, III) should be written in the one and the same answer book.
5. All questions carry equal marks.
6. Figures to the right indicate full marks.
7. Use of log tables and calculators is allowed.

Question Paper

Section I

Q 1. Answer the following (14 sub-questions) Marks 14 (1 x 14)

Multiple choice / fill in the blanks / define the term / True-False, predict the product, provide the reagent and conditions etc.

Sub-questions (i) to (xiv)

Section II

Q 2. a) - --- -- - - - - - - - Marks 07
b) - - - - - - - - - - - - Marks 07

Q 3. a) - --- -- - - - - - - - Marks 07
b) - - - - - - - - - - - - Marks 07

Q 4. a) - --- -- - - - - - - - Marks 07
b) - - - - - - - - - - - - Marks 07

Section III

Q 5. a) - --- -- - - - - - - - Marks 05
b) - - - - - - - - - - - - Marks 05
c) - - - - - - - - - - - - Marks 04

Q 6. a) - --- -- - - - - - - - Marks 05
b) - - - - - - - - - - - - Marks 05
c) - - - - - - - - - - - - Marks 04

Q 7. Write short notes on (any three) Marks 14

a) - - - - - - - - - - - -
b) - - - - - - - - - - - -
c) - - - - - - - - - - - -
d) - - - - - - - - - - - -

N.B. In sections II and III, the sub-questions (a, b, and c) in a given question should be from different topics of the syllabus.

At least 25 % questions should be problem oriented, where-ever possible, in view to train students for the SET/NET/GATE and other competitive examinations. These questions should test the understanding of candidate rather than the memory. The question paper should cover all the Units included in the syllabus of the respective paper and the weightage of the questions should correspond to the number of lectures allotted to the respective Units / Topics.

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

Unit-I: Wave Mechanics (15)

Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, matter waves, wave nature of the electron, the wave equation, the particle in one dimensional box, the particle in three dimentional 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: 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, metal clusters, metal carbonyls.

Unit-III: 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-III: 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-IV: 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.

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, Harper and Row Publisher Inc., New York (1972)
3. J. D. Lee, Concise Inorganic Chemistry, ELBS with Chapman and Hall, London
4. A.R. West, 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

(a) Reaction mechanism: Structure and reactivity (7)

Types of reactions, strength of acids and bases. Generation, structure, stability and reactivity of reaction intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, benzynes and ylides. Effect of structure on reactivity: resonance, steric, hyperconjugation effects

(b) Aliphatic Nucleophilic substitutions: (8)

The SN^2, $SN^1$and SN^i with respect to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. SN reactions at bridged head carbon, competition between SN^1 and SN^2, ambident nucleophiles, Neighbouring Group Participation.

Unit - II

(a) Aromatic Electrophilic Substitutions: (8)

Introduction, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in monosubstituted aromatic systems, energy profile diagrams. The ortho / para ratio, ipso attack, orientation in other ring systems (naphthalene, anthracene, 5 and 6 membered aromatic heterocyclic compounds). Diazo-coupling, Vilsmeir reaction, Gatterman-Koch reaction. Nucleophilic aromatic substitution reactions SN_1 ,$SN_2$and Arynes.

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

Mechanism and stereochemical aspects of the addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemo – selectivity, orientation and reactivity. Hydrogenation of double, triple bonds and aromatic rings. Michael reaction. Sharpless asymmetric epoxidation.

Unit - III

(a) Elimination Reactions: (8)

The E1, E2 and E1cB mechanisms. Orientation in Elimination reactions. Hofman versus Saytzeff elimination. Reactivity: effects of substrate structures , attacking base, the leaving group, the nature of medium on elimination reactions, competition between substitution and elimination reactions, pyrolytic elimination reactions.

(b) Rearrangements: (7)

Study of following rearrangements with mechanism and stereochemistry**:** Beckman, Fries, Hoffman, Schmidt, Curtius ,Lossen, Claisen, Benzilic acid, Wolff, Steven's &Sommelet-Hauser**.**

Unit – IV

Stereochemistry: (15)

Isomerism, classification of isomers (constitutional and stereoisomers). Concept of Chirality: Recognition of symmetry elements and chiral structures, Prochiral relationship. Racemic modifications and their resolution. R and S nomenclature. Geometrical isomerism E and Z omenclature., Erythro and Threo nomenclature, Conformational analysis of mono and isubstitutedcyclohexanes (stability and reactivity), representation of conformational isomers.

RECOMMENDED BOOKS

1) A guide book to mechanism in Organic Chemistry (Orient-Longmens)- Peter Sykes
2) Organic reaction mechanism (Benjamin) R. Breslow
3) Mechanism and structure in Organic Chemistry (Holt Reinh.)B. S. Gould.
4) Organic chemistry (McGraw-Hill) Hendrickson, Cram and Hammond.
5) Basic principles of Organic Chemistry (Benjamin) J. D.Roberts and M. C. Caserio.
6) Reactive Intermediates in Organic Chemistry (John Wiley) N. S. Issacs.
7) Stereochemistry of Carbon compounds. (McGraw-Hill)E.L.Eliel
8) Organic Stereochemistry (McGraw-Hill) by Hallas.
9) Organic reaction mechanism (McGraw-Hill) R. K. Bansal.
10) Organic Chemistry- R. T. Morrison and R. N. Boyd,(Prentice Hall.)
11) Modern organic reactions (Benjumin) H. O. House.
12) Principle of organic synthesis- R.O.C. Norman and J. M. Coxon.(ELBS)
13) Reaction mechanism in Organic Chemistry- S. M. Mukharji and S. P. Singh.
14) Stereochemistry of Organic Compounds) D. Nasipuri.
15) Advanced Organic Chemistry (McGraw-Hill) J. March.
16) Introduction to Stereochemistry (Benjumin) K. Mislow.
17) Stereochemistry by P. S. Kalsi (New Age International)

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

Unit-1: 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-2A:Thermodynamics of Solutions [5]

Thermodynamics of ideal solutions, Raoult's and Henrey's law, Excess and mixing thermodynamic properties of Non- ideal solutions and their determination.

Unit-2B:Fast Reactions: [10]

Study of kinetics by stop-flow technique, relaxation method, flash photolysis and magnetic resonance method, pressure jump method.

(More stress should be given in solving the numerical problems).

Unit-3: 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.

Unit-4: Colloids and macromolecules [15]

Colloids : Types of colloids, preparation and properties of colloids, surfactant: classification, micelle formation, critical micelle concentration, structure of micelle.

Macromolecules: Polymerization, mechanism and kinetics of Free radical polymerization, Step growth polymerization (Polycondensation), and ionic (cationic and anionic) chain polymerizations. Molecular weight of polymer, Number average, weight average, Viscosity average molecular weight, numerical problems on molecular weights. Degree of polymerization and molecular weight, methods of determination of molecular weights: Osmometry, Viscometry, Light scattering.

RECOMMENDED BOOKS

1. Physical Chemistry- P.W. Atkins
2. Text book of physical chemistry- S.Glasstone
3. Principles of Physical Chemistry – Marron and Prutton
4. Physical Chemistry- G.M.Barrow
5. Thermodynamics for chemists – S.Glasstone
6. Thermodynamics – Lewis and Randall, revised by Pitzer
7. Physical Chemistry of macromolecules –D D.Deshpande
8. Polymer Chemistry – F.Billimeyer
9. Kinetics and Mechanism – Frost and Pearson
10. Chemical and Kinetics by K. J. Laidler
11. An Introduction to Statistical Thermodynamics – T.L. Hill, Addison-Wesley. 1960.
12. Statistical Mechanics – Donald A. McQuarrie, 2000.
13. Elements of statistical thermodynamics - L. K. Nash, 2nd Ed. Addison Wesley. 1974.
14. Introduction to Colloid and Surface Chemistry – D. Shaw, Butterworth Heinemann, 1992.

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

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-2: Chromatographic Methods (15)

General principles, Classification of Chromatographic methods. Nature of partition forces, Chromatographic behavior of solutes, coloumn efficiency and resolution. Gas Chromatography: Theory and Instrumentation, column types, solid-liquid stationary phases, column switching techniques, basic and specialized detectors.

High Performance Liquid Chromatography: Theory and instrumentation, adsorption and applications.

Unit-3: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-4: Computer for Chemists: (15)

Introduction: Software: Overview of the key elements of basic programme structure, loops, arrays, mathematical functions. User defined functions, Conditional statements, strings, Applications, Data representation, Computerized instrument systems, Microcomputer interfacing.

Linear regression, X-Y plots, numerical integration and differentiation, operating with softwares such as PCMODEL, WINMOPAC, word processing, use of MSWORD, powerpoint and EXCEL in chemistry, use of internet.

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-104B

Unit 1 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.

Reference 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

(a) Study of following reactions with mechanism: (7)

Dieckmann, Benzoin, Favorskii reaction, Reimer-Tieman, Stobbe, Diels-Alder, Robinson annulation, Chichibabin, Simon- Smith, Ulhmann, Mc. Murry and Dakin.

(b)Reagents in organic syntheses: (8)

Complex metal hydrides, LDA, dicyclohexylcarbodiimide(DCC), PTC, crown ethers, Merrifield resin, Peterson's synthesis, 1,3-dithiane, diazomethane, DDQ.

Unit – II

(a) Reduction: (7)

Study of following reductions: Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, MeerweinPondorffVerley, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol.

(b) Oxidation: **(8)**

Application of following oxidizing agents: $KMnO_4$, chromium trioxide (Jone's reagent, PCC, PDC), Manganese dioxide, Osmium tetraoxide, Oppenauer oxidation and Lead tetra-acetate., Hydrogen peroxide, Baeyer-Villiger oxidation, Prevost-Woodward hydroxylation by silver oxide.

Unit – III

(a) Study of Organometallic compounds: **(8)**

Organo-magnesium, Organo-zinc, Organo-lithium, organo-copper and organo-tin reagents. Addition reactions: Additions to carbonyl and unsaturated carbonyl compounds, Witting reaction.

(b) Methodologies in organic synthesis: (7)

Ideas of synthons and retrones, functional group transformation and interconversions of Simple functionalities.

Unit – IV

(a) Hydroboration: Mechanism and synthetic applications **(5)**

(b) Enamines :Formation and reactivity of enamines **(5)**

(c) Protection of functional group: Principle of protection of alcohol, amine, carbonyl and carboxyl group**.** **(5)**

RECOMMONDED BOOKS

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

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

Unit-1: Photochemistry-I **[15]**

Introduction, Absorption of light and nature of absorption spectra, electronic transitions, Franck–Condon principle, electronic excitation, photodissociation and Predissocition, photoreduction, photooxidation, photochemistry in environment (Green house effect, ozone depletion).

Unit-2: 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-3A:Electrochemistry **[9]**

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-3B:Bio-Physical Chemistry **[6]**

Introduction to Biophysical chemistry, structure and functions of proteins, folding and defolding phenomena, Nucleic acids (DNA and RNA). Bioenergetics: Standard free energy change in biochemical reactions, exergonic and enderogonic, synthesis of ATP.

Unit-4: 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. Principles of Biochemistry – A. L. Lehninger
11. Biochemistry - L. Stryer, W. H. Freeman
12. Biochemistry – J. David Rawn
13. Physical Chemistry: A molecular Approach – Donald A. McQuarrie and John D. Simon, Viva Books, New Delhi, 1998.
14. Introduction to Photochemistry-Wells
15. Electrolytic Solutions by R. A. Robinson and R. H. Strokes, 1959
16. Basic chemical Kinetics- G. L. Agarwal, Tata-McGraw Hill

M.Sc.- I (Semester-II)

Green Chemistry-I

Paper No. SCT – 203B

UNIT I

1. Green chemistry: 15hr

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.

2. **Hazard assessment and mitigation in chemical industry**

UNIT II

3. Basic principles of Green Chemistry and their illustrations with examples. 15 hr

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 II

4. Examples of green synthesis/reaction and development of analytical technique 15hr

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

5. Future trends in Green Chemistry: 15hr

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

Reference 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)
Instrumental Methods of Analysis
Paper No. OET-204A

Unit-1: A) Ultraviolet and visible Spectrophotometry (8)

Introduction, Beer Lambert's law. Instrumentation, calculation of absorption maxima of dienes, dienones and polyenes, Qualitative and Quantitative applications .

Unit-1: B)Infra-red spectroscopy (7)

Introduction, instrutnentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications.

Unit-2: Nuclear Magnetic Resonance (15)

NMR: Introduction, principle, magnetic and nonmagnetic nucler , processional motion, Larmor frequency, absorption of radio frequency, Instrumentation (FT-NMR). Sample preparation, shielding and deshielding effects, chemical shift, internal standards, factor influencing chemical shifts, solvent used, peak area and proton ratio, anisotropic effect, spin-spin coupling, coupling constant and application to simple structure problem.

Unit-3: A) Mass spectroscopy (8)

Principle, working of mass spectrometer (double beam). Formation of different types of ions, Mc Lafferty rearrangements, fragmentation of alkanes, alkyl aromatics, alcohols and ketones in brief simple applications.

Unit-3: B) Simple structural problems based on IR,UV, NMR and MS. **(7)**

Unit-4: 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-4: B) Inductively Coupled Plasma Spectroscopy (7)

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

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).

M. Sc.-I (Semester-II)

Medicinal Chemistry

Paper No. OET-204B

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

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.

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