Shri Sangameshwar Education Society's

Sangameshwar College [Autonomous], Solapur

(Affiliated to Punyashlok Ahilyadevi Holkar Solapur University, Solapur) Kannada Linguistic Minority Institute

NAAC Accredited with 'A' Grade (III Cycle CGPA 3.39)

Name of the Faculty: Science

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus: CHEMISTRY

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

Organic Chemistry

(Syllabus to be Implemented from w.e.f. June 2021-22)

Sangameshwar College [Autonomous], Solapur

Academic Council 4(4.3)
26th March 2022

M. Sc. I Organic Chemistry Syllabus

(w.e.f. Academic Year 2021-22)

System: Choice Based Credit System (CBCS)

M. Sc. I Structure

Semester	Code	Title of the Paper	Semester exam			L	T	P	Credits
I		**Hard core**	**SEE**	**CA**	**Total**				
	HCT-1.1	Inorganic Chemistry -I	70	30	100	4	--	-	4
	HCT-1.2	Organic Chemistry -I	70	30	100	4		-	4
	HCT-1.3	Physical Chemistry -I	70	30	100	4		-	4
		Soft Core (Any one)							
	SCT-1.1	Analytical Chemistry-I	70	30	100	4		0	4
	SCT-1.2	Chemistry in Life Sciences	70	30	100	4		0	
		Practical							
	HCP-1.1	Inorganic Chemistry Practical	35	15	50	-	-	2	6
	HCP-1.2	Organic Chemistry Practical	35	15	50	-	-	2	
	HCP-1.3	Physical Chemistry Practical	35	15	50	-	-	2	
		Soft core (Any one)							
	SCP-1.1	Analytical Chemistry Practical	35	15	50	-	-	2	2
	SCP-1.2	Chemistry in Life Science Practical	35	15	50	-	-	2	
	T1	Tutorial			25	-	-		1
		Total for first semester	**420**	**180**	**625**				**25**
II		**Hard core**	**SEE**	**CA**	**Total**				
	HCT-2.1	Inorganic Chemistry -II	70	30	100	4	-	-	4
	HCT-2.2	Organic Chemistry -II	70	30	100	4	-	-	4
		Soft core (Any one)							
	SCT-2.1	Physical Chemistry -II	70	30	100	4	-	-	4
	SCT-2.2	Green Chemistry	70	30	100	4	-	-	
		Open elective (Any one)							
	OET-2.1	Medicinal Chemistry-I	70	30	100	4		-	4
	OET-2.2	Analytical Chemistry-II	70	30	100	4		-	
		Practical							
	HCP-2.1	Inorganic Chemistry Practical	35	15	50	-	-	2	2
	HCP-2.2	Organic Chemistry Practical	35	15	50	-	-	2	2
		Soft core (Any one)							
	SCP-2.1	Physical Chemistry Practical	35	15	50	-	-	2	2
	SCP-2.2	Green Chemistry Practical	35	15	50	-	-	2	
		Open elective (Any one)							
	OEP-2.1	Analytical Chemistry Practical	35	15	50	-	-	2	2
	OEP-2.2	Medicinal Chemistry Practical	35	15	50	-	-	2	

	T2	Tutorial			25	-	-	-	1
		Total for second semester	420	180	625				25

L: Lecture, T: Tutorials, P: Practical, SEE: Semester End Examination ,

CA: Continuous assessment

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

Program Outcomes (POs)

Sr No.	After completion of program students will be able to
PO 1	Apply their basic knowledge in various advanced chemistry fields such as Spectroscopic techniques, Organic synthesis, Reagents, Disconnections etc.
PO 2	Play the role of organic chemist in Society and also for environmental benignity
PO 3	Able to think and apply their organic subject skills to build a small-scale startup
PO 4	Acquire skills namely critical thinking, problem solving approach in the various fields of chemistry
PO 5	Publish/communicate the research works in oral and writing manner

Program Specific Outcomes (PSOs)

Sr No.	Up on successful completion of program candidate will be able to
PSO 1	Get enormous placement opportunities in Research and Development cell of pharmaceutical polymer and chemical industries.
PSO 2	Acquire various research skills through advanced synthesis practicals for their Doctoral studies in chemistry as well as various fields of science and technology.
PSO 3	Educate with advanced organic chemistry concepts beneficial in CSIR NET, GATE, and SET examination
PSO 4	Get an opportunity to work as Research Assistant (Project Assistant) in IIT's, IISER, CSIR-Labs

M. Sc. Part-I (Semester-I)

Academic Council 4(4.3)
26th March 2022

Inorganic Chemistry– I (2194101)

Paper No. HCT – 1.1

Hours: 60 Marks: 100

Credits: 4

Learning Objectives:

1. To study coordination chemistry, distortion, ligand field theory, energy parameters
2. To understand and know about electronic spectra of 3d series transition metal complexes, term symbols, and Orgel diagrams
3. To learn the magnetic properties of complexes
4. To understand the types and bonding in organometallic compounds
5. To imagine and execute the realization of stereochemistry in inorganic compounds

Course Outcome:

After the end of course student can:

1. Understand the importance of spectroscopic terms, selection rules, electronic spectra of complexes, Orgel diagrams
2. Easily distinguish amongst diamagnetism, paramagnetism, ferromagnetism in complexes etc. The different formulae to calculate magnetic moment for 3d and higher transition elements series.
3. Able to draw the important Walsh diagram and visualize the stereochemistry of inorganic compounds
4. Able to distinguish between metal clusters carbonyls and their classification. Also, the bonding and application of 18 e- rule.

Unit I: Chemistry of Transition Elements (15)

Introduction, Co-ordination chemistry of transition metal ions, splitting of d orbitals in cubic and low symmetry environment, Tetragonal distortion of Octahedral Complexes, CFSE, Factors Affecting Crystal Field Parameters, Strong and Weak Field Complexes, Spectrochemical Series, Nephelauxetic effect and Nephelauxetic series, Ligand field theory, ligand field energy parameters (Racah parameters B and C, Slater Condon Parameters, Slater Condon Shortley Parameters),

Unit II: Electronic Spectra of Transition metal complexes (15)

Energy Levels, Spin-Orbit Coupling, Term symbol, Microstates, Electronic spectra of

transition metal complexes, selection rules (Laporte and Spin), Orgel diagrams for octahedral and tetrahedral complexes (3d series), charge transfer spectra, calculation of Dq, Percentage of covalent character for transition metal complexes

Unit III: Magnetic Properties of Coordination complexes and Stereochemistry and Bonding

A) Magnetic properties of coordination complexes (08)

Origin magnetism, types of magnetism, Curie law, Curie-Weiss Law (graphical representation with explanation), Magnetic properties of complexes-Para magnetism, quenching of orbital angular momentum by Ligand fields

B) Stereochemistry and Bonding (07)

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 (atomic inversion, Berry pseudorotation, nucleophilic displacement, free radical reaction).

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 [$V(CO)_6$, $Cr(CO)_6$, $Ni(CO)_4$, $Fe(CO)_5$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$], 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. F. A. Cotton and R.G. Wilkinson, Advanced Inorganic Chemistry, Wiley Students Edition
5. Coordination Chemistry by R. Gopalan and V. Ramlingam
6. Principals of Inorganic Chemistry by B. R. Puri, L. R. Sharma, K. C. Kalia
7. Williams and L. Jooly, Modern Inorganic Chemistry, McGraw-Hill International Edition
8. Manas Chanda, Atomic Structure and Bonding, TMH Publication
9. N. N. Greenwood and A. Earnshaw, Chemistry of Elements, Pergamon
10. J. J. Lipard, Progress in Inorganic Chemistry, Vol 18 and 38,Wiley
11. E. Konig, Structure and Bonding, Vol 9, 1971,175

10. Inorganic Chemistry by Shriver and Atkins
11. Inorganic chemistry by Principle of Structures and Reactivity by Huheey, Keiter, Medhi
12. Inorganic Chemistry by Catherine Housecraft
13. Inorganic Chemistry by Meissler and Tarr
14. Ligand field theory and its applications by B.N. Figgis and M.A. Hitachman
15. Symmetry and spectroscopy of molecules by K. Veera Reddy
16. Elements of Magneto chemistry by R. L. Datta and A. Syamal
17. Organometallics by Christoph Elschenbroich
18. Organometallics by A Concise Introduction by Christoph Elschenbroich and Albrecht Salzer
19. Basic Organometallic Chemistry by B. D. Gupta and A. J. Elias

M. Sc.-I (Semester-I)

Academic Council 4(4.3)
26th March 2022

Organic Chemistry-I (2194102)

Paper No. HCT 1.2

Hours: 60 Marks: 100

Credits: 4

Learning Objectives:

1. To study nature of bonding in simple and complex organic molecules
2. To study the concept of aromaticity and its application to simple and complex organic molecules.
3. To inculcate the detailed basics of reaction mechanism and various intermediates
4. To understand the aliphatic nucleophilic substitution reaction at various centers. Mainly at allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons.
5. To inculcate imagination and critical thinking of real shapes of organic compound by using 3D models.
6. To study and understand the critical rearrangement reactions with their mechanisms.

Course Outcome:

After the end of course student can:

1. Understand the basics of bonding and able to draw correct structure of any organic molecule and comment on its stability.
2. Easily comment on aromaticity of any organic compound and its stability.
3. Understand the nucleophilic substitution and its facilitation via neighboring group participation.
4. Able to think and predict the possible mechanism of various critical organic reactions.
5. Able to imagine structure of molecules in 3D manner. Various important configurations such as R/S, E/Z Nomenclature and detailed conformational isomerism.

Unit-I: Bonding, Structure & Reactivity

A)**Nature of Bonding in Organic Molecules** **(08)**

Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyperconjugation, tautomerism. Aromaticity, Aromaticity in benzenoid and non-benzenoid compounds, Hückel rule, energy level of π-molecular orbitals, annulenes, crown ether complexes and cryptands, inclusion compounds.

B)**Reaction Mechanism: Structure and Reactivity** **(07)**

Generation, structure, stability and reactivity of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes, Arynes. Effect of structure on reactivity, resonance, steric and hyperconjugation effects. The Hammett equation, Linear free energy relationship, Substituents and reaction constants, Taft equation.

Unit II Aliphatic Nucleophilic substitutions (15)

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. Competition between SN^1 and SN^2, ambident nucleophiles, Neighboring Group Participation.

Unit-III: Stereochemistry (15)

Elements of symmetry, 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. Conformational analysis of cycloalkanes, Mono and disubstituted cyclohexanes, decalins, effect of conformation on reactivity

Unit IV: Rearrangements: (15)

Study of following rearrangements with mechanism, nature of migration and stereochemical aspects**:** Beckman, Hoffman, Schmidt, Curtius, Lossen, Benzilic acid, Wolff, Steven's & Sommelet- Hauser, Neber, Favorskii, Pumerer, Rupe.

RECOMMENDED BOOKS

1. Advanced Organic Chemistry, IV Edition: J. March
2. Stereochemistry of Carbon Compounds: E. L. Eliel
3. Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.
4. A Guide Book to Mechanism in Organic Chemistry: Peter Sykes.
5. Principles of Organic Synthesis: R. O. C. Norman
6. Stereochemistry of Organic Compounds: D. Nashipuri
7. Organic Chemistry: Clayden and Greeves
8. Mechanism and Structure in Organic Chemistry: E. S. Gould

Academic Council 4(4.3)
26th March 2022

Physical Chemistry-I (2194103)

Paper No. HCT-1.3

Hours: 60 Marks: 100

Credits: 4

Learning Objectives:

1. To study the quantum chemistry, importance quantum mechanics.
2. To study several laws of thermodynamics. Also, to understand the new concepts of activity, fugacity, and derivation of phase rule etc.
3. To deeply understand the concepts of Thermodynamics of solution and statistical thermodynamics

Course Outcome:

After the end of course student can:

1. Understand the Schrodinger wave equation, particle in one dimensional box, the particle in three-dimensional box.
2. Know about different laws of thermodynamics. Also able to derivations of Maxwell's Relations and Phase rule.
3. Be conceptually strong in basics and advanced levels of thermodynamics of solutions and statistical thermodynamics.

Unit-I: Wave Mechanics **(15)**

Introduction, Schrodinger wave equation, conditions for acceptable wave functions, linear operators, normalization and orthogonality, Eigen functions and Eigen values, postulates of quantum mechanics. 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. Transition dipole moment integral and selection rules, intensity of absorption bands, particle in a box applicable to electronic spectra of conjugated organic molecules.

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. Chemical potential, various forms of chemical potentials, effect of temperature and pressure on chemical potential, 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, vapour pressure curves of binary liquid mixtures (both as function of liquid and vapour compositions), azeotropic mixtures 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. Partition function and its significance, Rotational. Translationl, vibrational partition functions. Relationship between partition function and thermodynamic properties. Thermodynamic probability and and entropy, Sackur-Tetrode equation and numerical problems, Maxwell-Boltzmann (MB) distribution law and its Physical significance.

RECOMMENDED BOOKS

1. Quantum Chemistry- R. K. Prasad
2. Quantum Chemistry – Donald A.Mac Quarrie
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 andPearson
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.

M. Sc.- I (Semester-I)

Academic Council 4(4.3)
26th March 2022

Analytical Chemistry-I (2194104)
Paper No. SCT-1.1

Hours: 60 Marks: 100
Credits: 4

Learning Objectives:

1. To study statistical data analysis in chemistry.
2. To study the advanced techniques such as Thermo gravimetric analysis, Electron Spin Resonance and Mössbauer Spectroscopy.
3. To aware students about current trends in research.

Course Outcome:

After the end of course student can:

1. Understand the basics of spectroscopic techniques.
2. Know about thermal stability of compounds. Also, the variation of physical state with temperature graphically.
3. Able to find the number of lines in ESR spectrum of simple molecules.
4. Able to understand the Mössbauer effect to the investigations of compounds of iron (Fe) and tin (Sn).
5. Understand the importance of research. Able to find research papers and aware about current trends in research.
6. Become familiar with Scopus, H-index, reviewed research journals, Scientific writing etc.

Unit I: 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: Thermal method of analysis (15)

Thermo gravimetriy [TG], Differential Thermal Analysis [DTA], Differential Scanning Calorimetric [DCS], Thermo Mechanical Analysis [TMA] Instrumentation and Applications, Thermometric Titrations.

Unit III: Electron Spin Resonance [ESR] & Mössbauer Spectroscopy

A) **Electron Spin Resonance [ESR]** **(07)** Principle of ESR, Hyperfine Splitting in Simple Systems, Instrumentation, Factors affecting **g** values, Applications to few inorganic complexes.

B) Mössbauer Spectroscopy **(08)**

Introduction to Mössbauer effect, Recoilless Emission & Absorption of X‑rays, Instrumentation, Isomer shift, Quadrapole splitting and hyperfine interactions, application of Mössbauer effect to the investigations of compounds of iron (Fe) and tin (Sn).

Unit IV: Research, Software Tools and Their Use: **(15)**

Research, Access of research journals/papers, Scientific writing, Scopus, Scholar, Web of Science, Research Gate, Citation-index, Introduction to software useful for chemists, An overview: Origin, CHEM DRAW, Sci-Finder, MS Office, X-Y plots.

RECOMMENDED BOOKS

1. Analytical Chemistry (J.W.)-G. D. Christian.
2. Instrumental Methods of Analysis (CBS)-H. H. Willard, L. L. Merrit, J. A. Dean & F. A. Settle.
3. Instrumental Methods of Analysis: Chatwal and Anand.
4. Physical Methods in Inorganic Chemistry by R. S. Drago
5. Fundamentals of Molecular Spectroscopy by C. N. Banwell
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. Computer, Fundamentals-P. K. Sinha.
10. Computational Chemistry- G. Grant and W. Richards, Oxford UniversityPress.
11. Computer for chemists by S. K. Pundir and A.Ban
12. Mössbaur Spectroscopy, Greenwood N.N., Gibbs T.C., Chapmann Hall, 1971.
13. Spectroscopy in Inorganic Compounds CNR Rao& Ferraro G.R., Academic Press, 1970.
14. Chemical Application of Mossbauer Spectroscopy, Goldanski V.I &Harber R.H., Academic Press 1968.

Mössbauer Spectroscopy by Dominic P. E. Dickson https://doi.org/10.1017/CBO9780511524233

15. Basic Principles of Spectroscopy Cheney R.Mac Grows Hill, 1971.
16. Thermal Method, Wendlandt, W.W. John, Wiley, 1986.
17. Principles and Applications of Thermal Analysis by Paul Gabbott
18. Spin resonance spectroscopy Author: Chandran Karunakaran, ISBN: 9780128136089 eBook ISBN: 9780128136096 Elsevier, 2018

19. Principles Of Physical Chemistry by Madan S Pathania Br Puri, Lr Sharma

20. Electron spin resonance elementary theory and practical applications by J.E. Wertz and J. R. Bolton McGraw Hill Publications

21. Scientific writing and publishing for early-career researchers from the perspective of young chemists, Richardson *et al.* J. Mater. Chem. A, 2021, 9,18674. (https://doi.org/10.1039/D1TA90183D)

22. Whitesides' Group: Writing a Paper, G. M. Whitesides, Adv. Mater, 2004, 16 No. 1375-1377. (https://doi.org/10.1002/adma.200400767)

23. Training in scientific manuscript writing, CURRENT SCIENCE, VOL. 107, NO. 9, 10 NOVEMBER 2014

24. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses, The FASEB Journal, 2008, Vol. 22, 338-341 (https://doi.org/10.1096/fj.07-9492LSF)

25. Google Scholar as a new source for citation analysis, Ethics Sci Environ Polit 8: 2008, 61–73 (https://doi.org/10.3354/esep00076)

26. Testing the Calculation of a Realistic h-index in Google Scholar, Scopus, and Web of Science for F. W. Lancaster by Peter Jacso, Library Trends, Volume 56, Number 4, Spring 2008, pp. 784-815 https://doi.org/10.1353/lib.0.0011

27. Origin 7.0: Scientific Graphing and Data Analysis Software, Phillip M. Edwards,

28. J. Chem. Inf. Comput. Sci., Vol. 42, No. 5, 2002.

29. ResearchGate: An effective altmetric indicator for active researchers?, M.-C. Yu et al., Computers in Human Behavior 55 (2016) 1001e1006 http://dx.doi.org/10.1016/j.chb.2015.11.007

30. 30 Introduction to Structure Searching with SciFinder Scholar, Damon D. Ridley, Journal of Chemical Education, 2001, Vol. 78 No. 4, 559-560. (http://jchemed.chem.wisc.edu/Journal/)

M. Sc.- I (Semester-I)

Academic Council 4(4.3)
26th March 2022

Chemistry in Life Sciences (2194105)

Paper No. SCT-1.2

Hours: 60 Marks: 100

Credits: 4

Learning Objectives:

1. To study structure, classification of amino acids and nucleic acids
2. To provide an interdisciplinary approach between Chemical and Life Sciences.

Course Outcome:

After the end of course students will be able to know:

1. Protein Chemistry
2. Structure and properties of amino and nucleic acid.
3. About an interesting interdisciplinary approach and current research in interdisciplinary area.

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 – De Robertis 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)

Academic Council 4(4.3)
26th March 2022

Inorganic Chemistry – II (2194201)

Paper No. HCT – 2.1

Hours: 60 Marks: 100
Credits: 4

Learning Objectives:

1. To understand the p block elements with respect to their compounds structure and reactions.
2. To study the role of organometallic reagents in important industrial catalytic reactions.
3. To study the lanthanides and actinides chemistry importantly magnetic properties and preparation of trans-uranic elements.

Course Outcome:

After the end of course students can:

1. Understand the structure, physical and chemical properties of inorganic compounds.
2. Able to know about mechanism of industrial catalytic reactions hydrogenation, hydroformylation etc.
3. Able to differentiate between magnetic properties of 3d block and higher transition series.
4. Understand the metallurgy i.e. extraction, properties and applications of copper, silver, gold, zinc, tin and lead.

Unit-I: Chemistry of Boron and Carbon Gorups

A) Boron Group **(07)**

Boron Hydrides, preparation, structure and Bonding with reference to LUMO, HOMO, inter conversion of lower and higher boranes, metalloboranes, carboranes, reactions of organoboranes, STYX rules and structure of higher boranes.

B) Carbon Group (08)

Allotropes of carbon, Diamond, Graphite, Fullerenes, Graphene, Carbon Nanotube with synthesis properties, single walled and multi walled and its application, Intercalation compounds of graphite, Silicates, including Zeolites.

Unit-II: Chemistry of Nitrogen and Oxygen Gorups

A) Nitrogen Group (08)

Nitrogen activation, Boron nitride, Oxidation states of nitrogen and their interconversion, PN and SN Compounds, Applications of PN and SN compounds**.**

B) Oxygen Group (07)

Metal Selenides and Tellurides, oxyacid's, and oxoanions of sulphur and nitrogen.
Ring, Cage and Cluster compounds of p-block elements.

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

Introduction, 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 IV: Chemistry of Lanthanides and Actinides (15)

Introduction (occurrence and properties), color, oxidation state, spectral and magnetic properties, lanthanides and actinides, lanthanide contraction, Use of lanthanide compounds as shift reagent, compounds of lanthanides, photoluminescence properties of lanthanide compounds, modern methods of separation of lanthanides and actinides, preparation of trans-uranic elements, applications of lanthanide and actinide compounds in Industries, further extension of periodic table.

RECOMMENDED BOOKS

1. A. F. Wells, Structural Inorganic Chemistry – 5thEdition (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. Principals of Inorganic Chemistry by B. R. Puri, L. R. Sharma, K. C. Kalia
6. T.S. Swain and D.S.T. Black, Organometallic Chemistry
7. L.V. Azoroff and J.J. Brophy, Elecronic Processes in Materials, McGraw Hill–I
8. F.A. Cotton and R.G. Wilkinson, Advanced Inorganic Chemistry, Wiley Student Edition
9. Williams and L. Jooly, Modern Inorganic Chemistry, McGraw Hill International Edition
10. P. L. Pausan, Organometallic Chemistry
11. Principles of extractive metallurgy by H. S. Ray and A. Ghosh
12. Lanthanide and Actinide Chemistry by Simon Cotton

M. Sc.-I (Semester-II)

Academic Council 4(4.3)
26th March 2022

Organic Chemistry (2194202)
Paper No. HCT 2.2

Hours: 60 Marks: 100

Credits: 4

Learning Objectives:

1. To study the aromatic electrophilic and nucleophilic substitution reactions.
2. To study the concept of addition to carbon-carbon multiple bond
3. To learn addition to carbon-hetro multiple bonds (Grignard reagent, Organo zinc and organo lithium reagent to carbonyl and unsaturated carbonyl compounds)
4. To learn E_1, E_2, and E_1CB mechanisms.

Course Outcome:

After the end of course students can:

1. Understand the basics of arenium ion, orientation and reactivity in nitration, sulphonation and Friedel-Crafts reaction.
2. Easily comment on regioselectivity and chemoselectivity in Carbon-Carbon multiple bond addition reaction.
3. Understand the role of carbon as nucleophile in organometallic compounds and Carbon-Carbon bond formation.
4. Able to think and predict the possible mechanism of various critical organometallic (Grignard reagent, organo zinc and organo lithium) reagents and their reactions.
5. Able to imagine and predict the important E_1, E_2 and E_1CB mechanisms.

Unit I: Aromatic Substitutions: (15)

Aromatic Electrophilic Substitution: 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 substitution, orientation in other ring systems. Diazo-coupling, Vilsmeier reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution reactions SN^1, SN^2 and Arynes.

Unit II Addition to Carbon –Carbon multiple bond: (15)

Mechanism and stereochemical aspect of addition reaction involving electrophile, nucleophile and free radicals. Regioselectivity and chemoselectivity, orientation and reactivity, Michael addition, Sharpless asymmetric epoxidation.

Unit-III: Addition to Carbon–Hetero Multiple bond: (15)

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, ester and nitriles. Addition of Grignard reagent, Organo zinc and organo lithium reagent to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reaction involving enolates –Aldol, Knovenagel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction. Hydrolysis of esters.

Unit IV:

A) Elimination Reactions: (07)

The E_1, E_2, and E_1CB mechanism, orientation of double bond. Reactivity: effect of substrate structure, attacking base, the leaving group and the medium, pyrolytic elimination.

B) Study of following reactions (08)

Robinson annulation, Simon-Smith, Mc-Murry, Dakin, Wurtz-Fittig reaction, Hunsdiecker reaction, Rupe, Corey-Chaykovsky, Nef reaction, Baylis-Hilman reaction, Mitsunobu reaction.

RECOMMENDED BOOKS

1. Advanced Organic Chemistry, IV Edition: J. March
2. Advanced organic Chemistry, Part-A and Part-B: F. A. Carey, & R. J. Sundburg.
3. A Guide Book to Mechanism in Organic Chemistry: Peter Sykes.
4. Synthetic Organic Chemistry: H. O. House
5. Principles of Organic Synthesis: R. O. C. Norman
6. Organic Chemistry: Clayden and Greeves

7. Mechanism and Structure in Organic Chemistry: E. S. Gould

M.Sc.- I (Semester-II)

Academic Council 4(4.3)
26th March 2022

Physical Chemistry-II (2194203)
Paper No. SCT– 2.1

Hours: 60 Marks: 100
Credits: 4

Learning Objectives:

1. To learn about photochemistry (electronic transition due to absorption, photo-reduction, photo-oxidation), Jablonski diagram and applications.
2. To study advanced Electrochemistry Electrical double layer and its significance, Debye Huckel theory.
3. To study the Chemical Kinetics and Higher order reaction's kinetics.

Course Outcome:

After the end of course students will be able to:

1. Understand basics and advances in photochemistry like electronic excitation, photo-dissociation and Pre-dissociation, photo-reduction, photo-oxidation.
2. Learn advanced electrochemistry concepts including double layer, fluorescence, excimer, exciplex
3. Become familiar with advanced electrochemistry technologies such as batteries.
4. Understand higher order kinetics

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. Jablonski diagram. 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 emf data, determination of dissociation constant of monobasic acid by emf 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-McGrawHill

M.Sc.- I (Semester-II)

Academic Council 4(4.3)
26th March 2022

Green Chemistry (2194204)

Paper No. SCT – 2.2

Hours: 60 Marks: 100

Credits: 4

Learning Objectives:

1. To learn principles of green chemistry
2. To introduce new greener methods for important chemical transformation.
3. To learn green routes for synthesis of various important medicines.
4. To inculcate the future green trends related to Biomass conversion, Biocatalysis etc.

Course Outcome:

After the end of course student will be able to know:

1. Green synthetic routes, green solvents and green reactions.
2. Become familiar with principles of green and sustainable chemistry.
3. Learn and able to think about alternate energy sources.

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, 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; Noncovalent derivatization. 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)

Academic Council 4(4.3)
26th March 2022

Analytical Chemistry-II (2194205)
Paper No OET -2.1

Hours: 60 Marks: 100
Credits: 4

Learning Objectives:

1. To learn about electromagnetic radiations.
2. To study various types and importance of spectroscopic techniques in structure elucidation.
3. To learn and apply UV-Visible Spectroscopy to organic compounds
4. To learn applications of I. R. spectroscopy to identify functional group present in organic compounds.
5. To learn applications of NMR to elucidate structure of organic compounds.
6. To study advanced separation techniques such as column

chromatography, gas chromatography and high-performance liquid chromatography.

Course Outcome:

After the end of course student can:

1. Understand basics of spectroscopy, EMR, absorption, electronic, rotational and vibrational transitions.
2. Learn to calculate absorption maxima for various organic compounds.
3. Become familiar with frequencies for various functional groups.
4. Draw the structure of unknown compound with provided NMR data.
5. Learn real time applications of separation techniques

Unit-I: Spectroscopy

A) Ultraviolet and visible Spectrophotometry (07)

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

B) Infra-red spectroscopy (08)

Introduction, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies and applications. Problems based on IR.

Unit II: Nuclear Magnetic Resonance- Part I (15)

NMR: Introduction, principle, magnetic and nonmagnetic nuclei, 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. Simple problems based on NMR.

Unit III Column chromatography and Thin Layer Chromatography

A) **Column chromatography (adsorption chromatography): (08)**

Introduction of chromatography, principles, experimental techniques: apparatus, adsorbents, column preparation, solvent (eluent), experimental procedure: packing of column, sample preparation, development, detectors and applications.

B) Thin Layer Chromatography: (**07)**

Thin layer chromatography, basic principle, coating materials, solvent-solvent system, analytical and preparative TLC, methods of detection, applications and advances in TLC

including modern TLC techniques.

Unit IV: Gas Chromatography and High performance Liquid Chromatography

A) Gas chromatography (08)

Introduction, principles of gas liquid chromatography, instrumentation carrier gas, sample introduction system, columns, detectors, substrates, temperature control, evaluation retention volume, resolution, branches of gas chromatography and applications.

B) **High Performance Liquid chromatography (07)**

Principle, instrumentation- column, column packing, mobile phase, pumping system, detector system, practical procedure, applications, HPLC adsorption and partition chromatography.

RECOMMENDED BOOKS

1. The Determination of Molecular Structure : P. J. Wheatley
2. Physical Chemistry : G. M. Barrow
3. Instrumental Methods of Chem. Analy. Chatwal and Anand.
4. Instrumental Methods of Chemical Analysis - Willard, Merritt, Dean &Seatle
5. Instrumental Methods of Chemical Analysis - Chatwal, Anand
6. Instrumental Methods of Chemical Analysis - B.K. Sharma
7. Instrumental Methods of Chemical Analysis -R.D. Braun
8. Analytical Chemistry :Skoog and West
9. Principles of Instrumental Analysis: Skoog and West.
10. Fundamentals of Molecular Spectroscopy: Banwell.

11. Atomic and Molecular Structure :ManasChanda

12. Molecular Spectroscopy : B.D. Acharya

13. Molecular Spectroscopy: Dyer.

14. Organic Spectroscopy: P.S. Kalsi (6th Edition).

15. Spectroscopic Methods in Organic Chemistry: D.H. Williams and I. Fleming.

16. Spectrometric Identification of Organic Compounds: R.M. Silverstein, Morril and G.C. Bassler

17. Introduction to Spectroscopy : Pavia, Lampman and Ktiz (3rd Edition)

18. Organic Spectroscopy: William Kemp (3rd Edition).

19. Fundamental of Analytical Chemistry 8th Edn. Skoog, West Hollar, Couch.

20. Analytical Chemistry 6th Edition., Gary D. Christian

21. Chemical Separations and Measurements, D.G. Peters, J.M. Hayes and G.M. Hieftie

M. Sc.-I (Semester-II)

Academic Council 4(4.3)
26th March 2022

Medicinal Chemistry (2194206)

Paper No. OET-2.2

Hours: 60 **Marks: 100**

Credits: 4

Learning Objectives:

1. To learn about terminologies used in drug chemistry and fundamentals of drug designing.
2. To inculcate the importance of research in the field of drug designing.
3. To study pharmacokinetics and pharmacodynamics aspects of drug.
4. To introduce about cardiovascular drugs and Non Steroidal Anti- inflammatory Drugs (NSAIDs)
5. To study antibiotic drugs, anesthetic drugs and their mode of action.

Course Outcome:

After the end of course students will be able to:

1. Understand basics of drug designing
2. Learn the important aspects of drugs mainly pharmacokinetics and pharmacodynamics.

3. Know different types of drugs

Unit I: Drugs and Drug Design: (15)

Drugs: Essential Drugs, Nomenclature of Drugs, Routes of Drug Administration, Adverse effects of Drugs, IUPAC Naming of Drugs.
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: Pharmacokinetics and Pharmacodynamics: (15)

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

Unit-III Cardiovascular Drugs and Non Steroidal Anti-inflammatory Drugs (NSAIDs): (15)
Cardiovascular Drugs: Introductions, Classification, Cardiovascular Diseases, Synthesis of Diltiazem, Verapamil, Methyldopa, Atenolol.
Non-Steroidal Anti-inflammatory Drugs (NSAIDs): Introductions, Classification, Synthesis, Mechanism of action of Indomethacin, Ibuprophen, Dichlorophenac, Naproxen, Allorpurinol.

Unit IV: Antibiotics and General and local anaesthetics: (15)
Antibiotics: Introductions, Classification, β-Lactum antibiotics, Cephalosporins, Anticancer Antibiotics. Synthesis of Penicillin-G, Penicillin-V, Ampicillin, Amoxycillin, Chloramphenicol, Cephalophalosporin, Tetracyclin and Strectomycin.
General and local anaesthetics: Introduction, Classification, Mode of Action and mechanism of action of general and local anaesthetics.

RECOMMENDED BOOKS

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

M. Sc. Part – I

Academic Council 4(4.3)

26th March 2022

Inorganic Chemistry Practical (2194106)

Semester-I

Hours: 60 **Marks: 50**

Credits: 2

Learning Objectives

1. To learn about ore and alloy analysis theory and stepwise experiment.
2. To develop hands-on experience on preparation of various important complex salts.
3. To study about determination of purity of inorganic compounds.

Course Outcome

1.Student can learn systematic experimental skills in Ore and Alloy analysis.

2.Students can learn various synthesis steps like oxidation, reduction etc.

3.Students can able to prepare various complex salts and also determine their purity.

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. Copperacetate
4. Prussian blue
5. Manganeseacetate

Note: Any other relevant experiment be added

Inorganic Chemistry Practical (2194207)

Semester-II

Hours: 60 **Marks: 50**

Credits: 2

Ore analysis: (any one)

1. Pyrolusite ore
2. Bauxite 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. Potassiumhexathiocyanato chromate(III)

3. Hexathiourea plumbusnitrate

4. Hexaminecobaltnitrate

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 publishing Chichester.

4.A. J. E. Welch, Inorganic Preparations, George Allen & Unwin Ltd.

Organic Chemistry Practical (2194107)

Semester–I

Academic Council 4(4.3)

26th March 2022

Hours: 60 **Marks: 50**

Credits: 2

Learning Objectives

1.To develop the skill on separation of organic binary mixture

2.To learn about separation and purification techniques

3.To identify the functional group in separated mixture

4.To acquire the skills for the synthesis of organic compounds by using routine laboratory synthetic techniques.

Course Outcome

1.Students will be gaining expertise in organic binary mixture separation especially solid- liquid mixture.

2.Students will learn how to perform distillation techniques for purification of organic compounds.

3.Students can develop hands-on experience on separation, crystallization, derivative preparation and functional group detection.

4.Students will learn preparation methods (actual experiment) of important name reactions.

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

Organic Chemistry Practical (2194208)

Semester–II

Hours: 60 **Marks: 50**

Credits: 2

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-benzilicacid

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 Arun Sethi

6.Advanced practical chemistry by Jagdamba Singh

Physical Chemistry Practical (2194108)

Semester-I

Hours: 60 **Marks: 50**

Credits: 2

Learning Objective:

1.To perform non-instrumental experiments like kinetics and phase equilibrium.

2.To bridge the gap between theory and practical's by performing experiments.

3.To develop the hands-on experience of various instruments like potentiometer, PH-meter, polarimeter, colorimeter, conductometer, Refractometer etc.

4.To perform the experiment of determination of atomic parachor of C, H and Cl by surface tension measurements

Course Outcome:

After the completion of course students will be

1.Developing hands-on experience on important instruments like potentiometer, PH-meter, polarimeter, colorimeter.

2.Understanding and performing the non-instrumental experiments like determine dissociation constant, hydrolysis constant of solutions, kinetics etc.

NON-INSTRUMENTAL

Kinetics

1.To investigate the auto-catalytic reaction between potassium permanganate and oxalic acid. Iodonation of acetone

2.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 bypotentimetric method. (Orthophosphoricacid)

2.Determine the solubility and solubility product of sparingly soluble salts.

Physical Chemistry Practical (2194209)

Semester-II

Hours: 60 **Marks: 50**

Credits: 2

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 (or1% 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.

pH metry:

1.Determination of pKa of acid (Succinic acid)

2.Determination of hydrolysis constant of aniline hydrochloride

Conductometry

1.Solubility and solubility product of sparingly 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- Rajbhojand Chondhekar.
6. Experimental physical Chemistry- V.D. Athawale and P. Mathur
7. Advanced practical physical Chemistry- J. B. Yadav
8. Advanced physical Chemistry Experiments- Gurtuand Gurtu

Analytical Chemistry Practical (2194109) Semester I

Hours: 60 **Marks: 50**

Credits: 2

Learning Objective:

1. To perform experiment directly related to analytical techniques.
2. To link the sub branches of chemistry (physical, inorganic and organic) experimentally, through critical analytical experiments.
3. To develop the hands-on experience on separation, ion exchange method, titrimetric analysis, colorimetric experiments, conductometric titrations etc.

Course Outcome:

After the completion of course students will be

1.Developing hands-on experience on separation, ion exchange method, titrimetric analysis, colorimetric experiments, conductometric titrations etc.

2.Able to club the ideas from sub branches of chemistry and find their applications in analytical chemistry.

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

Organic Analytical Chemistry

1. Analysis of Pharmaceutical tablets.
2. To verify the Beer-Lambert's Law and determine the concentration of given dye solution colorimetrically.
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 / creatinine in urine.
6. Analysis of pharmaceutical tablet ibuprofen
7. Estimate amount of endosulphan.

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 KCl (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 pH-metery.
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.

Analytical Chemistry Practical (2194211)

Semester II

Hours: 60 **Marks: 50**

Credits: 2

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 exchange 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

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.

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 KCl (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 pH-metry
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- Gurtuand Gurtu
11. Practical organic Chemistry by F. G. Mann, B. C. Saunders
12. Quantitative organic analysis, A. I. Vogel

Chairman
BOS in MSc (Organic Chemistry)