M.Sc. CHEMISTRY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus
Regular (2015 – 2016)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

DEPARTMENT OF CHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari (Post), Coimbatore – 641 021,
Tamil Nadu, India

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Programme Learning Outcomes (PLO)

a. Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.
b. Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
c. Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
d. Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.
e. Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
f. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.
g. Students will be able to function as a member of an interdisciplinary problem solving team.
h. The graduate has specific skills in planning and conducting advanced chemical experiments and applying structural-chemical characterisation techniques.
i. Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
j. Are able to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry.

Programme Specific outcome (PSO)

k. A graduate with a Master's degree in Chemistry has in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.
l. Students should have an advanced level understanding of the following areas of chemistry - Analytical, Inorganic, Organic, and Physical Chemistry. They should master graduate level understanding of their major area(s) of research.
m. Students should be able to communicate scientific results in writing and in oral presentation.
n. Students should become proficient in their specialized area of chemistry and acquire the basic tools needed to carry out independent chemical research

Programme Educational Objectives

PEO-1

The Masters in Chemistry will extend your depth and breadth of knowledge in all branches of chemistry, suitable for a professional chemist capable of conducting research.

PEO-2

To carryout research in the trust areas of chemistry. Will be able to communicate effectively the scientific information and research results in written and oral formats, to both professional scientists and to the public.

PEO-3

To motivate critical thinking and analytical skills to solve complex chemical problems and the Ability to handle problems of practical relevance to society while complying with economical, environmental, ethical, and safety factors.

PEO-4

To practice chemistry by performance of experiments in the laboratory classes. To perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions

Mapping

PO	a	b	c	d	e	f	g	h	i	j	k	l	m	n
PEO 1	x	x			x			x	x		x	x	x	
PEO 2		x	x	x	x			x	x		x		x	x
PEO 3			x	x		x	x			x			x	x
PEO 4	x	x	x			x		x		x	x	x		x

DEPARTMENT OF CHEMISTRY

FACULTY OF ARTS, SCIENCE AND HUMANITIES
PG PROGRAM (CBCS) – M.Sc. Chemistry
(2015–2016 Batch and onwards)

Course code	Name of the course	Objectives & Outcomes		Instruction hours per week			Credits	Maximum Marks		
		PEO's	PO's	L	T	P		CIA	ESE	Total
SEMESTER I										
15CHP101	Organic Chemistry – I: Reaction Mechanisms	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP102	Inorganic Chemistry –I: Nuclear Chemistry and Metallic Clusters	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP103	Physical Chemistry- I: Quantum Chemistry and Group Theory	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP104	Organic and Inorganic Spectroscopy	1,2,3,4	a,b,c,h.j	4	0	0	4	40	60	100
15CHP105	Green and Medicinal Chemistry	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP111	Organic Chemistry Practical-I: Qualitative Analysis and Single Stage Preparations	3,4	b,h,j	0	0	4	2	40	60	100
15CHP112	Organic Chemistry Practical-II: Quantitative Analysis and Double Stage Preparations	3,4	b,h,j	0	0	4	2	40	60	100
	Seminar Presentation	1,2,3	A,b,c,d,e,h,j	2	0	0	-	-	-	-
	Semester Total			22	0	8	**24**	**280**	**420**	**700**
SEMESTER II										
15CHP201	Organic Chemistry-II: Rearrangements, Reactions, Photochemistry and Pericyclic Reactions	1,2,3	a,c,e	4	1	0	5	40	60	100
15CHP202	Inorganic Chemistry-II: Co-ordination Chemistry	1,2,3	a,c,e	4	1	0	5	40	60	100
15CHP203	Physical Chemistry II: Chemical Kinetics and Electrochemistry	1,2,3	a,c,e	4	0	0	4	40	60	100
15OEP201	Open Elective (Chromatographic Techniques)	3,4	f,h	0	0	0	3	-	100	100

15CHP205A	Elective – II	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP205B										
15CHP205C										
15CHP205D										
15CHP205E										
15CHP211	Inorganic Chemistry Practical-I: Qualitative Analysis and Preparations	3,4	b,h,j	0	0	5	3	40	60	100
15CHP212	Inorganic Chemistry Practical-II: Quantitative Analysis and Complex Preparations	3,4	b,h,j	0	0	5	3	40	60	100
	Seminar Presentation	1,2,3	A,b,c,d,e,h,j	2	0	0	-	-	-	-
	Semester Total			18	2	10	**27**	**240**	**460**	**700**
	SEMESTER III									
15CHP301	Organic Chemistry- III (Natural Products)	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP302	Physical Chemistry-III (Thermodynamics)	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP303	Physical Methods in Chemistry (Instrumentation**)**	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP304	Nanochemistry	3,4	F,h	4	0	0	4	40	60	100
15CHP305A	Elective – III	1,2,3	a,c,e	4	0	0	4	40	60	100
15CHP305B										
15CHP305C										
15CHP305D										
15CHP305E										
15CHP311	Physical Chemistry Practical –I : (Molecular Weight Determination and Conductometric Titrations)	3,4	b, h,i	0	0	4	2	40	60	100
15CHP312	Physical Chemistry Practical- II: (Chemical Kinetics and Potentiometric Titrations)	3,4	b, h,i	0	0	4	2	40	60	100
	Seminar Presentation	1,2,3	A,b,c,d,e,h,j	2	-	-	-	-	-	-
	Semester Total			22	0	8	**24**	**280**	**420**	**700**
	SEMESTER IV									
15CHP419	Project Work	1,2,3	A,b,c,d,e	-	-	30	15	80	120	200

			,h,j							
	Semester Total			-	-	30	**15**	**80**	**120**	**200**

*Only for Experiments. Calculations to be carried out at home.

List of Core Course Elective			
Elective-I		**Elective-II**	
Code	**Course**	**Code**	**Course**
15CHP204A	Advanced Organic Chemistry	15CHP305A	Polymer Chemistry
15CHP204B	Analytical Chemistry	15CHP305B	Textile Chemistry
15CHP204C	Organometallic Chemistry	15CHP305C	Industrial Chemistry
15CHP204D	Advanced Coordination Chemistry	15CHP305D	Applied Chemistry
15CHP204E	Organic Chemical Technology	15CHP305E	Printing Chemistry

Open Elective	
Code	**Course**
15OEP201	Chromatographic Techniques

Self study courses

Code	**Course(s)**	**Hrs / week**	**Marks**			**Exam / Hrs**	**Credit**
			CIA	**ESE**	**Total**		
15CHP306	Nano Technology	-	-	100	100	3	04
15CHP401	Analytical Techniques in Chemistry	-	-	100	100	3	04

Semester-I

15CHP101 ORGANIC CHEMISTRY- I 4H 4C
(REACTION MECHANISMS)

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total: 100

Course Objectives

- To understand aromaticity.
- To provide a versatile knowledge of different name reactions and their application in synthesis.
- To learn about familiar addition and elimination reactions.
- To gain knowledge about reaction intermediates.
- To understand the principles and reaction mechanisms involving various electrophilic and nucleophilic, addition and elimination reactions.
- To relate the different organic reaction mechanisms.

Course outcomes (CO's)

1. Learned the concept aromaticity and various types of aromaticity
2. Familiarized the various types of electrophilic and nucleophilic substitution reactions and their Mechanism
3. Learned the familiar addition and elimination reactions
4. Learned the concept of reaction intermediates.
5. Understood about the synthesise aromatic compounds using electrophilic and nucleophilic substitution, addition and elimination reactions.
6. Described the various organic reaction mechanisms.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Aromaticity and chemical methods in mechanisms: Aromaticity - introduction - aromaticity of benzenoid and heterocyclic compounds. Non-benzenoid aromatics – annulenes, azulenes, ferrocenes and fulvenes.

Kinetic and non-kinetic methods of study of reaction mechanisms - kinetic methods- Primary and secondary kinetic isotopic effects. Non-kinetic methods - study of intermediates, isotopic labeling, stereochemical studies, energy profile diagrams and cross over experiments. Hammond's postulate. Kinetic and thermodynamic control.

Linear free energy relationship - Hammett equation and Taft equation.

UNIT – II

Addition reactions: Electrophilic, nucleophilic and free radical addition to double and triple bonds - hydration, hydroxylation, Michael addition, hydroboration and epoxidation. Addition reactions to carbonyl compounds – Mannich reaction, Meerwein Pondroff-Verley reduction, Grignard, Claisen, Dieckmann, Stobbe, Knovenagel, Darzen, Wittig, Thorpe and Benzoin reactions.

UNIT – III

Electrophilic substitution reactions: Aromatic electrophilic substitution reactions-formylations–Gattermann, Gattermann Koch and Riemer Tiemann reactions. Kolbes, Bischler-Napieralski and Hofmann-Martius reactions. Friedel crafts alkylation and acylations.

Aliphatic electrophilic substitution reactions - mechanisms- SE1, SE2 and SEi - structure reactivity relationship, typical electrophilic substitution reactions - Friedel crafts acylation at olefinic carbon, Stork enamine reaction and decarboxylation of aliphatic acids.

UNIT – IV

Nucleophilic substitution reactions: Aliphatic nucleophilic substitution reactions-mechanisms - SN1, SN2, ion pair and SNi- substitution at vinyl carbon. Stereochemistry of nucleophilic substitution reaction - effect of substrate structure - solvent effects - leaving group effect – nucleophilicity, ambident nucleophiles and ambident substrates-neighbouring group participation.

Aromatic nucleophilic substitution reactions - benzyne mechanism, intermediate complex mechanism and SN1 mechanism, structure reactivity relationship.

Ziegler alkylation and Chichibabin reaction.

UNIT – V

Elimination reactions: Mechanisms - E1, E2, Ei and E1cB mechanisms- stereochemistry of eliminations. Hofmann rule-Saytzeff rule-Bredts rule – Substitution versus Elimination. Typical elimination reaction - Chugaev reaction, Hofmann degradation and Cope elimination.

Carbenes and nitrenes - structure, generation and reactions.

TEXT BOOKS:

1. Jerry March, 1992, Advanced Organic Chemistry. IV Edition, John Wiley & Sons (Asia) Pte. Ltd., Singapore.
2. Finar, I.L., 2000. Organic Chemistry Vol. II: Stereochemistry and the Chemistry of Natural Products. V Edition, Addison Wesley Longman (Singapore) Pte. Ltd-Indian Branch, New Delhi.
3. Gurdeep R. Chatwal, 2004. Organic Chemistry of Natural Products. Vol. II, Himalaya Publishing House, New Delhi.

REFERENCES:

1. Sanyal, S.N., 2003. Reactions, Rearrangements and Reagents. IV Edition, Bharathi Bhawan (Publishers and Distributors), New Delhi.
2. Tewari, N., 2011, Advanced Organic Reaction Mechanism. III Edition, Books and Allied (P) Ltd, Kolkata.

3. Agarwal, O.P., 2004. Natural Product Chemistry. Vol. II, Goel Publishing House, Meerut.
4. Gurdeep R. Chatwal, 2001. Organic Chemistry of Natural Products. Vol. I, Himalaya Publishing House, New Delhi.

Semester-I

15CHP102 INORGANIC CHEMISTRY-I 4H 4C

(NUCLEAR CHEMISTRY AND METALLIC CLUSTERS)

Instruction Hours/week:L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100

Course Objectives

- To learn the nuclear structure, stable and unstable atomic nuclei, nuclear reactions and different modes of radioactive decay and also methods for measurements of radioactivity.
- To analyses the various defects and its application on inorganic crystals.
- To understand the detection of radioactive rays and to measure the radiation.
- To learn about the fundamentals of metallic clusters.
- To understand the chemistry of boranes and related compounds.
- To apply the knowledge to know about the various forms of inorganic compounds

Course outcomes

1. Described the basic concepts of nuclear chemistry and types of nuclear reactions.
2. Discriminate the various defects and also known about its application on inorganic crystals
3. Understood the Basics of metallic clusters, preparation, properties and applications of metallic clusters
4. Learned the structure and bonding in molecules / ions and predict the structure of molecules / ions.
5. Described the type of defects in metals and about semi conductors
6. Understood the inorganic and organometallic chemistry, catalysis in the molecular level

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Inorganic chains – rings - cages and clusters (definition and structure) - metal clusters - dinuclear clusters - trinuclear clusters - tetranuclear clusters - hexanuclear clusters – organometallic clusters.

Boranes, boron hydrides (structure and properties) – carboranes - metallocarboranes - Wade's theory -closo-nido and arachno structures - borazines, phosphazenes – Sulphur-Nitrogen ring compounds. Isopoly and heteropoly acids of V, Cr, Mo and W.

UNIT – II

Metallic state-free electron, band and zone theories - non stoichiometry - point defects in solids - Schottky and Frenkel defects - linear effects - dislocation - effects due to dislocation - electrical properties of solids - insulators-intrinsic semiconductors - n and p type and super conductors - ceramics elementary treatment.

Organometallic compounds in homogeneous catalytic reactions-coordinative unsaturation – acid-base behavior reaction – migration of atoms or groups from metal to ligand – insertion reaction – reactions of coordinated ligands – catalytic reactions of alkenes – isomerisation of alkenes – hydrogenation – hydroformylation and hydrosilation of alkenes – alkene polymerization and oligomerisation – fluxional molecules.

UNIT – III

Nuclear Chemistry - the nucleus - subatomic particles and their properties, binding energy. N/P ratios in stable and meta stable nuclei - different type of nuclear forces - liquid model- shell model. Modes of radioactive decay - α, β and γ decay radiation, electron capture, nuclear isomerism, internal conversion.

UNIT – IV

Experimental methods - Cloud chamber, nuclear emulsion, bubble chamber, proportional counters-G.M counter, scintillation counters, semi conductor detector.
Particle accelerators - Cyclotron, synchrotron, betatron and bevatron.

UNIT – V

Nuclear reactions - Bethes's notation, Q-value, columbic barrier, cross section, different types of nuclear reactions - projectiles capture - particle emission, spallation, fission, fusion, theories of fission, use of fission products, nuclear reactors - fissile and fertile isotopes- U^{233},U^{235},Pu^{239},Th^{232},-atomic power projects in India, stellar energy, synthetic elements - application of radio isotopes - Hot atom chemistry**.**

TEXT BOOKS:

1. Huheey, J. E., E A. Keitler & R.L. Keitler, 2002. Inorganic Chemistry. IV Edition, Pearson Education, Singapore.
2. Shekar C. V., 2005. A text book of nuclear chemistry. I Edition, Dominant publishers and Distributors, New Delhi.
3. Arnikar, H. J., 2003. Essentials of Nuclear Chemistry. IV Edition, New Age International Publishers Pvt. Ltd., New Delhi.

REFERENCES:

1. Chakrabarty, D. K., 2005. Solid State Chemistry. I Edition, New Age International Publishers, New Delhi.
2. Cotton F.A. and Willkinson, 1998. Advanced Inorganic Chemistry. John-Wiley & Sons, New Delhi.
3. Glasstone S., 1967. Source Book on Atomic Energy. III Edition, East West Press, New Delhi.
4. Gurdeep Raj, 2002. Advanced Inorganic Chemistry. Vol. I, Goel Publishing House, Meerut.
5. Madan, R.D., 2005. Modern Inorganic Chemistry. S. Chand & Co., New Delhi.
6. Puri B.R. and L. R. Sharma, 2002. Principles of Inorganic Chemistry. Shoban Lal & Co., New Delhi.
7. Wahid Malik, R. D.Madan and G. D. Tuli, 2004. Selected topics in Inorgani Chemistry. S. Chand & Co., New Delhi.

Semester-I

15CHP103 PHYSICAL CHEMISTRY- I 4H 4C

(QUANTUM CHEMISTRY AND GROUP THEORY)

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

- To study the fundamentals and applications of classical mechanics and quantum chemistry
- To understand the structure of an atom and different approximation methods
- To learn the concept of Group theory and their applications.
- To discuss the molecular phenomena and its model problems
- To explain the probabilities, amplitudes, averages, expectation values and observables.
- To analyses the concept of group theory to predict the spectroscopic properties of a molecules

Course Outcomes (CO's)

Students have learned and understood

1. The differences between classical and quantum mechanics. The limitations of classical mechanics.
2. the connection of quantum mechanical operators to observables
3. probabilities, amplitudes, averages, expectation values, and observables
4. how molecular phenomena can be related to model problems
5. the fundamentals of group theory
6. the connection between common approximation methods and standard chemical frameworks (Born-Oppenheimer approximation, molecular orbitals, for example)
7. Identified the point groups of molecules and apply the concept of group theory to predict the spectroscopic properties.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Failure of classical mechanics and the success of quantum theory in explaining black body radiation and photoelectric effect.

The time dependent and time independent Schrodinger equations - Born's interpretation of the wave function. Requirements of the acceptable wave function.

Algebra of operators. Sums and products of operators - commutator - linear operators- eigen functions and eigen values - correspondence between physical quantities in classical mechanics and operators in quantum mechanics - Hamiltonian operator - angular momentum operator. Quantization of angular momentum and its spatial orientation - average values - postulates of quantum mechanics.

UNIT – II

Particle in a one-dimensional box - quantization of energy - normalization of wave function - orthogonality of the particle in a one-dimensional box wave functions. Illustration of the uncertainty principle and correspondence principle with reference to the particle in a one-dimensional box - particle in a three dimensional box - separation of variables.

Solving of Schrodinger equation for one-dimensional harmonic oscillator. Harmonic oscillator model of a diatomic molecule. Illustration of the uncertainty principle and correspondence principle with reference to harmonic oscillator.

Solving of Schrodinger equation for a rigid rotor. Rigid rotor model of a diatomic molecule.

UNIT – III

Schrodinger equation for the H-atom (or H-like species)- separation of variables - energy levels. Radial distribution functions - orbitals and orbital shapes. Probability density and radial distribution functions.

Need for approximation methods. The perturbation theory- application of perturbation method to systems such as anharmonic oscillator and He-atom.

The variation method - application of variation method to systems such as anharmonic oscillator and He-atom.

UNIT – IV

Symmetry elements and symmetry operations - definition of identical and equivalent elements configurations - effect of performing successive operations commutative and non-commutative - inverse operations.

Groups and their basic properties - definition of a group - basic properties of a group-definition of abelian - cyclic- isomorphic, finite, infinite groups and subgroup. Symmetry classification of molecules into point groups-Schoenflies symbol (only-difference between point group and space group).

Matrices- Definition of matrix, square matrix, diagonal matrix, null matrix, unit matrix, row matrix, column matrix, symmetric matrix, skew symmetric matrix and conjugate matrix. Multiplication, commutative and non commutative-determination of inverse of a matrix, block multiplication of matrices-addition and subtraction of matrices.

Matrix notations for symmetry operations of C_{2v} and C_{3v} groups-construction of character tables for C_{2v} and C_{3v} point groups**.**

UNIT – V

Definition of reducible and irreducible representations - irreducible representations as orthogonal vectors - direct product rule, the great orthogonality theorem and its

consequences - determinations of the characters for irreducible representation of C_{2v} and C_{3v} point groups using the orthogonality theorem.

Group theory and Vibrational spectroscopy - vibrational modes as basis for group representation - symmetry selection rules for IR and Raman spectra, Mutual exclusion principle - classification of vibrational modes.
Group theory and dipole moment.

TEXT BOOKS:

1. Prasad R.K., 2004 Quantum Chemistry. New Age International Publishers Pvt. Ltd., Second Edition, New Delhi.
2. Cotton F.A, 2002. Chemical Applications of Group Theory. III Edition, A Wiley Inter Science Publication, Texas.
3. Chandra A.K., 2002. Quantum Chemistry. IV Edition, Tata McGraw – Hill Publishing Company Ltd., New Delhi.
4. House Ames E., 2005. Fundamental of Quantum Chemistry. II Elsevier Academic Press, New Delhi.
5. Levine, Iran, 2004. Quantum Chemistry. Pearson Education Pvt. Ltd., New Delhi.
6. Raman K.V, 2002.Group theory. Tata Mc Graw Publishing Company, New Delhi.
7. Puri, Sharma & Pathania, 2006. Principles of Physical Chemistry, Millenium Edition, Vishal Publishing Co., Jalandar.
8. Veera Reddy K., 2005. Symmetry and Spectroscopy of Molecules, New Age International Pvt. Ltd., New Delhi.

REFERENCES:

1. Peter Atkins and Julio de Paula, 2009. Atkins' Physical chemistry, Oxford University press, Gopsons papers Ltd., Noida.

15CHP104 ORGANIC AND INORGANIC SPECTROSCOPY 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objective

- To learn about Electronic spectroscopy.
- To understand about IR spectroscopy.
- To understand the basic concept of NMR spectroscopy
- To apply the different aspects of NMR spectroscopy to predict the structure of compounds.
- To learn about the mass spectroscopy and Mossbauer spectroscopy.
- To learn about the invaluable tools in synthetic chemistry for the confirmation of known molecules and elucidation of shape and structures of unknown compounds of high complexity with a high degree of certainty.

Course outcomes

1. Understood the basic concepts of Electronic and IR spectroscopy.
2. Understood the valuable concepts in NMR spectroscopy.
3. Learned the basic knowledge about Mass spectroscopy.
4. Applied the different aspects of NMR spectroscopy to predict the structure of compounds.
5. Analyzed and identified simple organic molecules by using UV, IR, ^{1}H-NMR and ^{13}C-NMR and Mass spectral data.
6. The students learned how to interpret the spectral data and to identify the structure of the molecules

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

Ultraviolet and Visible Spectroscopy: Electronic spectra of diatomic molecules - laws of photochemistry - electronic absorption transitions-correlation of electronic structure with molecular structure - Simple chromophoric groups - effects of conjugation - Woodward -Fisher rules for α,β unsaturated carbonyl compounds & dienes - Aromatic systems with extended conjugation - applications to Organic and Inorganic compounds - Instrumentation**.**

UNIT-II

Infrared Spectroscopy: The vibrating diatomic molecules-the simple harmonic oscillator and unharmonic oscillator - the diatomic rotor - factors influencing vibrational frequencies - identification of fundamental groups. Fingerprint region-application to organic and inorganic compounds-Instrumentation**.**

UNIT-III

NMR Spectroscopy: Principle of NMR spectroscopy – description of the PMR instrument, factors affecting chemical shifts-chemical shift equivalence and magnetic equivalence - spin-spin coupling - first order and non first order spectra - Hetero nuclear coupling in ^{1}H NMR - deuterium exchange - high field spectra - double resonance-shift reagents-applications to organic and inorganic compounds. FT NMR.

^{13}C NMR spectroscopy- factors affecting the chemical shifts - broad band and off-resonance decoupling - applications in organic chemistry.

UNIT – IV

Mass Spectroscopy: Principles of mass spectrometry – resolution - description of single focusing and double focusing electron impact mass spectrometers - presentation and analysis of spectra - determination of molecular formulae - Nitrogen rule- Stevenson's rule - isotope abundance analysis - meta stable ions and peaks the molecular ion peak - fragmentation processes - Retro Diels - Alder rearrangement - McLaffertty rearrangement - Ortho Effect - fragmentation associated with functional groups - aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amine, ethers, sulphides and halides..

UNIT – V

Mossbauer and Problems: Mossbauer spectroscopy – Principles - Spectrometer - Isomer shift - Quadrapole interaction - Nuclear Zeeman Splitting – Applications.

Problems involving UV, IR, NMR, Mass spectral data (for compounds not more than 10 carbon atoms).

TEXT BOOKS:

1. Jag Mohan, 2001. Organic Spectroscopy Principles and Applications. Narose Publishing House, New Delhi.
2. Kemp W., 2004. Organic Spectroscopy. III Edition, Pal Grave, New York.
3. Sharma Y.R., 2005. Elementary Organic Spectroscopy: Principles and Chemical Applications. S. Chand Limited, New Delhi.
4. Silverstein, R. M., F. X. Webster and D. Kiemle, 1998. Spectroscopy of Organic Compounds. VI Edition, John Wiley & Sons, New York.

REFERENCES:

1. Levine, Ira. N., 2001.Quantum Chemistry. Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Prasad R.K., 2002. Quantum Chemistry. II New Age International Pvt. Ltd., New Delhi.
3. Russell S. Drago., 1965. Physical Methods in Inorganic Chemistry. Reinhold Publishing Corporation, New York.

Semester-I

15CHP105 GREEN AND MEDICINAL CHEMISTRY 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

- To introduce the concept of Green chemistry.
- To understand the basics of Medicinal chemistry.
- To introduce the 12 principles of Green chemistry as well as the tools of Gree chemistry.
- To demonstrate how to evaluate a reaction or process and determine "Greener" alternatives.
- To focus on the application of greener routes to improve industrial processes and to produce important products.
- To understand the drug targets, drug metabolism and about clinical training.

Course outcomes

The student understood the following

1. Designed of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.
2. Created awareness for reducing waste, minimizing energy consumption in organic synthesis.
3. Implemented techniques of green synthesis in organic reactions
4. Used the various alternative resources for green technology in organic synthesis.
5. Understood the drug targets, metabolism and about clinical training.
6. Applied the concept of microwaves and ionic liquids in various chemical reactions.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT–I

Introduction to green chemical principles: Definition, twelve principles of green chemistry, solventless reactions - reactions in water, microwaves and fluorous solvents - Atom efficient processes: evaluating chemical reactions according to their yield and atom efficiency - examples of enzymatic reactions and catalytic processes- Planning of green synthesis in a chemical lab.

UNIT – II

Greener reagents and reactions: Methods of designing safer chemicals. Examples of greener reagents including replacement of phosgene and solid state polymerizations.

Green reactions: Acyloin condensation, Aldol condensation, Arndt Eistert synthesis, Baker Venkatraman synthesis, Beckmann rearrangement, Clemmenson reduction and Baeyer Villiger oxidation.

UNIT - III

Basics of Medicinal chemistry: Classification of drugs- basics of molecular modeling and docking - prodrugs and soft drugs- types of pro drugs system.

Drug targets and drug solubility: Enzymes and enzyme inhibitor – competitive and non-competitive inhibitors – reversible and irreversible inhibitors – ligand receptor theories:- Clarke's theory and Paton's rate theory – effect of pH, pKa and polarity on drug solubility

UNIT – IV

Pharmacokinetics and drug metabolism and development of new drugs: Absorption, distribution , metabolism, elimination – oxidation and hydrolysis of a drug- Design of a new drug – procedures in drug design - accidental discovery - molecular modification of lead compounds.

UNIT – V

Clinical training and synthesis of drugs: Various phases in pre-clinical testing and clinical testing – designing organic synthesis – different types of synthesis –complexes and chelating agents – natural resources of lead compounds – extraction and isolation of bio active compounds.

TEXT BOOKS:

1. Ahluwalia V.K., 2012. Green Chemistry-Environmentally Benign Reactions. Ane Books Pvt Ltd, New Delhi.
2. Ghose J., 2005. A Text book of Pharmaceutical Chemistry, S. Chand Pub Ltd., Delhi.
3. Ilango K & P. Valentina, 2007. Text Book of Medicinal Chemistry. Vol I, Keerthi Publishers, Chennai.

REFERENCES:

1. Ashutosh Kar, 2005. Medicinal Chemistry. III Edition, New Age International Publishers, New Delhi.
2. Stanley E. Manahan, 2006. Green Chemistry and the Ten Commandments of Sustainability. II Edition, ChemChar Research, Inc Publishers Columbia, Missouri U.S.A.
3. Chatterjea, M. N and R. Shinde, 2012. Textbook of Medicinal Biochemistry. Jaypee Brothers, Medical Publishers (P) Ltd, New Delhi.

Semester -I

15CHP111 ORGANIC CHEMISTRY PRACTICAL-I 4H 2C

(QUALITATIVE ANALYSIS AND SINGLE STAGE PREPARATIONS)

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

- To provide the knowledge about the qualitative analysis by separation techniques of a two component mixture.
- To develop skills for the preparation of organic compounds by name reactions.
- To familiarizes the test involving identification special elements.
- To learn confirmation test of various functional groups.
- To learn systematic procedure for bimixture organic substance analysis
- To understand the solubility nature of different types of organic substances.
- To calculate the limiting reagent, yield and purity of the compounds.
- To list the various techniques of preparation and analysis of organic substances.

Course outcomes

1. Familiarized the solubility nature of organic substances of different functional group.
2. Learned the pilot separation of bimixtures and familiarize the systematic procedure of organic substances analysis
3. Learned two stage preparations involving molecular rearrangement and well known organic reactions.
4. Familiarized the test involving identification of special elements
5. Learned the confirmatory test for various functional groups.
6. Understand the techniques involving drying and recrystalliation by various method
7. Expertise the various techniques of preparation and analysis of organic substances.
8. Calculated a limiting reagent, yield and purity

Evaluated collected data to determine the identity, purity, and yield of products

Methodology

Blackboard teaching and Demonstration.

Contents

Analysis of two – component mixtures: Separation and characterization of compounds.

Note: Each student should analyze a minimum of six organic mixtures.

Preparations involving one stage comprising of the following process: Nitration, acylation, halogenation, diazotisation, rearrangement, hydrolysis, reduction, alkylation and oxidation and one preparation illustrating the following: Benzoin condensation, Canizzaro reaction, Perkin reaction, Reimer-Tiemann reaction, Sandmayer reaction, Fries rearrangement, Skraup synthesis- single stage.

Note: Each student should do a minimum of six preparations involving single stage.

REFERENCES:

1. Thomas, A.O., 2003. Practical Chemistry, Scientific Book Center, Cannanore.
2. Bansal, Raj K, 2001. Laboratory Manual of Organic Chemistry. IV Edition, New Age Publishers, New Delhi.
3. Arun Sethi, 2003. Laboratory experiments in Organic Chemistry. New Age Publishers, New Delhi.
4. Furniss B.S, A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, 2004. Vogel's Textbook of Practical Organic Chemistry. V Edition, Pearson Education Ltd., Singapore.
5. Lepse, Paul A and Lyle B.Peter, 1986. Lab Manual for Lingren's Essentials of Chemistry. Prentice Hall, New Delhi.
6. Mendham, J., R. C. Denney, J. D. Barnes and M. Thomas, 2002. Vogel's textbook of quantitative Chemical Analysis. VI Edition, Pearson Education Ltd., Singapore.

Semester - I

15CHP112 ORGANIC CHEMISTRY PRACTICAL-II 4H 2C
(QUANTITATIVE ANALYSIS AND DOUBLE STAGE PREPARATIONS)

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Objectives

On successful completion of the course the students should have

- To learn about the basic concept of quantitative analyses of organic compounds.
- to measure the Iodine value on oil
- To analyses the amount of glucose, phenol, ethyl methyl ketone, ascorbic acid and aniline in the given solutions.
- To learn the two stage preparation of organic compounds by important name reactions.
- To calculate the saponification and Iodine number of various oils for identifies its purity
- To understand preparation of various organic compounds in single step or in double step.

Course Outcomes

1. The students have learned about basic concept in quantitative analyses
2. Learned how to estimate the Glucose, Phenol, ethyl methyl ketone, Ascorbic acid and aniline.
3. Measured the Iodine number of oil
4. Understood the two stage preparation of organic compounds by important name reactions.
5. Measured the saponification and Iodine number of value to justify their purity.
6. Learned to prepare para-Nitro Benzamide for para-Nitro toluene and also know about double stage preperations like Anthranilic acid and pthalimides preperations

Methodology

Blackboard teaching and Demonstration.

Contents

Estimation of phenol, Ethyl methyl ketone, glucose, nitro, amino and methoxy groups, unsaturation in an organic compound.

Analysis of oils Reichert- Meissl value, Iodine value, saponification value and acetyl value.

Double stage preparations- Anthranilic acid and pthalimides.

Extraction and estimation of active constituents

Only for learning purpose and demo (Not for exam)

a. Lactose from milk.
b. Caffeine from tea.
c. Nicotine from tobacco extract.
d. Citric acid or ascorbic acid from a tablet or from a natural source.

e. Curcumin from turmeric.
f. Lycopene from tomato.

REFERENCES:

1. Arun Sethi, 2003. Laboratory experiments in Organic Chemistry. New Age Publishers, New Delhi.
2. Bansal, Raj K, 2001. Laboratory Manual of Organic Chemistry. IV Edition, New Age Publishers, New Delhi.
3. Furniss, B. S., A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, 2004.Vogel's Textbook of Practical Organic Chemistry. V Edition, Pearson Education Ltd., Singapore.
4. Lepse, Paul A and Lyle B.Peter, 1986. Lab Manual for Lingren's Essentials of Chemistry. Prentice Hall, New Delhi.
5. Mendham J., R.C.Denney, J.D.Barnes and M.Thomas, 2002. Vogel's textbook of quantitative Chemical Analysis. VI Edition, Pearson Education Ltd., Singapore.

Semester - II

15CHP201 ORGANIC CHEMISTRY-II 5H 5C

(REARRANGEMENTS, REACTIONS, PHOTOCHEMISTRY AND PERICYCLIC REACTIONS)

Instruction Hours/week:L: 4 T:1 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

On successful completion of the course the students should have

- To know about versatile knowledge of rearrangements
- To understand the different organic (radical and concerted) reactions and their applications in synthesis.
- To learn the principles of conformational analysis and stereochemistry.
- To explain the concepts in organic photochemistry
- To describe the basic ideas about pericyclic reactions
- To implement this basic concept to design and produce the new organic molecules

Course outcomes (CO's)

1. Understood the versatile knowledge of rearrangements
2. Understood the different organic reactions (radical and concerted).
3. Learned about the principle of conformational analysis and stereochemistry.
4. Explained about the molecular rearrangements, Pericyclic reactions and Cyclo addition and sigmatropic reactions
5. Described the basic ideas of pericyclic reactions.
6. Designed new form of organic compounds using these basic concepts.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Molecular rearrangements: Intramolecular 1,2 - shifts - Wagner - Meerwein and Pinacol-Pinacolone rearrangements.

Migration to carbonyl carbon – Demyanov and Neber rearrangements.

Rearrangements to electron deficient nitrogen and oxygen – Baeyer – Villiger, Dienone - phenol, Favorskii, Fries, Wolff, Benzidine and Stevens rearrangements.

Non-cyclic rearrangements – Chapman and Wallach rearrangements**.**

UNIT – II

Conformational analysis and stereochemistry: Stereochemistry of sulphur and nitrogen compounds, stereoselective and stereospecific reactions - R/S-notation of optically active carbon compounds. Optical isomerism of biphenyls, allenes and spiranes. Planar chirality - cyclophanes and ansa compounds - geometrical isomerism - E/Z notation-configuration in aldoximes and ketoximes. Conformation in cyclic system– decalins, perhydrophenanthrene and perhydroanthracene. Conformation and reactivity of cyclohexanes.

UNIT – III

Radical reactions: Configuration and generation of short lived free radicals- characteristics of free radical reactions – radical substitution, radical additions and rearrangement of free radicals. Typical reactions such as Sandmeyer, Gomberg, Pechmann, Ullmann, Pschorr and Hunsdiecker reactions.

Oxidation and reductions- mechanisms – aromatisation, oxidation of alcohols and glycols, ozonolysis, Sommelet reaction and selectivity in reduction-metal hydride reduction- reduction of nitro compounds and acyloin condensation.

UNIT – IV

Organic photochemistry: Introductory theory of light absorption- Jablonski diagram- photophysical processes- excimers and exciplexes - energy transfer-geometry of excited states – quantum efficiency - photochemical reaction of ketones- Norrish type-I and type-II reactions. Paterno Buchi reaction- cis and trans isomerisation-Photo-Fries rearrangement and Ene reaction.

UNIT – V

Pericyclic reactions: Definition-classification-characteristic features- the electrocyclic reaction-Woodward – Hofmann rules- orbital correlation diagram- the Frontier molecular orbital theory-electrocyclic conversion of 1,3-dienes and 1,3,5-trienes. Cycloaddition – [2+2] addition-Diel's Alder reaction- stereochemistry of Diel's Alder reaction. Sigmatropic reactions – [1,3], [1,5] and [3,3] sigmatropic shifts - Cope and Claisen rearrangements.

TEXT BOOKS:

1. Jerry March, 1992, Advanced Organic Chemistry. IV Edition, John Wiley & Sons (Asia) Pte. Ltd., Singapore.
2. Mukherji, S.M. and S.P. Singh, 2002. Reaction Mechanism in Organic Chemistry. III Edition, Rajiv Beri for Macmillan India Ltd., New Delhi.
3. Nasipuri D., 2003, Stereochemistry of Organic Compounds-Principles and Applications. II Edition, New Age International (P) Ltd., New Delhi.

REFERENCES:

1. Tewari, N., 2011. Advanced Organic Reaction Mechanism. III Edition, Books and Allied (P) Ltd., Kolkata.
2. Sanyal, S.N., 2003. Reactions, Rearrangements and Reagents. IV Edition, Bharati Bhawan (Publishers and Distributors), New Delhi.
3. Ramesh, P., 2005. Basic Principles of Organic Stereochemistry. I Edition, Meenu Publications, Madurai.
4. Depuy C.H. and O.L. Chapman, 1975. Molecular Reactions and Photochemistry, Prentice-Hall of India Private Limited, New Delhi.
5. Coxon, J.M. and B. Halton, 1974. Organic Photochemistry, Cambridge University Press, Bentley House, 200 Euston Road, London.

Semester-II

15CHP202 INORGANIC CHEMISTRY- II 5H 5C
(CO-ORDINATION CHEMISTRY)

Instruction Hours/week:L: 4 T:1 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

- To understand the theories of bonding in coordination compounds.
- To study the kinetics and mechanisms of reactions of complex compounds.
- To understand the magnetic properties of coordination compounds.
- To learn about the coordination compounds present in the biological systems and their functions.
- To remember the types of coordination compounds like metal carbonyls, carbocyclic pi complex in coordination compounds
- To evaluate the geometries of simple molecules.

Course Outcomes

1. Learned how to name coordination compounds and to be able to draw the structure based on its name
2. Used Crystal Field Theory to understand the magnetic properties (and in simple terms the colour) of coordination compounds
3. Described the stability of metal complexes by the use of formation constants and to calculate thermodynamic parameters from them
4. Recognized the types of coordination compounds like metal carbonyls, carbocyclic pi complexes in coordination compounds
5. Familiar with some reactions and applications of coordination compounds
6. Predicted the geometries of simple molecules

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT-I

Coordination Chemistry: Nomenclature, Isomerism and methods of preparation of coordination complexes- types of ligands.

Bonding: Valence bond theory- Crystal field theory – Crystal field effects in tetrahedral, octahedral and square planar symmetries. Crystal field stabilization energy - weak and strong fields- spectrochemical series. Molecular orbital theory: based on group theoretical approach. M.O. diagram of Oh. Td & square planar symmetries involving pi bonding- experimental evidence for the presence of pi bonding. Magnetic behaviour of the transition metal ions in crystal field and molecular orbital theories.

UNIT-II

Electronic spectra of complexes: Term symbols for d configuration. Characteristics of d-d transition and selection rules. Weak and strong field limits. Orgel and Tanabe - Sugano diagrams. Jahn-Teller tetrahedral distortion and spin orbit couplings. Nephelauxetic effect - charge transfer spectra.

UNIT-III

Metal carbonyls: Methods of preparation, structure, bonding and reactions. Carbonylate ions. Carbonyl hydrides–Vaska's compound, complexes of molecular nitrogen and oxygen. Nitrosyl complexes, dinitrogen complexes. Complexes of unsaturated hydrocarbons- alkenes, allyl and pentadienyl complexes.

UNIT-IV

Carbocyclic pi complexes: Cyclopendienyl and related complexes synthesis, bonding, structure and reaction. Arene complexes-Complexes of biochemical importance: Cytochromes, Haemoglobin, Myoglobin, Cyanocobalamine, Chlorophyll- structure and functions.

UNIT-V

Reaction of coordination compounds: Substitution reactions in square planar and octahedral complexes – Trans effect – mechanism of redox reactions.

Homogeneous catalysis by coordination compounds – hydroformylation –carboxylation of methanol – hydrogenation of unsaturated organic compounds.

TEXT BOOKS:

1. Huheey J. E., E. A. Keitler & R. L. Keitler, 2002. Inorganic Chemistry. Vol. IV, Pearson Education, Singapore.
2. Madan R. L and G. D. Tuli, 2005. Inorganic Chemistry Q & A. S. Chand and Co., New Delhi.
3. Sarn, K, 2005.Co-Ordination Chemistry. Rajat Publications, New Delhi.

REFERENCES:

1. Alan G. Sharpe, 1999. Inorganic Chemistry. III Edition, Addison Wesley Harlow, England.
2. Albert Cotton, F. Geoffrey Wilkinson and Paul. L. Gaus, 2002. Basic Inorganic Chemistry. John Wiley & Sons, New York.
3. Agarwal, R.C., 1998. Some Recent Aspects of Inorganic Chemistry. Kitab Mahal, Allahabad.
4. Chakraburty D.K., 2003. Inorganic Chemistry. New Age International Publishing Pvt. Ltd., New Delhi.
5. Cotton, F.A. & G. Wilkinson, 2003. Advanced Inorganic Chemistry. John Wiley & Sons, New York.
6. Drago, R.S. 1965. Physical Methods in Inorganic Chemistry. Rein Gold Publishing Corporation, New York.

Semester-II

15CHP203 PHYSICAL CHEMISTRY- II 4H 4C

(CHEMICAL KINETICS AND ELECTROCHEMISTRY)

Instruction Hours/week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

- To provide knowledge on fundamental understanding of chemical kinetics and to establish a relationship between the rate of reaction and the concentration of the reactants (the rate law, or rate equation).
- To apply the chemical kinetics concept to study the enzyme mechanisms.
- To provide knowledge to the students about coulometric methods and its application.
- To investigate the adsorption, classification of adsorption and factors affecting of adsorption over corrosion application.
- To remember the basic polarography concepts.
- To understand the theories of catalysis and types of catalysis.

Course outcomes

1. Student understood theories of reaction rates, how reaction rates are measured and represented in rate laws.
2. Understood the applications of chemical kinetics in studying enzyme mechanisms
3. Provided the knowledge of coulometric methods and applications.
4. Evaluated the electrochemical principles involved in corrosion and energy storage.
5. Remembered the basic polarography techniques.
6. Understood the theories of catalysis and types of catalysis

Methodology

Black-board teaching, Powerpoint presentation and group discussion.

UNIT-I

Theories of reaction rates: Arrhenius theory- hard - sphere collision theory of gas – phase reactions. Activated complex theory or Absolute reaction rate theory (ARRT) for ideal gas reactions (in terms of partition functions).

Reactions in solution: Comparison between gas-phase and solution reactions. The influence of the solvent on the reactions between ions. Influence of ionic strength on rates of reactions in solution - Primary salt effect-influence of pressure on rates of reactions in solution -significance of volume and entropy of activations.

Study of Fast reactions: Flow methods, pulse methods, relaxation methods, shock-tube method and nuclear magnetic resonance method.

UNIT-II

Homogeneous catalysis: Specific and general acid - base catalysis. Bronsted catalysis law- Hammett acidity functions. Enzyme catalysis (single substrate reaction only). Michaelis Menten law - Influence of pH and temperature on enzyme catalysis.

Surface phenomenon and heterogeneous catalysis: Adsorption and free energy relation at interfaces. Gibb's adsorption isotherm- physisorption and chemisorptions- Adsorption

isotherms (Freundlich & Langmuir). Kinetics of heterogeneous catalysis- Langmuir - Hinshelwood and Langmuir - Rideal - Eley mechanisms.

UNIT-III

Inter ionic attraction theory: Debye – Huckel – Onsager equation - Falkenhagen effect- Wien effect. Activity and activity coefficient- Ionic strength- Debye – Huckel limiting law and its applications.

Theories of double layer. Helmholtz – Perrin - Gouy chapmann – Stern theories**.**

UNIT – IV

Polarography: Current – voltage relationships-The dropping mercury electrode. Diffusion current- Half – wave potentials. Applications of polarography- Amperometric titrations.

Fundamental principles of coulometric methods- Constant current and controlled potential methods- Simple applications.

UNIT – V

Kinetics of corrosion: Importance–Graphical presentation of kinetic data-exchange current density- different types of polarization of electrodes. Activation polarization and Tafel plots-Mixed potential theory-Application of electrode kinetics to experimental observations-Faradic impedance and corrosion.

TEXT BOOKS:

1. Bahl, B. S, Arun Bahl and Tuli, G.D, 2005. Essentials of Physical Chemistry, S. Chand & Company, New Delhi-110 055.
2. Puri, B. R, Sharma, L.R, Madan S. Pathania, 2013. Elements of Physical Chemistry, Vishal Publishing, Jalandhar.

REFERENCES:

1. Keith J. Laidler, 2004, Chemical Kinetics, Pearson Education Publishing, Indian branch, New Delhi.
2. Atkins, P.W, 2002. Physical Chemistry. IX Edition, Oxford Publishers, Oxford.
3. Glasstone, S. 2002. An Introduction to Electrochemistry. Litton Educational Publishing, New Delhi.
4. Arora, M.G, 1996. Polarographic Methods in Analytical Chemistry. I Edition, Anmol Publications, New Delhi.
5. Raj Narayan, 1983. An Introduction to Metallic Corrosion and Its Prevention. Mohan Primlani for Oxford & IBH Publishing Company.
6. Moore W.J., 1999. Physical Chemistry. V Edition, Orient Longman Ltd., Prentice Hall-INC Delhi.
7. Rajaram, J and K.C. Kuriakose, 1993. Kinetics & Mechanisms of Chemical Transformations. Mac Millan, Chennai.

OPEN ELECTIVE **Semester-II**

15OEP201 **CHROMATOGRAPHIC TECHNIQUES** **3C**

Instruction Hours/week:L: 0 T:0 P:0 **External: 100 Total: 100**

Course Objectives

- To make non-chemistry graduates to get exposed to different chromatographic techniques.
- To learn the terms and definitions in general chemistry and use of popularly used chemicals.
- To enable the student to understand about instrumentation in chromatography.
- To explain the basic ideas of separation techniques.
- To implement the some chromatography techniques to separate the compounds from mixtures.
- To describe the concepts in Gas-Liquid and HPLC.

Course Objectives

1. Make non-chemistry graduates to get exposed to different chromatographic techniques.
2. Learned the terms and definitions in general chemistry and use of popularly used chemicals.
3. Enabled the student to understand about instrumentation in chromatography.
4. Understood the basic ideas of separation techniques.
5. Apply the some chromatography techniques to separate the compounds from mixtures.
6. Described the concepts in Gas-Liquid and HPLC.

Methodology

Self study

UNIT- I

Chromatographic methods, general aspects of chromatography, classification and types, mechanism.

UNIT- II

Column chromatography, construction and operation of column, choice of adsorbent elements, applications. Ion exchange chromatography : Anion and cation exchangers techniques applications.

UNIT- III

Paper chromatography: Mechanism of separation, development and applications. Thin layer chromatography: Techniques, choice of adsorbent solvents and applications.

UNIT- IV

Gas-liquid Chromatography, Principles, Retention Volumes, Instrumentation, Carrier Gas, Columns, Stationary Phase, Detectors, Thermal Conductivity, Flame Ionization, Electron Capture, application of G.L.C.

UNIT -V

High Performance Liquid chromatography: Scope, Column efficiency, Instrumentation, Pumping Systems, Columns, Column packing, Detectors, Applications.

TEXT BOOKS:

1. Vogel's, 2000. Text book of Quantitative Chemical Analysis. VI Edition, Pearson Education Limited, London.
2. Sharma B.K., 2005. Instrumental Methods of Chemical Analysis. 24 Edition, Krishna Prakashan Media (P) Ltd, Meerut.

REFERENCES:

1. Skoog, D. A And J. J. Leary, 1971. Principles of Instrumental Analysis. IV Edition, Saunders College Publishing, US.

ELECTIVE-I **Semester - III**

15CHP204A ADVANCED ORGANIC CHEMISTRY 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Objectives

On successful completion of the course the students should have:

- To describe heterocyclic compounds, synthetically important name reactions in organic chemistry.
- To list the various reagents used in organic synthesis
- To understand the composition of **c**hemotherapy.
- To learn about some basic anti biotics.
- To remember the various vitamins and its synthesis.
- To construct a small organic moiety with basic pharmacokinetics property.

Course Outcomes

1. Described the heterocyclic compounds and some important naming reactions.
2. Listed the various reagents used in organic synthesis.
3. Understood the composition of chemotherapy.
4. Learned about some basic anti-biotics
5. Remembered the various vitamins and its synthesis.
6. Applied to make a small organic moiety with basic pharmacokinetics property.

Methodology

Black-board teaching, Power point presentation and group discussion.

UNIT-I

Heterocyclic compounds: Nomenclature-methods of preparation and important reactions of indole, pyrazole, imidazole, quinoline, isoquinoline, uric acid and adenine. Structure elucidation of caffeine.

A general study of flavones, isoflavones and anthocyanins – structure and synthesis of quercetin and cyanidin chloride.

UNIT-II

Reagents in organic synthesis: Use of the following reagents in organic synthesis and functional group transformations: Gilmans reagent, Diazomethane, N-Bromosuccinimide, Lead Tetraacetate, Raney Nickel, Trimethylsilyl Iodide, Tri-n-Butyltin hydride, Periodic Acid, Sodium Amide, Jones reagent, Wilkinsons catalyst, 1,3-dithiane and Fenton's reagent.

UNIT-III

Some typical reactions and their applications in organic synthesis: C-C and C=C bond forming reactions-Vilsmeier – Haack, Shapiro, Wittig – Horner, Peterson synthesis and Heck reactions. Ring formation by Robinson annulation Simmons-Smith reaction.

Woodward Prevost hydroxylation, Oppenauer oxidation, Birch reduction, Clemmenson reduction, Wolff Kishner reduction, Sharpless asymmetric epoxidation.

UNIT-IV

Chemotherapy: Introduction-Sulphonamides-Antimalarials-Arsenical drugs.

Antibiotics: A detailed study of structure, stereochemistry and synthesis of Penicllin, Cephalosporin C, Chloramphenicol and Patulin. The macrolide group of antibiotics-polypeptide antibiotics-polyacetylene antibiotics.

UNIT- V

Vitamins: Structure and synthesis of vitamin B complex : Vitamin B1 (aneurin) - vitamin B2 (riboflavin) - pantothenic acid - folic acid - vitamin H (biotin) - vitamin B6 (pyridoxine) - vitamin E (tocopherol) - vitamin K1 (phylloquinone) and vitamin K2.

TEXT BOOKS:

1. Finar, I.L., 2007. Organic Chemistry Vol. I: The Fundamental Principles. VI Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi.
2. Finar, I.L., 2000. Organic Chemistry Vol. II: Stereochemistry and the Chemistry of Natural Products. V Edition, Addison Wesley Longman (Singapore) Pte. Ltd-Indian Branch, New Delhi.
3. Jerry March, 1992, Advanced Organic Chemistry. IV Edition, John Wiley & Sons (Asia) Pte. Ltd., Singapore.

REFERENCES:

1. Sanyal, S.N., 2003. Reactions, Rearrangements and Reagents. IV Edition, Bharathi Bhawan (Publishers and Distributors), New Delhi.
2. Tewari, N., 2011. Advanced Organic Reaction Mechanism. III Edition, Books and Allied (P) Ltd, Kolkata.
3. Gurdeep Raj, 2013. Organic Name Reactions and Molecular Rearrangements. III Edition, Krishna Media Prakashan Pvt. Ltd., Meerut.

ELECTIVE-I **Semester - II**

15CHP204B ANALYTICAL CHEMISTRY 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course objectives

This course enables the students

- To learn about quantitative inorganic analysis.
- To understand the different colorimetric analysis.
- To learn about electrochemical methods of analysis.
- To learn different chromatographic techniques.
- To understand how to analyze the data obtained.
- To Explain about various analytical techniques for inorganic compounds.

Course Outcomes (CO's)

On successful completion of the course the students should have to

1. Learned about quantitative inorganic analysis.
2. Understood the different colorimetric analysis.
3. Learned the electrochemical methods of analysis.
4. Understood the different chromatographic techniques.
5. Learned about how to analyze the data obtained.
6. Explained the various analytical techniques for inorganic compounds.

Methodology

Black-board teaching, Powerpoint presentation and group discussion.

UNIT-I

Quantitative Inorganic Analysis: Theoretical basis of quantitative inorganic analysis-common ion effect solubility product, effect of acid, temperature and solvent upon the solubility of a precipitate.

Supersaturation-Von Weimarn concept. Formation and treatment of precipitates-co-precipitation and post-precipitation. Precipitation from homogeneous solution. Specific and selective precipitants.

Principles of acid-base, oxidation-reduction, precipitation and complexometric titrations-indicators used in such titrations. Uses of organic reagents in inorganic quantitative and qualitative analysis.

UNIT-II

Data Analysis: Errors in chemical analysis-Defining terms: Mean median, accuracy and precision – classification of errors: Systematic errors and random errors. Improving accuracy of analysis – mean, standard deviation and Q-test. Comparison of results – Least square, 't'-teat, 'F'-test and 'Chi' square test.

UNIT-III

Techniques in Inorganic Chemistry: Colorimetry: Theoretical and practical aspects of colorimetric analysis. Flame emission and atomic absorption spectroscopy – types of

atomic spectroscopy – emission methods – absorption methods – fluorescence methods – source and atomizers for atomic spectroscopy – flame atomizers – Eletrothermal atomizers – principle and applications of atomic absorption spectroscopy. Advantages of atomic absorption spectrometry over flame photometry.

UNIT-IV

Electrochemical Methods of Analysis: Cyclic Votammetry, Coulometry and amperometry-principle and applications.

Thermal Characterization techniques: Principle and applications of Differential Thermal Analysis (DTA), Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration.

UNIT- V

Chromatographic Methods: Classification – techniques and applications in column, size-exclusion, ion exchange, paper and thin layer chromatography.

Gas chromatography and high performance liquid chromatography (HPLC)-principle, equipment design, sample injection system, columns, detectors and applications.

TEXT BOOKS:

1. Vogel A. T, 1962. A Text Book of Quantitative Inorganic Analysis. Longman Publishing Group, United Kingdom.
2. Christian G. D, 2007. Analytical Chemistry. VI Edition, John Wiley & Sons, United States.

REFERENCES:

1. Skoog, D. A., D. M .West, F. J. Holler and S. R. Crouch, 2014. Fundamentals of Analytical Chemistry. IX Edition, Cengage Learning, United States of America.
2. Skoog, D. A., F. J. Holler and S.R. Crouch, 2007, Principles of Instrumental Analysis. VI Edition, Thomson Brooks/Cole Publishers, United States of America.
3. Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch, 2000. Analytical Chemistry – An Introduction. VII Edition, Cengage Learning, United States of America.

ELECTIVE-I **Semester - II**

15CHP204C ORGANOMETALLIC CHEMISTRY 4H 4C

Instruction Hours/week:L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total:100

Course objectives

This course enables the students

- To learn about nature of the bonding between organic ligands and metals.
- To understand about the metal alkyl complexes.
- To learn about the alkene and cyclopentadienyl complexes.
- To understand about the usage of organometallic compounds as catalysts
- To learn about the organometallic compound used as the catalyst in hydrogenation and hydroxylation of olefins.
- To study the concept of oxidation and polymerization of olefins.

Course Outcomes

On the completion of the course

1. Learned about the Alkyls and Arene complexes
2. Understood the bonding in olefin, acetylene and allyl systems
3. Known about the concepts of synthesis, structure and bonding in metallocenes
4. Understood the Organometallic reaction mechanisms and its applications
5. Learned about the Catalysis, hydrogenation of olefins and oxoprocess
6. Studied the concept of oxidation of olefins and polymerization

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

Metal carbonyls: Definition of organometallic compound - 18 electron rule - effective atomic number rule classification of organometallic compounds - the metal carbon bond types - ionic bond - sigma covalent bond - electron deficient bond - delocalised bond - dative bond - metal carbonyl complexes - synthesis - structure and reactions of metal carbonyls - the nature of M- CO bonding - binding mode of CO and IR spectra of metal carbonyls - metal carbonyls- metal carbonyl anions - metal carbonyl hydrides - metal carbonyl halides - metal carbonyl clusters - Wades rule and isolobal relationship - metal nitrosyls - dinitrogen complexes - dioxygen complexes.

UNIT- II

Metal alkyl complexes: Stability and structure - synthesis by alkylation of metal halides - by oxidative addition - by nucleophilic attack on coordinated ligands - metal alkyl and 18 electron rule - reactivity of metal alkyls - M-C bond cleavage reactions - insertion of CO to M-C bonds - double carbonylation - insertions of alkenes and alkynes - insertions of metals with C-H bonds - alkylidene and alkylidyne complexes - synthesis of alkylidene complexes in low oxidation states and in high oxidation states - bonding in

alkylidene complexes - synthesis and bonding in alkylidyne complexes - reactivity of alkylidene and alkylidyne complexes.

UNIT- III

Alkene complexes: Synthesis of alkene complexes by ligand substitutuion - by reduction and by metal atom synthesis - bonding of alkenes to transition metals - bonding in diene complexes - reactivity of alkene complexes - ligand substitution - reactions with nucleophiles - olefin hydrogenation - hydrosilation - Wacker process - C-H activation of alkenes - alkyne complexes - bonding in alkyne complexes - reactivity of alkynes - alkyne complexes in synthesis - cobalt catalysed alkyne cycloaddition.

UNIT- IV

Cyclopentadienyl complexes: Metallocenes - synthesis of metallocenes - bonding in metallocenes - reactions of metallocenes - Cp_2Fe/Cp_2Fe+ couples in biosensors - bent sandwich
complexes - bonding in bent sandwich complexes - metallocene halides and hydrides - metallocene and stereospecific polymerisation of 1-alkenes - cyclopentadiene as a non-spectator
ligand - monocyclopentadienyl (half-sandwich) complexes - synthesis and structures of allyl complexes - arene complexes - synthesis - structure and reactivity of arene complexes - multidecker complexes.

UNIT - V

Organometallic compounds in homogeneous catalytic reactions: Coordinative unsaturation - acid-base behaviour reaction - migration of atoms or groups from metal to ligand - insertion reaction - reactions of coordinated ligands - catalytic reactions of alkenes - isomerisation of alkenes - hydrogenation - hydroformylation and hydrosilation of alkenes - alkene polymerisation and oligomerisation - fluxional molecules.

TEXT BOOKS:

1. Huhee, J. E., 1978. Inorganic Chemistry - Priciples of Structure and Reactivity, Harper International Edition, Harper and Rone, New York.
2. Haiduc J and J. J. Zuckerman, 1985. Basic Organometallic Chemistry, Walter de Gruyter, Brelin.

REFERENCES:

1. Bockmann, 1996. Organometallics 1, Complexes with transition metal-carbon-bonds, Oxford science publications, Oxford, UK.
2. Bockmann, 1996. Organometallics 2, Complexes with transition metal-carbon bonds, Oxford science publications, Oxford, UK.
3. Cotton, F. A and G. Wilkinson, 1978. Basic Inorganic Chemistry, Wiley Easter.

ELECTIVE-I **Semester-II**

15CHP204D ADVANCED COORDINATION CHEMISTRY 4H 4C

Instruction Hours/week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

- To understand bonding parameters in cubic and distorted geometries from absorption spectra.
- To identify coordination compounds with noble electrochemical and photochemical properties suitable for the construct ion of supramolecular assemblies and nanostructures.
- To envision the importance of inorganic photosensitizers for solar energy conversion.
- To identify complexes suitable for application in medicinal inorganic chemistry.
- To implement these ideas to synthesis any new metal coordinate compounds.
- To set research goals in the highly topical areas of research in coordination chemistry.

Course Outcomes

1. Understood bonding parameters in cubic and distorted geometries from absorption spectra.
2. Identified the coordination compounds with noble electrochemical and photochemical properties suitable for the construct ion of supramolecular assemblies and nanostructures.
3. Proposed the importance of inorganic photosensitizers for solar energy conversion.
4. Remembered the complexes suitable for application in medicinal inorganic chemistry.
5. Applied these ideas to synthesis any new metal coordinate compounds.
6. Set research goals in the highly topical areas of research in coordination chemistry.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

Electronic Structure and Geometry of Coordination Compounds: Electronic spectroscopy: crystal field spectra of Oh and Td complexes, effect of distortion on the spectra, structural evidence from electronic spectra, evaluation of Δo values in Co(III) and Ni(II) Oh and Td complexes, quantification of covalency nephelauxetic ratio.

Nuclear magnetic resonance spectroscopy: application of spin-spin coupling to inorganic structural determinations, NMR spectra of quadrupolar nuclei, NMR of paramagnetic transition metal complexes: scalar shift and pseudocontact shift, scalar shift and covalency.

Electron spin resonance spectroscopy: hyperfine and zero field effects on the epr spectra of coordination compounds, ligand field interpret at ion of the g- and A- tensors, nuclear qudrupole interaction.

Mossbauer spectroscopy: quadrupole and magnetic interactions, isomer shift and site symmetry of metal ions in coordination compounds, Mossbauer emission spectroscopy and applications.

UNIT- II

Electrochemical Studies and Photochemistry: Applications of AC polarography, cyclic voltammetry, and differential pulse voltammetry to the study of coordination compounds: computation of electrochemical parameters and evaluation of reversibility. Spectroelectrochemistry: optically transparent electrodes and cells, chrono absorptometry.

Solar and renewable energy: light- to-chemical energy conversion in lamellar solids and thin films, solar energy conversion by dye-sensitized photovoltaic cells and by coordination compounds anchored onto semiconductor surfaces.

Photochemistry of lanthanide complexes: A-ET-E processes, NIR- to-visible photon up conversion, nonlinear optical behavior, exciting multiplication and relaxation dynamics in quantum dots and applications.

UNIT- III

Supramolecular Assemblies and Devices: Supramolecular assemblies: design principles, homo- and heteropoly metallic polypyridyl systems, inter component energy and electron transfer, role of bridging ligands.

Dendrimers and metallodendrimers: synthetic methodology-divergent and convergent methodologies; types of metallodendrimers, dendrimer encapsulated catalysis.

Molecular devices: supramolecular photochemistry, photo- and electrochemical sensors, molecular electronic devices.

UNIT-IV

Inorganic Biochemistry and Medicinal Inorganic Chemistry: Photosynthesis: biological photosynthesis, chemical approaches to artificial photosynthesis-light harvesting dendrimers and multiporphyrin arrays.

Bioredox agents: rubredoxins and ferredoxins- functions and structural features.

Contrast enhancing agents for MRI: theory of MRI imaging, synthesis of Gd-based contrast agents.

Metal complexes for radiotherapy: diagnostic radiopharmaceuticals, non- technetium for diagnostic imaging, Tc-labelled small molecules and peptides as diagnostic radiopharmaceuticals.

Metal complexes as photosensitizers.

UNIT-V

Synthesis of Novel Coordination Compounds and Assemblies: Synthesis of Schiff base macrocycles and macrocyclic binucleating ligands by coordination template effects.

Polyazamacrocycles and macrocycles with pendant arms.

Construction of polynuclear supramolecular assemblies and nanostructures.

TEXT BOOKS:

1. Huheey, J. E, E. A. Keiter and R. L. Keiter, 1983. Inorganic Chemistry. IV Edition, Harper and Row, New York.
2. Lever. A. B. P., 1984. Inorganic Electronic Spectroscopy. II Edition, Elsevier Publishing Company, Amsterdam.
3. Steed, J. W and J. L. Atwood, 2000. Supramolecular Chemistry, John Wiley & Sons Ltd., New York.
4. Drago, R. S., 1977. Physical Methods in Chemistry, Saunders, Philadelphia.

REFERENCES:

1. Cotton, F. A., G. Wilkinson, C. A. Murillo and M. Bochmann, 1998. Advanced Inorganic Chemistry. VI Edition, Wiley Interscience, New York.
2. Purcell, K. F and J. C. Kotz, 1976. Inorganic Chemistry, Saunders, Philadelphia.
3. Weil, J. A., J. R. Bolton and J. E. Wertz, 1994. Electron Paramagnetic Resonance, Wiley Interscience, New York.
4. Kissinger, P. T and W. R. Heinnan, 1996. Laboratory Techniques in Electroanalytical Chemistry. II Edition, Marcel Dekker Inc., New York.
5. Sawyer, D. T., A. Sobkowiak and J. L. Roberts, 1995. Electrochemistry for Chemists. II Edition, Wiley Interscience, New York.
6. Lehn, J.M., 1995. Supramolecular Chemistry, Concepts and Perspectives, VCH, Weinheim.

ELECTIVE-I **Semester - II**

15CHP204E ORGANIC CHEMICAL TECHNOLOGY 4H 4C

Instruction Hours/week: L: 4 T: 0 P: 0 arks: Internal: 40 External: 60 Total:100

Course Objectives

This course enables the students

- To understand the elements of chemical engineering in organic synthesis.
- To know the unit processes in organic chemical technology.
- To understand the techniques involved in typical organic synthesis.
- To know the thermodynamics in organic unit processes.
- To apply the knowledge of chemical reactions in organic synthesis.
- To study the detailed manufacture techniques to synthesis dye, pigment and dugs.

Course Outcomes

On the completion of the course, students to

1. Understood the elements of chemical engineering in organic synthesis.
2. Knew the unit processes in organic chemical technology.
3. Understood the techniques involved in typical organic synthesis.
4. Learned the thermodynamics in organic unit processes.
5. Applied the knowledge of chemical reactions in organic synthesis.
6. Studied the detailed manufacture techniques to synthesis dye, pigment and dugs.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT– I

Elements of Chemical Engineering: Unit operations in chemical engineering: Fluid flow: Reynold's number; Laminar and turbulent flow. Bernoullis' equation, head loss in piping. Calculation of head as an aid in selecting pumps. Turbulent flow and its relevance in heat transfer. Agitation and mixing of liquids.

UNIT- II

Heat transfer: Heat transfer coefficient, Importance of heat transfer in chemical process. Special provisions for heat transfer in highly exothermic reactions. Corrosion and scale formation in heat exchangers and condensers. Preliminary data to aid design of heat transfer equipment.

Mass transfer: Distillation- two and three component systems. Ideal and non- ideal systems, various types of fractioning columns. Calculation of HETP from distillation curves. Leaching and extract ion based on process parameters.

Filtration and Drying: Select ion of proper equipment for above operations.

UNIT- III

Applications of Thermodynamics in Organic Unit Processes: Energy balance over a f low system, heat of react ion, effect of temperature upon heat of react ion Chemical equilibrium, calculation of equilibrium conversion, entropy changes, simultaneous react ions, vapour phase and liquid phase catalytic react ions.

Organic Chemical Process Kinetics: Factors affecting chemical processes Type and shape of reactors used, the method of operation, temperature control Batch or f low process, batch mixing, fixed or fluidized bed.

UNIT- IV

Unit Process in Industrial Organic Synthesis: Study of Organic react ions as they apply to industrial processes. Process parameters of importance in scaling up of these reactions from laboratory to pilot plant to main plant.

Select ion of suitable plant equipment, especially the shape and size of the reactor stirrer, condenser etc. choice of material of construct ion.

Study of industrial scale nitration, sulphonation, homogeneous and heterogeneous hydrogenation, oxidation and halogenations reactions.

UNIT-V

Study of Detailed Technologies of Manufacture- a dye, a drug and a pigment: Three specific chemicals, one each from the above category will be discussed, illustrating the chemical engineering principles used in proper select ion of equipment.

The logic involved in the layout of the plant, the control tests for the process itself and isolation methods of the product and its standardization.

Importance of quality control and technical service to customers will be pointed out.

TEXT BOOKS:

1. Chris A. Clausen and Guy Matson, 1978. Principles of Industrial Chemistry, John Willey & Sons, New York.
2. Gopala Rao M and Marshall Sittig, 2001. III Edition, Outlines of Chemical Technology. Affiliated East-West Press Pvt. Ltd., New Delhi.

REFERENCES:

1. McCabe W.L and J.C. Smith, 1976. Unit Operations of Chemical Engineering. III Edition, McGraw-Hill Kogakusha Ltd., Tokyo.
2. Groggins, P.H., 1958. Unit Processes in Organic Synthesis. V Edition, McGraw-Hill Kogakusha Ltd., Tokyo.
3. Dridens, 2001. Outlines' of Chemical Technology. Affiliated East-West Press Pvt. Ltd., New Delhi.

Semester - II

15CHP211 INORGANIC CHEMISTRY PRACTICAL–I 5H 3C
(QUALITATIVE ANALYSIS AND PREPARATIONS)

Instruction Hours/week:L: 0 T:0 P:5 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the students should have

- To learn about the qualitative analysis by semi micro-qualitative analysis method.
- To learn the preparation of inorganic complexes.
- To describe the basic concept and advantages of semi- micro qualitative analysis.
- To understand the systematic separation d-block elements
- To study the step wise procedure to predict the anions along with metals
- To identify the d-block elements with their special tests.

Course Outcomes

Students have to,

1. Learned about the qualitative analysis by semi micro-qualitative analysis method.
2. Learned the preparation of inorganic complexes.
3. Described the basic concept and advantages of semi- micro qualitative analysis.
4. Understood the systematic separation d-block elements
5. Studied the step wise procedure to predict the anions along with metals
6. Identified the d-block elements with their special tests.

Methodology

Blackboard teaching and Demonstration.

Contents

Thallium, Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, titanium, Zirconium, Vanadium, Beryllium, Uranium and Lithium.

Note: Each student should analyze a minimum of six inorganic mixtures.

About ten preparations involving different techniques selected from the following:
Lead tetra acetate, dipyridinium hexaplumbate, hydroxylamine hydrochloride, ortho and para- hydroxy phenyl mercuric chloride, potassium cupric chloride, chrome alum, copperI chloride, tris(thio urea) copper(I) Chloride, potassium trioxalato- aluminato(III), potassium trioxalato-chromate(III), potassium trioxalato- ferrate(III), hexammine cobalt(III)chloride, chloropentammine chromium(III), chloro aquo pentammine chromium(III) nitrate, tetrammine copper(II) sulphate, ammonium hexa chloro stanate(IV).

Note: Each student should do a minimum of ten preparations.

REFERENCES:

1. Ramanujam, V.V. 2004. Inorganic Semi-micro Qualitative Analysis. III Edition, The National Publishing Company, Chennai.
2. Venkateswaran, V. R. Veeraswamy and A. R. Kulandaivelu, 2004. Basic Principles of Practical Chemistry. II Edition, S. Chand Publications, New Delhi.
3. Siddhiqui, Zeba N 2002. Practical industrial Chemistry. I Edition, Anmol Publications Pvt. Ltd., New Delhi.
4. Mendham, J. R. C. Denney, J. D. Barnes and M. Thomas, 2002. Vogel's textbook of quantitative Chemical Analysis. VI Edition, Pearson Education Ltd., Singapore.
5. Lepse, Paul A and Lyle B. Peter, 1986. Lab Manual for Lingren's Essentials of Chemistry. Prentice Hall, New Delhi.

Semester - II

15CHP212 INORGANIC CHEMISTRY PRACTICAL –II 5H 3C
(QUANTITATIVE ANALYSIS AND COMPLEX PREPARATIONS)

Instruction Hours/week:L: 0 T:0 P:5 Marks: Internal:40 External: 60 Total:100

Course Objectives

Course enables the students should have

- To learn about the basic principles about quantitative analyses.
- To study the concepts and systematic procedure in gravimetric analysis.
- To must know about the systematic procedure for estimation.
- To describe the synthesis method for in-organic co-ordination complexes
- To separate the molecules and identify its nature through chromatography technique.
- To apply this ideas and concepts to water treatment process, food science and forensic fields.

Course Outcomes

On successful completion of the course the students should have

1. Learned about the basic principles about quantitative analyses.
2. Studied the concepts and systematic procedure in gravimetric analysis.
3. Knew about the systematic procedure for estimation.
4. Described the synthesis method for in-organic co-ordination complexes
5. Known about separate the molecules and identify its nature through chromatography technique.
6. Applied this ideas and concepts to water treatment process, food science and forensic fields.

Methodology

Blackboard teaching and Demonstration.

Contents

Analysis of mixture of ions – Volumetry and Gravimetry. Any four Complexometric titration- estimation of Zinc, nickel, magnesium and calcium ions using Eriochrome black-T or muroxide indicator.

Titrimetry: Oxidation using ceric and vanadium salts.

Chromatography: Column, Paper and Thin layer chromatography.

Titrations in non aqueous solvents.

Preparation, analysis and study of co-ordination complexes (any 5).

REFERENCES:

1. Lepse, Paul A. and Lyle B.Peter, 1986. Lab Manual for Lingren's Essentials of Chemistry. Prentice Hall, New Delhi.
2. Mendham, J. R. C. Denney, J. D. Barnes and M. Thomas, 2002. Vogel's textbook of quantitative Chemical Analysis. VI Edition, Pearson Education Ltd., Singapore.
3. Ramanujam V.V., 1993. Inorganic Semi-micro Qualitative Analysis. III Edition, The National Publishing Company, Chennai.
4. Siddhiqui,Zeba N 2002. Practical industrial Chemistry. I Edition, Anmol Publications Pvt. Ltd., New Delhi.
5. Venkateswaran, V. R. Veeraswamy and A. R. Kulandaivelu, 2004. Basic Principles of Practical Chemistry. II Edition, S. Chand Publications, New Delhi.

Semester-III

15CHP301 ORGANIC CHEMISTRY- III 4H 4C
(NATURAL PRODUCTS)

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

On successful completion of the course the students should have,

- To Study about Isolation, classification and structure determination of simple terpenoids.
- To learn about Isolation, classification and structure determination of simple steroids and alkaloids
- To know the structure of proteins, enzymes and nucleic acids.
- To discuss about the biological application of DNA and RNA.
- To list the various reagents used in organic synthesis
- To apply this fundamentals to clarify the pharmacological and biological activity of organic molecules

Course outcomes

The students have

1. Studied about Isolation, classification and structure determination of simple terpenoids.
2. Learned about Isolation, classification and structure determination of simple steroids and alkaloids
3. Knew the structure of proteins, enzymes and nucleic acids.
4. Discussed about the biological application of DNA and RNA.
5. Remembered the various reagents used in organic synthesis
6. Applied this fundamentals to clarify the pharmacological and biological activity of organic molecules

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT-I

Terpenoids: Isolation and classification of terpenoids – general methods of determining structure of terpenoids –structural elucidation and synthesis of Zingiberene, Eudesmol, Abietic acid, Caryophyllene and Santonin-biosynthesis of monoterpenoids**.**

UNIT-II

Steroids: Introduction – structural elucidation and synthesis of Cholesterol (synthesis not necessary), Ergosterol, Vitamin D, Equilenin, Oestrone, Testosterone and Progesterone. Bile acids – biosynthesis of sterols.

UNIT-III

Alkaloids: Definition of an alkaloid-extraction of alkaloids-general properties - general methods of determining structure of alkaloids – structural elucidation and synthesis of Atropine, Morphine and Quinine -biosynthesis of quinoline alkaloids.

UNIT-IV

Proteins: General nature of proteins - classification of proteins – synthesis of peptides – oxytocin- insulin.

Enzymes: Nomenclature and classification - cofactors – specificity of enzyme action-mechanism of enzyme action. Nucleic acids- structures of RNA and DNA and their biological importance.

UNIT- V

Reagents in organic synthesis: Preparations and synthetic applications of DDQ, DBU, Ozone, Diborane, Osmium tetroxide, Selenium dioxide, Dicyclohexylcarbodiimide (DCC), LDA, DIBAL-H and Mercuric acetate.

TEXT BOOKS:

1. Gurdeep R. Chatwal, 2004. Organic Chemistry of Natural Products. Vol. II, Himalaya Publishing House, New Delhi.
2. Finar, I.L., 2000. Organic Chemistry Vol. II: Stereochemistry and the Chemistry of Natural Products. V Edition, Addison Wesley Longman (Singapore) Pte. Ltd-Indian Branch, New Delhi.
3. Jerry March, 1992, Advanced Organic Chemistry. IV Edition, John Wiley & Sons (Asia) Pte. Ltd., Singapore.
4. Agarwal O.P, 2004. Natural Product Chemistry. Vol. II, Goel Publishing House, Meerut.

REFERENCES:

1. Gurdeep R. Chatwal, 2001. Organic Chemistry of Natural Products. Vol. I, Himalaya Publishing House, New Delhi.
2. Sanyal, S.N., 2003. Reactions, Rearrangements and Reagents. IV Edition, Bharathi Bhawan (Publishers and Distributors), New Delhi.
3. Tewari, N., 2011. Advanced Organic Reaction Mechanism. III Edition, Books and Allied (P) Ltd, Kolkata.

Semester-III

15CHP302 PHYSICAL CHEMISTRY- III (THERMODYNAMICS) 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

The course enables the student to

- Understand about thermodynamics and Non-ideal systems
- Learn the third law of thermodynamics
- Study the classical Maxwell-Boltzman and quantum statistics
- Know about partition functions and determining thermodynamic properties
- Understand heat capacity of solids.
- Apply the thermodynamic factors in various organic synthesis processes (how the reaction condition and reaction rate various depend on the thermodynamic factors).

Course Outcomes

The students have to,

1. Understood about thermodynamics and Non-ideal systems
2. Learned the third law of thermodynamics
3. Studied the classical Maxwell-Boltzman and quantum statistics
4. Knew about partition functions and determining thermodynamic properties
5. Understood heat capacity of solids.
6. Applied the thermodynamic factors in various organic synthesis processes (how the reaction condition and reaction rate various depend on the thermodynamic factors).

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Themodynamics and Non-ideal systems: Chemical potential and the definition of fugacity. Determination of fugacity of gases by graphical method and from equations of state. Variation of fugacity with temperature. Fugacity and the standard states for non ideal gases.

Definition of activity. Activity coefficient. Temperature coefficient of activity. Standard states. Applications of activity concept to solutions. The rational and practical approaches. Measurement of activity of solvent from colligative properties. Determination of activity of solute.

UNIT – II

Third Law of Thermodynamics: Probability and third law. Need for third law. Nernst heat theorem and other forms stating third law. Thermodynamic quantities at absolute zero. Statistical meaning of third law and apparent exception.

Mathematical Introduction: Theories of permutation & combination, Laws of probability. Distribution laws. Gaussian distribution.

UNIT – III

Classical Maxwell – Boltzmann Statistics: Maxwell distribution law for molecular velocities and molecular speeds in an ideal gas. Velocity and speed distribution functions. Experimental verification of Maxwell distribution law. Evaluation of average speed, root mean square speed and most probable speed from distribution law. Distribution function in terms of the kinetic energy of an ideal gas. The principle of equipartition of energy and the calculation of heat capacities of ideal gases. Limitations of the principle of equipartition of energy.

Quantum statistics: Maxwell-Boltzmann statistics. Thermodynamic probability. Thermodynamic probabilities of systems in equilibrium. Boltzmann expression for entropy. Stirling's approximation. State of maximum thermodynamics probability. Legrangian multipliers. Thermodynamic probabilities of systems involving energy levels. Maxwell-Boltzmann distribution law. Evaluation of alpha and beta in MB distribution law.

UNIT – IV

Partition function: Definition, justification of nomenclature, microcanonical and canonical ensembles. Molecular partition and canonical function. The relation between the total partition function of a molecule and the separate partition functions. Translational partition function, rotational partition function. Effect of molecular symmetry on rotational partition function. Ortho and Para hydrogen. Vibrational partition function. Electronic partition function. Evaluation of thermodynamic properties E,H,S,A,G,Cv and Cp from monoatomic and diatomic ideal gas molecules partition functions. Thermodynamic properties of polyatomic ideal gases. Calculation of equilibrium constants of reaction involving ideal gases from partition functions.

UNIT – V

Heat capacities of solids: Einstein's and Debye's theories of heat capacities of solids. Bose-Einstein and Fermi-Dirac Statistics: Bose Einstein distribution law- Entropy of Bose Einstein gas. Planck distribution law of black body radiation. Fermi-Dirac distribution law. Entropy of a Fermi-Dirac gas. Heat capacities of the electron gas and the heat capacities of metals. Negative absolute temperature.

TEXT BOOKS:

1. Glasstone, S. 2002. Thermodynamics for Chemists. Litton Edition Publishing, New York.

REFERENCES:

1. Atkin, P.W. 2002. Physical Chemistry. VII Edition, Oxford University Press, Oxford, UK.
2. Kapoor, K.L 1994. A Text Book Physical Chemistry. Vol. I & II, Mac Millan India Ltd., New Delhi.
3. Lavin, I.N 2002. Physical Chemistry. V Edition, Tata-Mc Graw Hill Publishing Company, New Delhi.
4. Whittakar, A.G., 2001. Physical Chemistry. Mount & Heal Viva Books Pvt. Ltd., New Delhi.

Semester -III

15CHP303 PHYSICAL METHODS IN CHEMISTRY (INSTRUMENTATION) 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal: 40 External: 60 Total:100

Course Objectives

The course successfully enables the student,

- To understand different chromatographic methods.
- To discuss about electron spectroscopy and thermal analysis
- To learn Circular Dichroism and Optical Rotatory Dispersion
- To describe the Electron Spin Resonance spectroscopy
- To know about flame emission spectroscopy.
- To apply the chromatographic and spectroscopic concepts for separation and identification of mixture compounds/complex/metals.

Course outcomes

The students have to

1. Understood different chromatographic methods.
2. Discussed about electron spectroscopy and thermal analysis
3. Learned Circular Dichroism and Optical Rotatory Dispersion
4. Described the Electron Spin Resonance spectroscopy
5. Knew about flame emission spectroscopy.
6. Applied the chromatographic and spectroscopic concepts for separation and identification of mixture compounds/complex/metals.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Chromatography: Theory, instrumentation, basic principles & application in the chemical analysis of the following – columns, paper, thin layer and ion exchange-gel permeation-HPLC applications in chemical analysis-gas chromatography**.**

UNIT – II

Thermal analysis: Differential thermal analysis DTA and differential scanning calorimetry DSC - basic principles - thermo gravimetric analysis.

Electron spectroscopy: ESCA XPS: Principle, chemical shifts - description of ESCA spectrometer, X-ray sources, samples, analysis, detectors and recording devices-applications.

Auger electron spectroscopy AES and Ultra-Violet photo electron spectroscopy UPS/PES principles and applications.

UNIT – III

Circular Dichroism and Optical Rotatory Dispersion: Basic principles - Cotton effects-Octants rule –axial halo ketone rule-application of ORD and CD. Tyndal Scattering-turbidimetry and nephelometry-applications. Atomic Absorption Spectroscopy.

UNIT – IV

ESR spectroscopy: Theory - derivative curves - g shift - hyperfine splitting-isotropic and anisotropic systems-zero field splitting and Kramer degeneracy. Identification of free radicals – applications to copper complexes.

UNIT – V

Flame Emission Spectroscopy: Introduction, Flames and flame spectra, Flames temperature, Chemical reaction in flame and flame background. Flame photometers, Flame spectrophotometers, Photosensitive detectors, Single beam and double beam instruments, calibration curve, Errors in flame photometers, applications.

TEXT BOOKS:

1. Gopalan, V., P. S. Subramanian and K. Rangarajan, 2003. Elements of Analytical Chemistry. S. Chand and Sons, New Delhi.
2. Usharani, S., 2002. Analytical Chemistry. Mac Millan India Ltd., Chennai.
3. Sharma, B.K., 2005. Instrumental Methods of Chemical Analysis. 24 Edition, Krishna Prakashan Media (P) Ltd, Meerut.

REFERENCES:

1. Galen W. Ewing, 1988. Instrumental Methods of Chemical Analysis. III Edition, Mc Graw Hill International Edition, Singapore.
2. Gurdeep R. Chatwal and Sham. K. Anand. 2004, Instrumental methods of chemical analysis. V Edition, Himalaya Publishing House, New Delhi.
3. Russel. S. Drago.1965, Physical Methods in Inorganic Chemistry, Reinhold Publishing Corporation, New York.
4. Skoog D. A and D. M. West, 2004. Fundamentals of Analytical Chemistry. VIII Edition, Thomson Book Store, Singapore.
5. Vogel, A.I 2002. Vogel's Quantitative Inorganic Analysis. VII Edition, Pearson Education, Singapore.

Semester–III

15CHP304 POLYMER AND NANOCHEMISTRY 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the students

- To know about the basic concepts of polymerization.
- To understand about the coordination polymerization.
- To discuss the various molecular weight determination methods of the polymers and its application.
- To explains the various polymer processing and properties of commercial polymers.
- To study the fundamentals in nano-chemistry and its instrumentation techniques.
- To Apply the polymerization technique to prepare polymers and nanocompounds and characterized by using various electron spectroscopic technique.

Course outcomes

On the successful completion of the course, students have

1. Knew about the basic concepts of polymerization.
2. Understood about the coordination polymerization.
3. Discussed the various molecular weight determination methods of the polymers and its application.
4. Explained the various polymer processing and properties of commercial polymers.
5. Studied the fundamentals in nano-chemistry and its instrumentation techniques.
6. Applied the polymerization technique to prepare polymers and nanocompounds and characterized by using various electron spectroscopic technique.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Step polymerization: Kinetics of step polymerization, self catalyzed polymerization, external catalysis of polymerizations.

Radical chain polymerization: Kinetic scheme for polymerization in presence of initiator.

Ionic chain polymerization: Comparison of radical and ionic polymerizations.

Chain copolymerization: Types of copolymers, the copolymer equation, the Q-e scheme and rate of copolymerization. Ziegler-Natta catalysis and polymerization.

UNIT - II

Plastic Technology: Production of ethenic polymers (polythene, PVC polyvinyl acetate, polyvinyl alcohol, polymethyl methacrylate. Polyacrylonitrile). Production of polycondensation polymers (phenol – formaldehyde, urea formaldehyde and epoxy resins).

Polymer additives – use of fillers in plastics – antioxidants and other stabilizers – plasticizers – effect of plasticizers on polymer properties (Tg. Fluidity, mechanical properties and dielectric properties) – use of flame retardants and colourants.

UNIT - III

Fibre technology: Production of natural and synthetic fibre, cellulosic fibres, polyamide fibres, polyester and acrylic fibres. Properties of textile fibres – criteria for fibre formation orientation of molecules on drawing.

Spinning processes – melt spinning- dry spinning and wet spinning.

UNIT- IV

Nano materials: Preparation: - plasma assisted chemical vapour deposition-sol-gels-electro deposition.

Carbon nano materials: New form of carbon-fullerene C_{60} nano tubes-types of nano tubes-single walled nano tube-multi walled nano tube. Formation, purification, properties and uses of nano tubes.

UNIT- V

Molecular nanotechnology: Scanning electron microscope (SEM) - modern transmission electron microscope (TEM) - Atomic force microscope (AFM)-scanning tunneling microscope (STM).

TEXT BOOKS:

1. Gowarikar V. R & N. V. Viswanathan, 1986. Polymer Science. Wiley Eastern Ltd., New Delhi.
2. Pradeep, T, 2010, Nano: The essential, Understanding Nanoscience and Nanotechnology, Fifth Reprint, Tata McGraw-Hill Education Private limited, New Delhi.
3. Billmeyer, F.W., 2003. Text Book of Polymer Science. III Edition, Wiley Interscience Publications, New York.

REFERENCES:

1. George Odian, 2004. Principles of Polymerization. IV Edition, John Wiley Interscience and Sons, New York.
2. Richard Booker and Earl Boysen, 2008. Nanotechnology. Unique Color Carton, New Delhi.
3. Bhatnagar, M. S., 2004. A textbook of Polymers. Vol. I, II, III, S.Chand Publications, New Delhi.
4. Cowie, J. M. G 1998. Polymer Science. II Edition, Stanley Thomas Publishers Ltd., New Delhi.
5. Sinha, R 2003. Outlines of Polymer Technology Processing Polymers Q & A. Prentice Hall of India Pvt. Ltd., New Delhi.
6. Mick Wilson and Kamali Kannangara, 2005. Nano Technology-Basic Science and Emerging Technologies. I Edition, Overseas Press, New Delhi.
7. Mark Ratner and Daniel Ratner, 2005. Nano technology- A Gentle Introduction to the Neat Big Idea. Pearson Education, UK.

ELECTIVE-II **Semester-III**

15CHP305A **POLYMER CHEMISTRY** **4H 4C**

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the student

- To study about the basic concepts of polymerization.
- To explains the coordination polymerization and apply the Ziegler-natta catalyst in polymer synthesis.
- To understand the molecular weight determination methods of the polymer and apply it identifies the polymer properties.
- To discuss about the polymer processing and properties of commercial polymers
- To apply the polymer processing technique to prepare the polymer products
- To list out the commercial polymers and its application

Course outcomes

The students have

1. Studied about the basic concepts of polymerization.
2. Explained the coordination polymerization and apply the Ziegler-natta catalyst in polymer synthesis.
3. Understood the molecular weight determination methods of the polymer and apply it identifies the polymer properties.
4. Discussed about the polymer processing and properties of commercial polymers
5. Applied the polymer processing technique to prepare the polymer products
6. Remembered the commercial polymers and its application

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT – I

Polymer Basic Concepts: Monomers, repeat units, degree of polymerization, Linear, branched and network Polymers. Condensation Polymerization: Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization : Free radical, cationic and anionic polymerization. Polymerization conditions. Polymerization in homogeneous and heterogeneous systems.

UNIT – II

Co-ordination Polymerization: Kinetics, mono and bimetallic mechanism of co-ordination polymers. Zeigler Natta catalyst, co-polymerization: Block and graft co-polymers, kinetics of copolymerization. Types of co-polymerization. Reactivity ratio.

UNIT–III

Molecular Weight and Properties: Polydispersion – average molecular weight concept, number, weight and viscosity average molecular weights. Measurement of molecular weights. Viscosity, light scattering, osmotic and ultracentrifugation methods. Polymer

structure and physical properties – crystalline melting point Tm. The glass transition temperature.Determination of Tg. Relationship between Tm and Tg.

UNIT – IV

Polymer Processing: Plastics, elastomers and fibres. Compounding, processing techniques: calendering, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion, moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT – V

Properties of Commercial Polymers: Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers, Fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

TEXT BOOKS:

1. Billmeyer, F.W., 2003. Text Book of Polymer Science. III Edition, John Wiley, New York.
2. Gowariker, V. R., N. V. Viswanathan and J. Sreedhar, 1986. Polymer Science, New Age International Private Ltd., New Delhi.

REFERENCES:

1. Alcock H. R and F. W. Lamber, 1981. Contemporary Polymer Chemistry, Prentice Hall, Englewood Cliffs, NJ.
2. Flory, P. J., 1953. Principles of Polymer Chemistry, Cornell University Press, New York.
3. Odian, G., 1981. Principles of Polymerization. II Edition, John Wiley & Sons, New York.

ELECTIVE-II **Semester-III**

15CHP305B **TEXTILE CHEMISTRY** **4H 4C**

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

The course enables the student

- To understand about the classification, Chemical structure, production, properties and uses of fibers.
- To learn about the dyeing process on fibers.
- To discuss the classification of dyes
- To learn the Pollution Control in Textile Industry.
- To explain the various finishing process of fibers.
- To apply this fundamentals to fabricate the material and its dying process.

Course outcomes

On the successful completion of this course, Students

1. Understood about the classification, Chemical structure, production, properties and uses of fibers.
2. Learned about the dyeing process on fibers.
3. Discussed the classification of dyes
4. Learned the Pollution Control in Textile Industry.
5. Explained the various finishing process of fibers.
6. Applied these fundamentals to fabricate the material and its dying process.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

Fibers: General classification of fibres-chemical structure, production, properties and uses of the following natural fibres (a) natural cellulose fibres (cotton and jute) (b) natural protein fibre (wool and silk).

Chemical structure, production, properties and uses of the following synthetic fibres. (i) Man made cellulosic fibres (Rayon, modified cellulose fibres) (ii) Polyamide fibres (different types of nylons) (iii) Poly ester fibres.

UNIT- II

Dyeing Process: Impurities in raw cotton and grey cloth, wool and silk- general principles of the removal – Scouring – bleaching – Desizing – Kierboiling- Chemicking.

Dyeing - Dyeing of wool and silk –Fastness properties of dyed materials – dyeing of nylon, terylene and other synthetic fibres.

UNIT- III

Finishing: Finishes given to fabrics- Mechanical finishes on cotton, wool and silk, method used in process of mercerizing –Anti-crease and Anti-shrink finishes –Water proofing

UNIT-IV

Types of Dyes: Quinonoid Dyes-Examples and structure-Anthroquinone and Mordant Dyes-Synthesis and Applications of Alizarin-Phthalocyanin dyes-Copper Phthalocyanin-Synthesis and Applications.

Diphenylmethane Dyes- Auramine-Triphenylmethane Dyes-Malachite Green, Crystal Violet, Pararosaniline-Preparation and applications.

Indigo Dyes-Preparation and application-Derivatives of Indigo- Synthesis and uses of Indigosol and tetrahaloindigo.

Phthalein Dyes-Phenolphthalein- Preparation and applications.

Xanthene Dyes-Rhodamine B, Fluorescein-Eosin- Preparation and applications.

UNIT-V

Pollution Control in Textile Industry: Textile Effluent-Characteristics, effect of untreated effluent, degradability of wastes. Effluent treatment plants-Aerated lagoon, photo oxidation process.

TEXT BOOKS:

1. Chatwal, R., 1995. Synthetic Dyes, Himalayan Publishing House, Mumbai.
2. Sadov F and M. Horchagin, 1978. Chemical Technology of fibrous Materials, A. Matetshy, Mir Publishers Easton's Books, Inc. Mount Vernon, WA, U.S.A.
3. Joseph, M. L., P. B. Hudson., A. C. Clapp., and D. Kness 1992. Joseph's Introductory Textile Science. VI Edition, Harcourt Brace Jovanovich College Publishers, Fort Worth.

REFERENCES:

1. Bruno Luniak, 1953. The Identification of Textile Fibres: The Identification of Textile Fibres: Qualitative and Quantitative Analysis of Fibre Blends. I. Pitman Publisher, London.
2. Sharma, B.K., 1997. Industrial Chemistry, Goel Publishing Co, New Delhi.
3. Prayag. R.S., 1989. Dyeing of Wool, Silk and Manmade Fibres. Noves Data Corporation, Dharwad.
4. Shenai. V.A., 1973. Chemistry of Dyes and Principles of Dyeing. Sevak Publication, Bombay.

ELECTIVE-II **Semester - II**

15CHP305C INDUSTRIAL CHEMISTRY 4H 4C

(APPLIED BIOINORGANIC CHEMISTRY, INORGANIC DRUG TARGETS AND METALS IN MEDICINE)

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the students

- To give the knowledge of the role of metals in human body
- To learn about the physical methods in bioinorganic chemistry, metal biomolecules interactions, complexes, and drug discovery.
- To give knowledge in Binding of Metal Ions and Complexes to Biomolecules
- To Learn about complexes and chelating agents
- To Provide fundamental knowledge in Drug Discovery and Design
- To Apply these parameters to discover new pharmacokinetic molecules.

Course Outcomes

On the completion of this course, student should

1. Knew the knowledge of the role of metals in human body
2. Learned about the physical methods in bioinorganic chemistry, metal biomolecules interactions, complexes, and drug discovery.
3. Understood the knowledge in Binding of Metal Ions and Complexes to Biomolecules
4. Learned about complexes and chelating agents
5. Provided the fundamental knowledge in Drug Discovery and Design
6. Applied these parameters to discover new pharmacokinetic molecules.

Methodology

Black-board teaching, Powerpoint presentation and group discussion.

UNIT- I

Metals in the Human Body: General principles - the elements in the human body - biological significance, storage and transport of Fe, Zn, Cu, Mo, Co, Cr, V and Ni - metal functions in metalloproteins -metallo enzyme functions -supplying elements to the body - metals and human health.

UNIT- II

Physical Methods in Bioinorganic Chemistry: X-ray methods - magnetic resonance methods - Mossbauer spectroscopy - magnetic measurements -other instrumental methods -Atomic Force Microscopy - Fast and Time-Resolved Methods - Stopped-Flow Kinetic Methods - Flash Photolysis - Time-Resolved Crystallography.

UNIT- III

Binding of Metal Ions and Complexes to Biomolecules: Nucleic acid structures - fundamental interactions with nucleic acids - binding interactions of tris(phenanthroline) metal complexes with DNA - techniques to monitor binding - applications of metal complexes that bind to nucleic acids -biopolymer promoted metal ligand interactions.

UNIT- IV

Complexes and Cheating Agents: Labile and inert complexes - metal-ligand selectivity-HSAB approach-chelate effect and Irving-William series -survey of metals used for diagnosis and chemotherapy-radiodiagnostic agents-Magnetic Resonance Imaging(MRI) - gold and other metal phosphines-main-group and transition metal compounds - miscellaneous metals in medicine-chelating agents and therapy - EDTA-evolution, chemical properties, in vivo chelation of radionuclides, dosage and toxicity .

UNIT-V

Drug Discovery and Design: Outline- therapeutic index, chemotherapeutic index, structure- activity relationship (SAR) and quantitative structure-activity relationship (QSAR)- Factors governing drug design- Computer aided drug design-Cancer chemotherapy-bioinorganic chemistry (DNA binding) of platinum anticancer drugs (cisplatin and carboplatin)-mechanism of action studies-clinical trials and their significance- production and quality control- patent protection.

TEXT BOOKS:

1. David M. Taylor and David R. Williams, 1995. Trace element medicine and Chelation therapy, The Royal Society of Chemistry, United Kingdom.
2. Ashutosh Kar, 2000. Medicinal Chemistry, New Age International Publishers, New Delhi.
3. Gareth Thomas, 2000. Medicinal Chemistry, John-Wiley & Sons Ltd., United Kingdom.

REFERENCES:

1. Bertini I, Gray H. B, Lippard S. J, and Valentine J. S, 1994. Bioinorganic Chemistry, University Science books, California.
2. Rosette M. Roat-Malone, 2002. Bioinorganic Chemistry, John Wiley & Sons, Inc., NJ.

ELECTIVE-II **Semester-III**

15CHP305D **APPLIED CHEMISTRY** **4H 4C**

Instruction Hours/week:L: 4 T:0 P:0 **Marks: Internal:40 External: 60 Total:100**

Course Objectives

This course enables the students,

- To make non-chemistry graduates to get exposed to day to day chemistry related materials and science.
- To learn the terms and definitions in general chemistry and use of popularly used chemicals.
- To discuss the various fields about industrial fuels, sugar and paper industry.
- To understand the fertilizers in the agriculture fied.
- To list the some of the commercial polymers along with their application
- By applying these concepts they can get job opportunities in various industrial sectors.

Course Outcomes

This course enables the students,

1. Understood the non-chemistry graduates to get exposed to day to day chemistry related materials and science.
2. Learned the terms and definitions in general chemistry and use of popularly used chemicals.
3. Discussed the various fields about industrial fuels, sugar and paper industry.
4. Understood the fertilizers in the agriculture fied.
5. Listed the some of the commercial polymers along with their application
6. Applying these concepts they can get job opportunities in various industrial sectors.

Methodology

Black-board teaching, Powerpoint presentation and group discussion.

UNIT- I

Industrial Fuels: Energy sources: non-renewable, classification of fuels, solid, liquid and gaseous. Calorific value of fuels and its determination.

Solid fuels: Coal: types, properties and uses of lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal.

Liquid fuels: Refining of crude petroleum and uses of fractions. Hydrodesulphurisation. Cracking: thermal and catalytic (fixed bed and fluidized bed catalysis). Octane number.

Gaseous fuels: Natural gas and gobar gas: production, composition and uses, Gobar electric cell.

UNIT- II

Chemistry and agriculture: Fertilizers: Discussion on ammonium nitrate, urea, superphosphate, triple superphosphate, diammonium phosphate, potassium nitrate, uses of mixed fertilizers, micronutrients and their role.

Pesticides: Classification of pesticides with examples.

Insecticides: stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC(gammexane: conformation of gamma isomer) pyrethrin mention of aldrin, dieldrin, endrin and pentachlorophenel (and its Na salt) (structures excluded)
Herbicides: 2,4-D and 2,4,5-T.
Fungicides: Bordeaux mixture, mention of lime sulphur, creosote oil and formula.

UNIT- III

Sugar and Paper industry: Sugar industry: Double sulphitation process, refining, and grading of sugar.
Saccharin: synthesis and uses as a sugar substitute. Ethanol: manufacture from molasses by fermentation.
Paper industry: Manufacture of paper: production of sulphite pulp and conversion to paper (bleaching, filling, sizing and calendaring)

UNIT-IV

High Polymers: Classification, types of polymerization.
Natural polymers: polysaccharides (starch and cellulose), polyhydrocarbons (natural rubber) and proteins.
Synthetic polymers: Polyhydrocarbons (polythene, synthetic rubber), polychlorohydrocarbons (PVC, neoprene), polyamides (nylon) and polyphenols (phenolformaldehyde resin). Addition and condensation polymerization, step growth and chain growth polymers.
Comparison and properties of thermoplastics and thermosetting polymers, copolymers. Synthesis, structure and uses: a) rubber: cis-structure and elasticity, Synthetic rubber: neoprene and Buna-S, vulcanization of rubber, additives used in rubber manufacture. Plastics: polythene, polypropene (isotactic structure), Ziegler-Natta polymerization, PVC, PVA, Polystyrene and Bakelite. Blow moulding and injection moulding.
Fibres: rayon, terylene and nylon.

UNIT- V

Articles used in daily life: Glass: composition, manufacture and uses.
Cement: Manufacture: wet and dry processes, composition and setting of cement
Dyes: classification based on structure and application. Synthesis of congo red and malachite green.
Pharmaceuticals: Manufacture of aspirin and penicillin (fermentation process) mention of antibiotics.

TEXT BOOKS:

1. Biswas, A.K., 1989. Frontiers in Applied Chemistry, Narosa publishing House, New Delhi.

REFERENCES:

1. Vermani, O.P and A.K. Narula, 2008. Applied chemistry theory and Practice. New Age International Pvt Ltd Publishers, New Delhi.
2. Thiagarajan,V.T., 1995. Pharmaceutical chemistry, K. S. C. Desikan & Co, Chennai.

ELECTIVE-II **Semester-III**

15CHP305E PRINTING CHEMISTRY 4H 4C

Instruction Hours/week:L: 4 T:0 P:0 Marks: Internal:40 External: 60 Total:100

End Semester Exam: 3 Hrs

Course Objectives

This course enables the students

- To learn about nature of the light source and its spectral properties.
- To understand about the colour mixing process and its applications in photography and printing.
- To study about the various color measurement techniques.
- To discuss about the colour matching technique through automatically and manually.
- To know about the colour differences and its effect in various application.
- To describe the various instrumentation and its handling in printing process.

Course Outcomes

On the completion of this course, students

1. Learned about nature of the light source and its spectral properties.
2. Understood about the colour mixing process and its applications in photography and printing.
3. Studied about the various color measurement techniques.
4. Discussed about the colour matching technique through automatically and manually.
5. Knew about the colour differences and its effect in various applications.
6. Described the various instrumentations and its handling in printing process.

Methodology

Blackboard teaching, Powerpoint presentation and group discussion.

UNIT- I

Light and colour: Sources of light. Colour rendering, reflection, refraction, transmission, absorption and scattering. Colour attributes. Relation between colour and optical spectrum. Spectral colours and metamerism.

Colour perception: Reflection, transmission and absorption spectra. The physical basis of colour. The human colour vision system. Scotoic and photopic vision. Colour receptors and their spectral response. Hue and saturation, lightness and luminance

UNIT- II

Colour Description: Arrangement of colour, visual attribution of colour, Beer-Lambert's law, colour primaries and color mixing, additive and subtractive color mixing. Applications in photography, electronic colour moniters and colour printing. Colour specification, colour order systems-Munsel colour order system and Ostwald colour order system.

UNIT- III

Colour measurement: Principles of colour measurement, Tristimulus values, CIE diagram, standard illuminant, standard observer and colour matching functions. Spectral reflectance, graphical representation and numeric representation. CIEXYZ and CIELab representation. Colour gamut, RGB, CMY and CYMK gamuts and limitations.

UNIT- IV

Colour matching: Definition. Manuel colour matching, single constant (K/S) Kubelka-Munk theory, spectral match, tristimulus match. Color matching and metamerism.

Computer colour matching: Colour sensors, spectral sensitivity. Filters-neutral density and colour filters. Absorption and interference filters. Concept of computer color matching (CCM) system. Application of CCM system to textile processing. Advantages of CCM system. Limitations of CCM system. Colour reproduction-characteristics of electronic monitors.

UNIT- V

Color Differences: Perceptibility and acceptability, methods of assessment, colour difference formula. Measurement of fluorescence- Visual photoelectric and spectro-photemetric colourimeter. Advantage of spot spectral measurements- fibre optic spectrophotometer.

TEXT BOOKS:

1. Xin J, 2006. Total colour Management in textiles. Woodhead Publishing Limited, Cambridge.
2. Shah H. S and Gandhi R.S, 1990. Instrumental Colour Measurements and Computer Aided Colour Matching for Textiles. Mahajan Publications, Ahmadabad.

REFERENCES:

1. Gulrajani M. L., 2010. Colour measurement: Principles, Advances and Industrial Applications. Woodhead Publishing Ltd., Cambridge.
2. McDonald R, 1997. Colour Physics for Industry. Woodhead Publishing Limited, Cambridge.
3. Lucas J and Valldeperas J., 1996. Eurotex Colour Measurement Fundementals.Vol I, Guimaraes Portugal.
4. Volz H.G., 1994. Industrial colour testing-Fundementals and Techniques.VCH, Weinheim, Germany.
5. Mc Laren K, 1983. The colour Science of Dyes and Pigments. Adam-Hilger, Bristol, U.K.
6. Peters A. T and Freeman H.S., 1996. Physio-Chemical Principles of Colour Chemistry. Blackie A & P, London.

Semester-III

15CHP311 PHYSICAL CHEMISTRY PRACTICAL -I 4H 2C

(MOLECULAR WEIGHT DETERMINATION AND CONDUCTOMETRIC TITRATIONS)

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the students should have

- To Learn about the heat of solution, determination of molecular weight and distribution coefficient
- To study about basic concepts of conductometric titrations.
- To understand the various laws in electrochemistry.
- To apply the conductometric method for the solutions and measure its conductivity
- To know about how to handle the conductivity meter, spectrophotometer.
- To may realize the how distribution co-efficient influence the solubility of various systems.

Course Outcomes

On the completion of this course, students

1. Learned about the heat of solution, determination of molecular weight and distribution coefficient
2. Studied about basic concepts of conductometric titrations.
3. Understood the various laws in electrochemistry.
4. Applied the conductometric method for the solutions and measure its conductivity
5. Knew about how to handle the conductivity meter, spectrophotometer.
6. Applied the knowledge to realize the how distribution co-efficient influence the solubility of various systems.

Methodology

Blackboard teaching and Demonstration.

Contents

Heat of solution from solubility.

Molecular weight determination by

i. Freezing point depression of solvents benzene and water by Beckmann method
ii. By Rast micro methods

Distribution of activity and activity co-efficient by freezing point method.

Distribution co-efficient and determination of equilibrium constant.

Conductivity experiments:
Determination of

i) Equivalent conductance of a strong electrolyte and verification of Debye-Huckel Onsager law
ii) Verification of Ostwald dilution law and Kohlraush law for weak electrolytes.

Conductometric determination of Pka of a weak acid.

Hydrolysis constant of aniline hydrochloride.

Determination of the solubility of a sparingly soluble salt.

Conductometric titrations:

Acid-base and precipitation titrations including mixture of halides.

REFERENCES:

1. Lepse, Paul A and Lyle B. Peter, 1986. Lab Manual for Lingren's Essentials of Chemistry. Prentice Hall, New Delhi.
2. Pandey, O.P, D. N. Bajpai and S. Giri, 2001. Practical Chemistry. VIII Edition, S.Chand Publications, New Delhi.
3. Santi Rajan palit and Sadhan Kumar, 1971. Practical Physical Chemistry. I Edition, Joy Publishers, Calcutta.
4. Siddhiqui, Zeba N, 2002. Practical industrial Chemistry. I Edition, Anmol Publications Pvt. Ltd., New Delhi.
5. Thomas, A.O, 2003. Practical Chemistry. Scientific Book Center, Cannanore.
6. Venkateswaran, V. R. Veeraswamy and A. R. Kulandaivelu, 2004. Basic Principles of Practical Chemistry. II Edition, S. Chand Publications, New Delhi.

Semester-III

15CHP312 PHYSICAL CHEMISTRY PRACTICAL- II 4H 2C
(CHEMICAL KINETICS AND POTENTIOMETRIC TITRATIONS)

Instruction Hours/week:L: 0 T:0 P:4 Marks: Internal:40 External: 60 Total:100

Course Objectives

This course enables the students should have

- To learn about the principles of electrochemistry and determination EMF
- To understand about the basic needs of Chemical Kinetics and Potentiometric titrations.
- To study the principles about adsorption process.
- To know about how to handle the potentiometer, electrodes and spectrophotometer.
- To apply the knowledge of chemical kinetics in various preparation organic/inorganic compounds.
- To investigate the metal concentration in water samples using adsorption technique.

Course Outcomes

On the completion of this course, students to

1. Learned about the principles of electrochemistry and determination EMF
2. Understood about the basic needs of Chemical Kinetics and Potentiometric titrations.
3. Studied the principles about adsorption process.
4. Knew about how to handle the potentiometer, electrodes and spectrophotometers.
5. Appling the knowledge of chemical kinetics in various preparation organic/inorganic compounds.
6. Investigating the metal concentration in water samples using adsorption technique.

Methodology

Blackboard teaching and Demonstration.

Contents

Electromotive force determination of standard potentials of Cu, Zn, Ag.

Determination of pH and pKa values using hydrogen and quinhydrone electrodes and glass electrode pH meter- potentiometric acid-base titrations.

Determination of formal redox potential of a redox system and redox titrations.

Determination of solubility product of a sparingly soluble salt concentration cell and chemical cell.

Determination of activity co-efficients from emf data.

Precipitation titration of a mixture of halides.

Chemical Kinetics:

i . Evaluation of Arrhenius parameters using acid hydrolysis of an ester.

ii. Base catalysed hydrolysis of an ester conductometrically.

iii. Rate of reaction between persulphate and iodide ions study of salt over the persulphate- iodide reaction.

Evaluation of catalytic constants for weak acids and verification of Bronsted catalysis law.

Adsorption Experiments:

Adsorption of oxalic acid and acetic acid on activated charcoal-Fruendlich isotherm.

REFERENCES:

1. Lepse, Paul A and Lyle B. Peter, 1986. Lab Manual for Lingren's Essentials of Chemistry. Prentice Hall, New Delhi.
2. Pandey, O. P, D. N. Bajpai and S. Giri, 2001. Practical Chemistry. VIII Edition, S.Chand Publications, New Delhi.
3. Santi Rajan Palit and Sadhan Kumar, 1971. Practical Physical Chemistry. I Edition, Joy Publishers, Calcutta.
4. Siddhiqui, Zeba N, 2002. Practical industrial Chemistry. I Edition, Anmol Publications Pvt. Ltd., New Delhi.
5. Thomas, A. O, 2003. Practical Chemistry. Scientific Book Center, Cannanore.
6. Venkateswaran, V., R. Veeraswamy and A. R. Kulandaivelu, 2004. Basic Principles of Practical Chemistry. II Edition, S. Chand Publications, New Delhi.

SELF STUDY COURSES **Semester-III**

15CHP306 NANO TECHNOLOGY 4C

Instruction Hours/week: L: 0 T: 0 P: 0 **External: 100 Total: 100**

Course Objectives

The course enables the student

- To know the history and perspectives of Nanotechnology.
- To learn about the various types and significant of 1D, 2D and 3D nanoparticles
- To list the various types of nanoparticles and its application.
- To discuss about carbon based nanomaterials and its properties
- To explain the metal oxide based nano materials
- To motivate and lead the student in the field of nanotechnology.

Course Outcomes

The completion of this course, students

1. Knew about the history and perspectives of Nanotechnology.
2. Learned about the various types and significant of 1D, 2D and 3D nanoparticles
3. Remembered the various types of nanoparticles and its application.
4. Discussed about carbon based nanomaterials and its properties
5. Explained the metal oxide based nano materials
6. Motivated and lead them in the pathway of nanotechnology

Methodology

Self study

UNIT- I

Nanotechnology: Introduction-definition-origin of nanotechnology-difference between bulk and nanomaterials-size dependent properties (magnetic, electronic, transport and optical).

UNIT- II

Classification of nanomaterials: Classification based on dimensional property - zero D, 1D, 2D and 3D nanostructures.

UNIT- III

Types of nanomaterials: Metal oxides and metal nano particles-ceramic nano particles-semi conducting quantum dotscoveshell, quantum dots-nanocomposites - micellar nanoparticles

UNIT- IV

Carbon based nanomaterials: Fullerenes- Carbon nanotubes-single walled and multiwalled nano tubes- structures-carbon nanofibre.

UNIT- V

Metallic and oxide based nanomaterials: Metallic and oxide based nanomaterials – ceramic oxide nanomaterials – semiconductor oxide nanomaterials – nanocomposites and core-shell nanomaterials – micellar nanomaterials.

TEXT BOOKS:

1. Pradeep, T., 2007. Nano: The Essentials Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill publishing company Ltd., New Dehli.
2. Charles P Poole Jr. & Frank J Owens, 2003. Introduction to Nano Technology, Wiley Interscience, New York.
3. Rao, C. N. R., A. Muller and A.K. Cheetham, 2005. The Chemistry of Nanomaterials. Synthesis, Properties and Applications, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

REFERENCES:

1. Guozhong Cao and Ying Wang, 2004. Nanostructures and Nanomaterials: Synthesis, Properties and Applications. II Edition, Imperial College Press, London.
2. Mick Wilson, Kamli Kannangara, Geoff smith, Michelle Simmons and Burkhard Raguse, 2005. Nanotechnology: Basic Science and Emergic Technologies, Overseas Press, New Delhi.
3. Mark A. Rather, Daniel Rather and Mark Rather, 2002. Nanotechnology: A Gentle Introduction to the Next Big Idea. I Edition, Prentice Hall PTR, UK.
4. Robert W. Kel Sall, Mark Geoghenan and In W. Hamley, 2005. Nano Scale Science and Technology, John Wiley and Sons, New York.
5. Brain L.Cushing, Valdimir L. Kolesnichenko, and Charles J.O Connor, 2004. Recent advances I the Liquid Phase Synthesis of Inorganic Nanoparticles. Chem. Rev., 104, 3893-3946.
6. Palical M.Ajayan, Linda S.Schadles and Paul V. Braues, 2003. Nano Composite Science and Technology, Wiley-VCH Verlag Weileim.

SELF STUDY COURSE **Semester-IV**

15CHP401 ANALYTICAL TECHNIQUES IN CHEMISTRY 4C

Instruction Hours/week: L: 0 T: 0 P: 0 **External: 100 Total: 100**

Course Objectives

This course enables the students,

- To understand the basic concepts in UV-Visible, IR and Raman spectroscopic analysis.
- To study important terms in NMR of ^{1}H, ^{13}C, ^{31}P, ^{19}F.
- To discuss the ESR Spectroscopy and the magnetic property of molecules.
- To explain the colourimetric analysis and its relationship with UV-Visible spectroscopy.
- To learn about basic thermal analysis instruments.
- To apply this techniques to identify the molecular structure of compounds and predict their properties.

Course Outcomes

On the completion of this course, students have to

1. Understood the basic concepts in UV-Visible, IR and Raman spectroscopic analysis.
2. Studied the important terms in NMR of ^{1}H, ^{13}C, ^{31}P, ^{19}F.
3. Discussed the ESR Spectroscopy and the magnetic property of molecules.
4. Explained the colourimetric analysis and its relationship with UV-Visible spectroscopy.
5. Learned about basic thermal analysis instruments.
6. Apply these techniques to identify the molecular structure of compounds and predict their properties.

Methodology

Self study

UNIT- I

Analytical Chemistry: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

UNIT- II

Colourimetric Analysis and UV-Visible Spectroscopy: Beer Lambert's law, Principles of single and double beam instruments – applications for analysis of inorganic and organic samples.

Infrared spectrophotometric analysis – principle and instrumentation and molecular structure determination.

Raman Spectra – principle, basic instrumentation – structural analysis.

UNIT- III

NMR, NQR and Mossbauer Spectroscopy: Nuclear Magnetic Resonance – Principle, instrumentation, structure determination. NMR of ^{1}H, ^{13}C, ^{31}P, ^{19}F.

NQR - Nitrosyl compounds, Mossbauer of Fe and Sn systems.

UNIT- IV

Electron Spin Resonance: Principle, instrumentation, applications to coordination compounds.

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

UNIT-V

Thermal Analysis: Thermo gravimetric and differential thermal analysis, thermometric titrations, differential scanning colourimetry – basic instrumentation and applications.

TEXT BOOKS:

1. Skoog, D.A., F. J. Holler and S. R. Crouch, 2007. Principles of Instrumental Analysis. VI Edition, Thomson Brooks/Cole Publishers, UK.
2. Frank A. Settle, 1997. Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall PTR (ECS Professional), UK.

REFERENCES:

1. Christian G.D, 2007. Analytical Chemistry. VI Edition, John Wiley & Sons, United States.
2. Skoog, D. A., D. M .West, F. J. Holler and S. R. Crouch, 2014. Fundamentals of Analytical Chemistry. IX Edition, Cengage Learning, United States of America.