J.J COLLEGE OF ARTS AND SCIENCE (Autonomous)

Re-Accredited by NAAC with Grade 'A' in 3rd Cycle

SIVAPURAM, PUDUKKOTTAI-622422

DEPARTMENT OF CHEMISTRY

PG - PROGRAMME - M.Sc CHEMISTRY

(2019-2020)

PROGRAMME OBJECTIVES FOR M.Sc

- To make the students aware of descriptive chemistry
- To impart the basic analytical and technical skills to work effectively in the various fields of chemistry
- To develop the ability to perform accurate quantitative measurements with an understanding of theory and use of chemical instrumentations
- To develop laboratory competence relating to chemical structure and spectroscopic phenomena
- To develop the ability to synthesize, separate and characterize the chemical compounds using published reactions, protocols and modern instrumentation

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DEPARTMENT OF CHEMISTRY
PG – PROGRAMME – M.Sc CHEMISTRY
Course Structure under **CBCS** Autonomous Status for Candidate Admitted from the Academic year **2019-2020**

Sem	Course Code	Course Title	Hrs/ Week	Credit	Exm Hrs	Marks		Total
						Int	Ext	
I	P1R1CHCC1	Organic Chemistry-I	6	5	3	25	75	100
	P1R1CHCC2	Inorganic Chemistry-I	6	5	3	25	75	100
	P1R1CHCC3P	Organic Chemistry Practical-I	6	5	6	40	60	100
	P1R1CHCC4P	Inorganic Chemistry Practical-I	6	5	6	40	60	100
	P1R1CHEC1	Elective Course-I-Any one from the given list	6	3	3	25	75	100
		Total	**30**	**23**				**500**
II	P2R1CHCC5	Physical Chemistry-I	5	5	3	25	75	100
	P2R1CHCC6	Physical Methods in Chemistry-I	5	5	3	25	75	100
	P2R1CHCC7	Organic Chemistry-II	5	5	3	25	75	100
	P2R1CHCC8P	Organic Chemistry Practical-II	5	5	6	40	60	100
	P2R1CHCC9P	Inorganic Chemistry Practical-II	5	5	6	40	60	100
	P2R1CHEC2	Elective Course-II-Any one from the given list	5	3	3	25	75	100
		Total	**30**	**28**				**600**
III	P3R1CHCC10	Physical Chemistry-II	5	5	3	25	75	100
	P3R1CHCC11	Inorganic Chemistry-II	5	5	3	25	75	100
	P3R1CHCC12	Physical Methods in Chemistry-II	5	5	3	25	75	100
	P3R1CHCC13P	Physical Chemistry Practical-I	5	5	6	40	60	100
	P3R1CHCC14P	Physical Chemistry Practical-II	5	5	6	40	60	100
	P3R1CHEC3	Elective Course-III-Any one from the given list	5	3	3	25	75	100
		Total	**30**	**28**				**600**
IV	P4R1CHEC4	Elective Course-IV-Any one from the given list	6	3	3	25	75	100
	P4R1CHCC15PW	Project Work	24	8	3			100
		Total	**30**	**11**				**200**
		Grand Total	**120**	**90**				**1900**

CC-Core course/EC-Elective Course/P-Practical

Sem	List of Elective Course (Any Four)
I	Bioorganic Chemistry
	Medicinal chemistry
II	Industrial Chemistry
	Green Chemistry
III	Quality Control and Environmental chemistry
	Natural Products Chemistry
IV	Advanced Topics in Chemistry
	Instrumental Methods of Analysis

SEMESTER-I: CORE COURSE-I: ORGANIC CHEMISTRY-I

Course Code : P1R1CHCC1	**Max. Marks : 100**
Hours/Week : 6	**InternalMarks : 25**
Credit : 5	**External Marks : 75**

Objectives: To make students aware of

- *the nomenclature, structure and bonding of organic compounds*
- *the aromaticity and heterocyclic compounds*
- *To understand basic concepts of stereochemistry*
- *the reactive intermediates and reaction mechanisms*
- *the scope of organic photochemistry*

UNIT – I: Nomenclature,Structure and Bonding (14 Hrs)

1.1.Nomenclature: IUPAC nomenclature of linear and branchedalkanes, alkenes, polyenes and alkynes with and without functional groups.Nomenclature of alicyclic, bicyclic and tricyclic compounds. (Basic skeletal structures only with or without one substituent).

1.2.Structure and Bonding: Localized Chemical Bonding: Electronic Structure of molecules; VB, MO and HOMO-LUMO theory, Electronegativity, Dipole Moment, Inductive and Field Effects. Bond distances, Bond angles, Bond energies.

1.3.Delocalized Chemical Bonding: Bond energies and Bond distances in compounds containing delocalized Bonds, Cross conjugation, Resonance, Steric inhibition of resonance, Hyperconjugation, Keto – EnolTautomerism.

UNIT – II: **Aromaticity and Heterocycles (14 Hrs)**

2.1.Aromaticity: Concept of Aromaticity- Huckel's theory of aromaticity Five,six, seven-, and eight-membered rings - Other systems with aromatic sextets - Concept of homo-aromaticity and anti-aromaticity, Electron occupancy in MO's and aromaticity - NMR concept of aromaticity and anti-aromaticity, systems with 2,4,8 and 10 electrons, systems of more than 10 electrons, alternant and non-alternant hydrocarbons (azulene type). Bonding properties of systems with (4n +2)π electrons and 4nπ electrons,

2.2. Heteroaromatic molecules: Annulenes and sydnones and fullerenes.

2.3. Heterocycles: Nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen and sulphur. Synthesis, reactivity and applications of the following heterocycles: Pyrazoles, Oxazoles, Pyridazines, Pyrimidine and Pyrazines.

UNIT- III: Stereochemistry (14 Hrs)

3.1. Fundamentals of Organic Stereochemistry:Streoisomerism-Optical isomerism, Optical activity and chirality – Types of molecules exhibiting optical activity-Symmetry elements – Definitions – Conventions used in stereochemistry: Fischer notations,Newman, Sawhorse projection and their interconversions. Relative Configuration (D/L). Absolute configuration (R/S) - Cahn–Ingold–Prelog rules for cyclic and acyclic compounds. Atropisomerism – Biphenyls, allenes and spiranes. Enantiomerism of compounds containing chiral heteroatoms – Walden inversion – Asymmetric synthesis based on Cram's rule and Prelog's rule.Concepts of prochirality and enantiotopic and diastereotropic atoms.

3.2. Geometrical Isomerism: E & Z,Syn and anti nomenclature, determination of configuration of geometrical isomers, stereospecific and stereoselective reactions – [elementary examples].

3.3. Conformational Analysis: Basic concepts of conformational analysis – conformations of *n*-butane, cyclohexane and decalins.

UNIT-IV: Reactive Intermediates and Reaction Mechanisms (14 Hrs)

4.1. Reactive Intermediates: Carbocations, carbanions, carbenes,nitrenes and arynes – generation and stability. Correlation of reactivity with structure of reactive intermediates. Free radicals – configurations – identification by chemical and spectral methods – free radical halogenation - NBS.

4.2. Methods of Determining Reaction Mechanisms: Types of reactions: homolytic and heterolytic cleavages of bonds, characteristics of nucleophilic, electrophilic and free radical reactions. Thermodynamic and kinetic aspects, Hammond's postulate, isotope effects. Energy profile diagrams–intermediate versus transition state, product analysis and its importance, crossover experiments, kinetic methods, stereochemical studies, isotopic and substituent effects.

UNIT- V: Organic Photochemistry (13 Hrs)

5.1. Fundamental concepts – Jablonski diagram – energy transfer, characteristics of photoreactions, photoreduction and photoxidation, photoreactions of ketones and enones, Norrish Type I and II reactions.

5.2. Photochemistry of alkenes, dienes and aromatic compounds, reactions of unactivated centres – photolytic cycloadditions and photolytic rearrangements – photosenstitisation – photoadditions – Barton reaction – ParternoBuchi reaction.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: On completing the course, learners will be able to

- take up further reading on nomenclature, structure and bonding
- identify reactive intermediates and their properties
- see the aromaticity of organic compounds and its applications
- Apply Huckel's theory to various aromatic compounds and predict their stability
- predict and confirm the Streochemical structure of compounds
- understand the Laws of photochemistry and photochemical reactions

Text Books

1. J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 7th Ed., Wiley, 2013.
2. D. Nasipuri, Stereochemistry of organic compounds-Principles and applications, New Age International, 2nd Ed, 2002.
3. R.K. Bansal, Organic Reaction Mechanisms, Tata McGraw Hill, 1975.
4. P.S. Kalsi, Stereochemistry, Wiley eastern limited, 5th edition, 2003.
5. G.R. Chatwal, Organic Photochemistry, Himalaya Publications house, II nd Ed, 2010.

Reference Books

1. R.T. Morrison and R.N. Boyd, Organic Chemistry, 4th Ed., Pearson, 2013.
2. F.A. Carey and R.J. Sund berg –"Advanced organic chemistry" Vol. A and B– 5th Ed., 2007.
3. I.L. Finar, Organic Chemistry, 6th Ed., ELBS 2008.
4. J.D. Coyle, Organic Photochemistry - Wiley, 1985.
5. J.M. Coxon, B. Halton, Organic Photochemistry, Camb. Uni. Press, 2ndEd, 1987.

SEMESTER-I: CORE COURSE-II: INORGANIC CHEMISTRY-I

Course Code : P1R1CHCC2	**Max. Marks : 100**
Hours/Week : 6	**InternalMarks : 25**
Credit : 5	**External Marks : 75**

Objectives: To help students acquire a deep knowledge of

- *main group elements and their compounds*
- *factors affecting the stability of coordination compounds*
- *theories related to coordination compounds*
- *the reaction mechanism of coordination compounds*
- *inorganic photochemistry and its mechanism*

UNIT – I: Main Group Chemistry and Ionic Model (14 Hrs)

1.1.Chemistry of boron–borane, higher boranes, carboranes, borazines and boron nitrides. Chemistry of silicon–silanes, higher silanes, multiple bonded systems, disilanes, silicon nitrides, siloxanes and silicates.

1.2.P-N compounds-cyclophosphazenes and cyclophosphazanes. S-N compounds – S_4N_4, $(SN)_x$.

1.3.Ionic Model: Lattice energy – Born-Lande equation –Kapustinski equation–high $T_c$superconductors – solid state reactions – types and examples.

UNIT-II: Coordination Chemistry: Principles (13 Hrs)

2.1. Studies of coordination compounds in solution – detection of complex formation in solution – stability constants – stepwise and over-all formation constants – simple methods (potentiometric, pH metric and photometric methods) of determining the formation constants – **2.2.Factors affecting stability** – statistical and chelate effects – forced configurations.

UNIT-III: Theories of Metal - Ligand bond (14 Hrs)

3.1.VB Theory and its limitations – crystal field theory –splitting of *d*-orbitals under various geometries – factors affecting splitting – CFSE and evidences for CFSE (Structural and thermodynamic effects) – spectrochemical series – Jahn-Teller distortion – spectral and magnetic properties of complexes – site preferences - limitations of CFT – ligand field theory.

3.2. MO Theory – σ(sigma) – and π(pi) –bonding in complexes – Nephelauxetic effect – the angular overlap model.

UNIT – IV: Coordination Chemistry – Reaction Mechanism (14 Hrs)

4.1.Kinetics and mechanism of reactions in solution–labile and inert-complexes–ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions – trans effect – theory and applications.

4.2.Electron transfer reactions – electron exchange reactions – complementary and non-complementary types – inner sphere and outer sphere processes. Application of electron transfer reactions in inorganic–isomerisation and racemisation reactions of complexes. Molecular rearrangement – reactions of four and six-coordinate complexes – interconversion between stereoisomers.

4.3.Reactions of coordinated ligands – template effect and its application for the synthesis of macrocyclic ligands – unique properties.

UNIT – V: Inorganic Photochemistry (14 Hrs)

5.1. Electronic transitions in metal complexes-metal-centered and charge-transfer transitions – various photophysical and photochemical processes of coordination compounds –unimolecular charge-transfer photochemistry of cobalt(III) complexes.

5.2. Mechanism of CTTM photoreduction-Ligand-field photochemistry of chromium(III) complexes, Adamson's rules, photoactive excited states, V-C model–photophysicsand photochemistry of ruthenium–polypyridine complexes, emission and redox properties –

5.3. Photochemistry of organometallic compounds-metal carbonyl compounds, compounds with metal-metal bonding Reinecke's salt chemical actinometer.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: By the end of this course, the learners will be able to

- Identify main group elements and their derivatives
- Know the VB and MO theories of coordination compound
- Identify the Stability of coordination compounds and factors affecting the stability
- Demonstrate and discuss the reaction of coordination compounds by electron transfer reaction
- Understand more deeply the concepts of photochemistry

Text Books

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 4th Ed., A Wiley - Interscience Publication, John –Wiley & Sons, Reprint 2012.
2. J.E. Huheey, Inorganic Chemistry 3rd Ed., Harper & Row publisher, Singapore.
3. S.F.A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum Academic Publishers, Oxford University Press, 2012.
4. J. Ferraudi, Elements of Inorganic Photochemistry, Wiley, New York, 1988.

Reference Books

1. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd.2nd Ed.,1985.
2. A. W. Adamson and P. D. Fleischauer, Concepts of Inorganic Photochemistry, Wiley,New York, 1975.
3. F.Basolo and R.G.Pearson, Mechanism of Inorganic Reactions, John Wiley, New York.

SEMESTER-I: CORE COURSE-III: ORGANIC CHEMISTRY PRACTICAL-I

Course Code :P1R1CHCC3P	**Max. Marks : 100**
Hours/Week : 6	**InternalMarks : 40**
Credit : 5	**External Marks : 60**

Objectives: Train students in

- *the separation of binary organic mixtures*
- *the methods of qualitative analysis of organic compounds*
- *single stage preparations of organic compounds*

A. Qualitative Analysis of an organic mixture containing two components (40 Marks)

Pilot separation, bulk separation, analysis and derivatization.

B. Preparation of Organic compounds (Single stage) (10 Marks)

(a) methyl –*m*- nitrobenzoate from methylbenzoate (nitration)

(b) glucose pentaacetate from glucose (acetylation)

(c) resorcetophenone from resorcinol (acetylation)

(d) benzophenoneoxime from benzophenone (addition)

(e) *o*-chlorobenzoic acid from anthranillic acid (Sandmayer reaction)

(f) *p*-benzoquinone from hydroquinone (oxidation)

(g) Phenyl-azo-2-napthol from aniline (diazotization)

Course Outcomes: At the end of the course, the learners will be able to

- Perform qualitative separation of binary mixture of organic compounds and individual qualitative analysis of isolated compound adopting qualitative methods
- Separate the functional groups and demonstration the regeneration process
- Understanding the isolation and purification of compounds

Scheme of Valuation:

Record and Viva	- 10 Marks
Solvent Separation	- 10 Marks
Analysis and Derivative	- 30 Marks
Preparation (Single stage)	- 10 Marks

Reference Book

1. B.S. Furniss, A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, Vogel's Textbook of Practical Organic Chemistry- 5th Ed., Pearson publication.

2. V. Vengataswaran,*et al.*, Basic Principle of Practical Chemistry – Sultan Chand and sons, New Delhi (1997).
3. Ganapragasm and Ramamurthy,Organic Chemistry Lab Manual, 2nd Ed.,S. Vishwanathan Printers and Publishers (P) Ltd., Chennai (2007)

SEMESTER-I: CORE COURSE-IV: INORGANIC CHEMISTRY PRACTICAL-I

Course Code :P1R1CHCC4P	**Max. Marks : 100**
Hours/Week : 6	**InternalMarks : 40**
Credit : 5	**External Marks : 60**

Objectives: to train students in

- *the qualitative analysis of common metals and rare metals*
- *the principles and instrumental analysis of colorimetric method*
- *demonstrate the common ion effect and solubility product*
- *preparing inorganic complexes qualitatively*

1. Theoretical Principles

Classification of cations into groups, group reagents – intergroup and intragroup separations –Confirmatory test for cations– the react ions and the products.

2. Analysis of Mixture of Cations (35 Marks)

Analysis of a mixture of four cations containing two common and two rare cations.

Common cations: Group I: Pb and Hg; Group II: Cu, Cd, Bi, Sb, As, and Sn;

Group III: Al, Fe, and Cr; Group IV: Mn, Zn, Co, and Ni; Group V: Ca, Sr, and Ba; Group VI: Mg and NH_4^+

Rare cations: Group I: W and Tl; Group IA: Se and Te; Group II: Mo; Group III: Be, Ce, Ti, Th, Zr, V; Group VI: Li

3. Estimation of ions using photoelectric colorimeter (15 Marks)

Estimation of Cu, Fe, Ni, Cr, Co and Mn using photoelectric colorimeter

Course Outcomes: At the end of the course, the learners will be able to

- Get better knowledge on qualitative analysis of common metals and rare metals
- Understand the Beer's Lamberts law and colorimetric analysis of common metals
- Set up manage experimental conditions for the preparation of complexes
- acquire expertise in the elimination of interrupting ions during analysis

Scheme of Valuation:

Record and Viva	- 10 Marks
Procedure Writing and Presentation	- 07 Marks
Analysis	- 4 radicals correct with suitable test: 28 Marks
	3 radicals correct with suitable test: 21 Marks
	2 radicals correct with suitable test: 14 Marks
	1 radical correct with suitable test: 07 Marks

Colorimetric Estimations

1-2% - 15 Marks

2-3% - 12 Marks

3-4% - 09 Marks

> 4% - 06 Marks

Reference Books

1. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis, 3rd Ed., The National Publishing Company, Chennai, 1990.
2. Vogel's Text book of Inorganic Qualitative Analysis, 7th Ed, ELBS, London, 1996.
3. G. H. Jeffery, J. Bassett,J.Mendham, R. C. Denney, Vogel's 's Textbook of Quantitative Chemical Analysis; 5th Ed., VELBS" 1989.
4. J. D. Woollins, Ed., Inorganic Experiments; VCH: Weinheim, 1994.

SEMESTER-I: ELECTIVE COURSE-I: BIOORGANIC CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 6	**InternalMarks : 25**
Credit : 3	**External Marks : 75**

Objectives: To make students learn about

- *amino acids and proteins*
- *enzymse and co-factors*
- *nucleic acids and protein synthesis*
- *lipids and carbohydrates*
- *retrosynthetic analysis*

UNIT-I: Amino Acids and Proteins (13 Hrs)

1.1.Amino Acids: Structure, classification, synthesis and properties of amino acids, isoelectric point, biosynthesis of amino acids.

1.2.Peptides: oligo- and polypepides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis.

1.3.Proteins: classification and properties (denaturation, isolelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins, collagen and triple helix.

UNIT-II: Enzymes and Cofactors (14 Hrs)

2.1.Enzymes: Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: chymotrypsin, ribonuclease and lysozyme, Enzyme-catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerisation, group transfer and rearrangement reactions.

2.2.Co-factors:structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid and Vitamin B_{12}. Mechanisms of reactions catalysed by the above cofactors.

UNIT-III: Nucleic Acids and Protein Synthesis (14 Hrs)

3.1.Nucleic Acids: Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA.

3.2.RNA and Protein Synthesis: Messenger RNA synthesis-transcription, Ribosomes- rRNA, Transfer RNA. Determination of base sequence of DNA. Polymerase Chain Reaction (PCR).

3.3.Antisense technology in chemotherapy and other nucleic acid-targeted drugs-intercalaters, sequence specific drugs. A brief account of ribozyme and iRNA(interference).

UNIT-IV: Lipids and Carbohydrates (14 Hrs)

4.1.Lipids: Classification – Neutral lipids,phospholipids(lecithines,cephalins,plasmalogens) and glycolipids-importance,synthesis and degradation. Bio-synthesis of cholesterol, lipds-synthesis of fatty acids and triglycerids

4.2.Carbohydrates: Classification–reducing and non-reducing sugar. Glucose:structure, conformation,stability.

4.3. Carbohydrates of cell membrane – starch , cellulose and glycogen, TCA cycle. Relation between glycosis and respiration.principles of bioenergetics.

UNIT-V: Guidelines of Retrosynthesis (14 Hrs)

5.1.Designing organic synthesis-disconnection approach-synthons and synthetic equivalents-one group disconnections: alcohol, olefin, ketone, acids.

5.2. Two group disconnections:1,2, 1,3, 1,4 and 1,5-difunctional compounds-convergent synthesis-functional group interconversions- functional group additions-carbon heteroatom bonds-methods for 3- to 6-membered rings.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the various structure of proteins and peptide synthesis from amino sequence
- Identify enzyme action and biosynthesis of enzymes by cofactors
- Get knowledge on structure identification of nucleic acids and proteins
- Know about the planning of synthesis form disconnection

Text Books

1. Hermann Dugas and C. Penny, Springe-Verlag.,Bioorganic Chemistry: A Chemical approach to Enzyme action.
2. N.C. Price and L.Stevens, Fundamentals of Enzymology, Oxford University Press.
3. C. Walsh, W.H.Freeman., Enzymatic Reaction Mechanisms,
4. Stuart Warren, Designing Organic Synthesis: The Disconnection Approach, Wiley, 2nd Ed., 1984.

References Books

1. H. B. Kagan, Asymmetric Synthesis, Thieme Medical Publishers, 2003.
2. Francis A. Carey and Richard B. Sundberg, Advanced Organic Chemistry: Part-A and Part-B by, Springer, 5thEd, 2007.
3. Harish K.Chopra, Anupriya parmar and Parmjit S.Panesar, Bio organic Chemistry, Narosa publishers, 2013.
4. Herman dugas, Bio organic Chemisrty, 3rd Edition, 2003.

SEMESTER-I: ELECTIVE COURSE-II: MEDICINAL CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 6	**InternalMarks : 25**
Credit : 3	**External Marks : 75**

Objectives: To introduce learners

- *To the action of drugs and the importance of drugs*
- *Some important drugs and their Mechanism of Action*
- *To the procedures of Drug Discovery, Design and Development*
- *To the Lead and analogue synthesis by group disconnection approach*
- *To the Lead and analogue synthesis by asymmetric synthesis*

UNIT-I: Introduction to Drugs and Their Action (13 Hrs)

1.1.Drugs: Historical background-sources and classification of drugs-important terminologies in medicinal chemistry.

1.2.Drug Action: Role of intermolecular forces-drug targets: lipids, carbohydrates, proteins (enzymes,receptor) and nucleic acids as drug targets.

1.3.Pharmacokinetics and pharmacodynamics: administration,absorption, distribution, metabolism, elimination of drugs-bioavailability of drugs-side effects.

UNIT-II: Selected Examples of Drugs and Their Mechanism of Action (14 Hrs)

2.1.Antibacterial agents: Mechanism of action-antibacterial agents that act against cell metabolism(sulfonamides), inhibit cell wall synthesis (penicillins, cephalosporins), interact with plasma membrane(valinomycin and gramicidin A), impair protein synthesis (tetracyclines, chloramphenicol) and act on nucleicacids (quinolones and fluoroquinolones, rifamycins).

2.2.Antiviral and antifungal agents: General principles-nucleic acidsynthesis inhibitors (HIV), host cell penetration inhibitors, inhibitors of viral protein synthesis. Azoles, allyamines and phenols. Anticancer drugs and their mechanism of action- role ofantimetabolites, antisense drugs, alkylating agents and interchelating agents in cancer chemotherapy.

2.3.Cardiovascular drugs: Antiarrhythemic and antihypertension drugs.

UNIT-III: Drug Discovery, Design and Development (14 Hrs)

3.1.Identification of diseases and corresponding targets- bioassays and leads. Stereochemistry and solubility issues in drug design. Structure activity relationships (SARs): changing size and shape-introduction of newsubstituents.

3.2.Quantitative structure activity relationships (QSARs): lipophilicity-electronic and steric effects-Hansch Analysis-Topliss decision tree. Chemical and process development of drugs. Preclinical trials:pharmacology, toxicology, metabolism and stability studies-formulation. **3.3.Clinical trials:** phase I-IV studies ethical issues. Patent protection. Regulation.

UNIT-IV: Lead and Analogue Synthesis-I (14 Hrs)

4.1. Designing organic synthesis: Disconnection approach-synthons and synthetic equivalents-one groupdisconnections: alcohol, olefin, ketone, acids.

4.2.Two group disconnections:1,2-, 1,3-, 1,4- and 1,5-difunctionalcompounds-convergent synthesis-functional group interconversions- functional group additions-carbonheteroatombonds-methods for 3- to 6-membered rings.

UNIT-V: Lead and Analogue Synthesis-II (14 Hrs)

5.1. Combinatorial synthesis in medicinal chemistry: Solid phase techniques-methods of parallel synthesis-mix and split techniques-dynamic combinatorial chemistry-screening and deconvolution-limitations of combinatorial synthesis.

5.2. Assymmetric synthesis: basic principles-stereoselective and stereospecific reactions-methods for determining enantiomeric excess-chiral auxiliary, reagents and catalysts and their applications (wherever applicable) in alkylation, hydrogenation, hydroxylation, epoxidation and hydroboration of alkenes, reduction of ketones-Cram and Felkin-ahn models. Noyori's BINAP – Jacobson catalyst – Evans catalyst.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the basic concepts of Drugs and their functions
- To know about the Action of drugs
- Understand the processes of drug discovery and development
- Have a deeper understanding of lead and analogue synthesis through disconnection approach and asymmetric synthesis

Text Books

1. Gareth Thomas, Fundamentals of Medicinal Chemistry, John Wiley & Sons, 2003.
2. Gareth Thomas, Medicinal Chemistry: An Introduction, Wiley-Interscience, 2nd Ed, 2008.

3. Graham L. Patric, An introduction to Medicinal Chemistry, Oxford University Press, USA, 3rd Ed., 2005.
4. Wilson and Giswald's Textbook of Organic Medicinal and Pharmaceutical Chemistry by John Blockand John M Beale (Eds), Lippincott Williams & Wilkins, 11th Ed., 2003.

Reference Books

1. The Organic Chemistry of Drug Design and Drug Action by Richard B. Silverman, Academic press,2nd Ed., 2004.
2. Designing Organic Synthesis: The Disconnection Approach by Stuart Warren, Wiley, 2nd Ed., 1984.
3. Asymmetric Synthesis by H. B. Kagan, Thieme Medical Publishers, 2003.
4. Francis A. Carey and Richard B. Sundberg,Advanced Organic Chemistry: Part-A and Part-B, Springer, 5th Ed.,2007.

SEMESTER-II: CORE COURSE-V: PHYSICAL CHEMISTRY –I

Course Code :P2R1CHCC5	**Max. Marks : 100**
Hours/Week : 5	**InternalMarks : 25**
Credit : 5	**External Marks : 75**

Objectives: To help students to understand

- *Quantum Mechanics and its applications in simple system*
- *theories of reaction rate and their applications*
- *about symmetry elements and point groups*
- *Photochemistry and Solar cells*
- *Molecular Thermodynamics*

UNIT – I: Quantum Mechanics (12 Hrs)

1.1. Inadequacy of classical mechanics-Black body radiation, Planck's quantum concept, Photoelectric effect. Bohr's theory of hydrogen atom:Hydrogen spectra, Wave-particle dualism, Uncertainty principle, Inadequacy of old quantum theory. Schrödinger equation, Postulatory basis of quantum mechanics.

1.2. Operator algebra: operator, linear and hermitian, eigen functions and eigen values, angular momentum operator, commutation relations, related theorems.

1.3.Applications of wave mechanics to simple systems – particle in a box, one and three-dimensional, distortion of the box and Jahn-Teller effect, quantum numbers, zero-point energy, orthogonalisation and normality, finite potential barrier – tunneling.

UNIT – II: Chemical Kinetics- I (11 Hrs)

2.1. Theories of reaction rate – Absolute reaction rate theory (ARRT) - Significance of reaction co-ordinate – Potential energy surfaces – Kinetic isotope effect – Molecular dynamics –Marcus theory of electron transfer processes. Principle of microscopic reversibility-Steady–state approximation.

2.2. Chain reactions: Thermal and photochemical reactions between hydrogen and halogens - Explosions and hydrogen – oxygen reactions.

2.3. Application of ARRT to solution kinetics-effect of solvent and ionic strength, influence of pressure on rates in solution.

UNIT – III: Group theory - Concepts (12 Hrs)

3.1.Elements of group theory – definition – group multiplication tables – conjugate classes, conjugate and normal subgroups – symmetry elements and operations.

3.2.Point groups – assignment of point groups to molecules -Matrix representation of geometric transformation and point groups – reducible and irreducible representations– properties of irreducible representation.

3.3. Construction of character tables – bases for irreducible representation – direct product – symmetry adapted linear combinations – projection operators.

UNIT –IV: Photochemistry and Radiation Chemistry (11 Hrs)

4.1.Photochemistry: Chemi-luminescens, phosphorescences, quantum yield. Photo-physical processes electronically excited molecules Jablonski diagram – Stern-Volmer equation and its applications – experimental techniques in photochemistry – chemical action meters –lasers and their applications.

4.2.Photo-catalysts and photovoltic cell: Solar energy: Conversion, Basic concept of photo-catalyst, visible light water splitting, photovoltaic cells. Perovskites solar cells. Dye sensitized solar cells, efficiency and measurement.

4.3.Fast reaction techniques: Introduction, flow methods (continuous and stopped flow methods)- Relaxation methods (T and P jump methods) – Pulse techniques (pulse radiolysis, flash photolysis, Shock tube method)- molecular beam method – lifetime method.

UNIT – V: Molecular Thermodynamics –I (11 Hrs)

5.1.Calculation of Thermodynamic probability of a system – Difference between thermodynamic probability and statistical probability – Ergodic hypothesis –Derivation of Boltzman distribution equation – physical significance of partition function- translational, rotational, vibrational and electronic partition functions.

5.2. Quantum statistics – Bose – Einstein and Fermi – Dirac distribution equations – comparison of B.E and F.D statistics with Boltzman statistics – Concept of Negative Kelvin Temperature.Relationships between partition function and thermodynamic properties such as *E, H, Cp, Cv, P*,Derivation of $PV=RT$.

5.3. Molecular interpretation of entropy- Derivation of $S=klnW$- Establishment of analogous nature of $S= klnW$ to $ds= dq_{rev}/T$. Calculation of *S, A, G* etc., from partition functions– calculation of equilibrium constants for very simple reactions.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course outcomes: At the end of the course, the learners will be able to

- ❖ Know the basic concepts of Group theory and its application to simple systems
- ❖ Understand more deeply processes involved in quantum mechanics
- ❖ Understand the applications of Photochemistry and Solar cells
- ❖ Know the applications of ARRT to solution kinetics
- ❖ Understand Molecular Thermodynamics

Text Books

1. F. Albert Cotton, Chemical Applications of Group Theory, 3rd Ed., John Wiley & Sons, 2003
2. K.J. Laidler, Chemical Kinetics, 2nd Ed., Tata McGraw Hill, 1975.
3. P.W. Atkins, Physical Chemistry, 7th Ed., Oxford University press, 2002.
4. R.P.Wayne, Photochemistry, Butterworths, London, 1970.
5. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry – Classical, Statistical and Irreversible, ShobhanLal Nagin, New Delhi, 198

Reference Books:

1. Robert L. Carter, Molecular Symmetry and Group Theory, John Wiley &Sons, Inc., 1998.
2. D. A. McQuarrie and D. Simon, Physical chemistry, A Molecular Approach,Viva Books.
3. A.K. Chandra, Introductory Quantum Chemistry, 4th Ed,. Tata McGraw Hill, 1994.
4. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 1997.

SEMESTER-II: CORE COURSE-VI: PHYSICAL METHODS IN CHEMISTRY-I

Course Code :P2R1CHCC6	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To help students understand

- *Principles of Molecular Spectroscopy*
- *the basic concepts and interpretations of NMR spectroscopy*
- *the instrumentation and applications of UV-Visible, IR Spectroscopy*
- *the principles and instrumentation of ESR, ORD,CD*
- *about X-Ray Diffraction of crystal systems*

UNIT-I: Principles of Molecular Spectroscopy (12 Hrs)

1.1. Interaction of electromagnetic radiation with molecular systems – Time evolution of the systems under radiation – Einstein transition probability for induced absorption and spontaneous and stimulated emission – Transition moment and Oscillator strength Microwave spectroscopy - rotational spectra of diatomic molecules, rigid and non-rigid rotors, - Intensity of spectral lines - Effects of isotopic substitution.

1.2. Infrared spectra – diatomic molecules, simple harmonic and anharmonic oscillators - diatomic vibrating rotator, rotation-vibration spectrum of carbon monoxide - Interaction of rotation and vibration (breakdown of Born – Oppenheimer approximation) – Influence of the rotation on the spectrum of polyatomic molecules, linear and symmetric top molecules, parallel and perpendicular vibrations, Influence of nuclear spin.

1.3. Raman spectra – Rotational Raman spectra of linear and symmetric top molecules – Vibrational Raman spectra, Rotational fine structure. Electronic spectra of diatomic molecules, Vibrational coarse structure – Intensity of vibrational lines in electronic spectra – Rotational fine structure – Fortrat diagram.

UNIT-II: Advanced Spectroscopy (NMR) (12 Hrs)

2.1. ^{1}H NMR: Multiplicity – Coupling constant – First order and second order proton, Spin - spin splitting – Dependence of *J* on dihedral angle –Vicinal and geminal coupling constants – Karplus equation – long range coupling constants, Influence of stereochemical factors on chemical shift of protons. Simplification of complex spectra – Double resonance techniques, shifts reagents. Chemical spin decoupling of rapidly exchangeable protons (OH, SH, COOCH, NH, NH_2), an elementary treatment of NOE phenomenon.

2.2.^{13}C NMR: Basic theory of FT – NMR, Relaxation – Broad band decoupling. Off resonance decoupling and chemical shifts of common functional groups, DEPT spectra.Identification of small compounds based on NMR data.

2.3. 2D Techniques: ^{1}H–^{1}H COSY, ^{1}H–^{13}C COSY–HMBC and NOESY.

UNIT-III:Advanced Spectroscopy: (UV –Vis, IR) (11 Hrs)

3.1.UV-Visible Spectroscopy : Introduction - Instrumentation, Sampling techniques - Woodward–Fieser and Scott rules for conjucateddienes and polymers, ketones, aldehydes, α and β-unsaturated acids, esters, nitriles, and amides.

3.2.Differentiation of geometrical isomers and positional isomers – Disubstituted benzene derivatives - Study of steric effect in aromaticity.

3.3.Infrared Spectroscopy: Introduction- Instrumentation, Sampling techniques, factors influencing group frequencies – Both internal and external – quantitative studies. Hydrogen bonding – (intermolecular andintramolecular).

UNIT: IV: ESR, ORD and CD (11 Hrs)

4.1. Electron Spin Resonance Spectroscopy: Basic principles – comparison between ESR and NMR spectra – hyperfine splitting – factors affecting the magnitude of *g* – values – calculation of unpaired electron density on an atom in a delocalized system – applications to organic free radicals.

4.2. Optical Rotatory Dispersion and Circular Dichroism: Introduction to theory and terminology – cotton effect – ORD curves – axial haloketone rule and its applications – octant rule – its applications – applications of ORD to determine absolute configuration of monocyclic ketones – comparison between ORD and CD – their inter relationships.

4.3. Mass Spectrometry: Instrumentation – Resolution, EI and CI methods – Base peak, isotopic peaks, metastable peak, parent peak, determination and use of molecular formula, recognition of molecular ion peak – FAB. Fragmentation – General rules – Pattern of fragmentation for various classes of compounds, McLafferty rearrangement, Importance of metastable peaks.

UNIT-V: Methods of Diffraction (11 Hrs)

5.1. X-ray diffraction: X-ray diffraction by single crystal – Space groups –Systematic absences in X-ray data and identification of lattice types, glide planes and screw axes.X-ray intensities, structure factor and its relation to intensity and electron density , phase problem. Structure

solution by Heavy atom method and direct method. Determination of absolute configuration of molecules. A brief account of Cambridge Structural Database (CSD) and Protein Data Bank.

5.2. Electron Diffraction by gases: Scattering intensity *vs*Scattering angle, wierl equation, measurement technique, elucidation of structure of simple gas phase molecules.

5.3. Neutron diffraction by crystals: Magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the principles of UV-Vis ,IR, Raman and NMR spectroscopy
- Verify the spectroscopic selection rules applying group theory concepts
- Generate structural elucidation of newly synthesized compounds in the research field
- Apply the X-ray diffraction with several crystal systems

Text Books

1. C.N. Banwell, Fundamentals of molecular Spectroscopy, 4th Ed., TMH, New Delhi, 2016.
2. P.K.Ghosh, Introduction to Photoelectron Spectroscopy, John Wiley New York, 1989.
3. W. Kemp, Organic Spectroscopy, 3rd Ed., MacMillon, 1994.
4. Y.R. Sharma, Elementary Organic Spectroscopy – Principles and Chemical applications,S.Chand,1992.
5. W.Clegg, Crystal structure determination, Oxford University press, New York,1998.
6. G.H.Stout, L.H. Jensen, X-ray structure determination: A practical guide, John wiley& sons Publication: New York,1989.

Reference Books:

1. B.P. Straughan and S.Walker Spectroscopy Vol.3, Chapman Hall London, 1976.
2. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York, 1964.
3. P.M. Silverstein, F. X. Wester, Spectroscopic Identification of Organic Compounds, 6th Ed., Wiley 1998.
4. J.R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall, 1965.
5. J.P. Glusker, K. N. Trueblood, Crystal structure analysis: A primer., Oxford university press, New York,1972.

SEMESTER-II: CORE COURSE-VII: ORGANIC CHEMISTRY –II

Course Code :P2R1CHCC7	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To make students learn

- *The Nucleophilic substitution reaction and its rearrangements*
- *Electrophilic Substitution Reactions and their naming reactions*
- *About Addition and Elimination Reactions*
- *Pericyclic Reactions and Rearrangements*
- *About the Some important Reagents in Organic Synthesis*

UNIT – I: Nucleophilic Substitution Reactions (11 Hrs)

1.1. Aliphatic Nucleophilic substitution: Mechanisms–Effect of structure-Stereochemical factors–Neighbouring group participation, substitutions at allylic and vinylic carbons. Correlation of structure wither activity–Solvent effects.

1.2. Rearrangements involving Carbocations-Wagner Meerwein and Dienone–phenol rearrangements.

1.3. Aromatic Nucleophilic substitution: S_N1, S_NAr, Benzyne mechanism–reactivity orientation–Ullman,Sandmeyer and Chichibabin reaction.

1.4. Rearrangements involving nucleoplilic substitution–Stevens–sommelet Hauser and Von–Richter rearrangements.

UNIT - II: Electrophilic Substitution Reactions (12 Hrs)

2.1. Aromatic electrophilic substitution reaction:Orientation, reactivity and mechanisms based on transitionstate theory with suitable reactions, substitutions in Thiophene, Pyridine and Pyridine-N-Oxide.

2.2. Quantitative treatment of the structural effects on reactivity-Substituents effects – Origins of Hammett equation–Principles of Hammett correlation – Effect of structure on reaction mechanisms Hammett parameters; σ and ρ, modified forms of Hammett equation. Taft Equation.

2.3. Aliphatic Electrophilic Substitution: S_E2,S_Ei and $S_E1$mechanisms,Diazonium coupling reactions. Metals as electrophile in substitution reactions and decomposition of diazonium salts.

UNIT – III: Addition and Elimination Reactions (12 Hrs)

3.1. Addition Reactions: Addition to carbon–carbon multiple bonds: Electrophilic, nucleophilic and free radical additions–Orientation of the addition–Stereochemical factors influencing the addition of bromine and hydrogenbromide, hydroxylation, hydroboration leading to formation of alcohols.

3.2. Addition to carbonyl and conjugated carbonyl systems-Mechanism–Grignard reagents–1,2 and 1,4-additions (dimethyllithiumcuprate), Benzoin, Knovenagel, Stobbe and Darzen's glycidic ester condensation and Reformatsky reactions.

3.3. Elimination Reactions: E1,E2, E1cB – Stereochemistry of elimination, Hofmann and Saytzeffrules–Competition between elimination and substitution – Pyrolytic *cis* elimination, Chugaev reaction–Examples such as dehydration, dehydrohalogenation, Hofmann degradation, Cope elimination–Bredt's rules with examples.

UNIT – IV: Pericyclic Reactions and Rearrangements (11 Hrs)

4.1. Concerted reactions–stereochemistry-orbital symmetry and concerted symmetry and correlation diagram–Frontier molecular orbital approach–Woodward and Hoffmann rules–Electrocylcic reactions.

4.2. Cycloaddition reactions–sigmatropic rearrangements–selection rules and examples with simplemolecules–1,3 and 1,5 hydrogen shifts–Cope and Claisen rearrangements.

4.3. Other molecular rearrangements: Wolff–Lossen–Schmidt–Favorski–Pummmerer and Hofman Freytas reagents.

UNIT-V: Reagents in Organic Synthesis (11 Hrs)

5.1. Reduction: Catalytic hydrogenation–Wilkinson Catalyst, dehydrogenation, reduction with LAH, $NaBH_4$, tertiarybutoxy aluminum hydride, $NaCNBH_3$, tributyltinhydride, alkali metals for reduction, reductions involving hydrazines, Wolf Kishner reduction.

5.2. Oxidation: Osmium tetroxide, Sharpless asymmetric epoxidation, Chromyl chloride, Ozone, DDQ,Dioxiranes, Lead tetraacetate, Selenium dioxide, DMSO with either Ac_2O or Oxalyl chloride, Dess-Martinvreagent.

5.3. Synthesis involving phase transfer catalysis (**PTC),**use of crown ethers, Merrifield resin, Baker'syeast.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the nucleophilic substitution reaction and its rearrangements
- Understand the aromatic and aliphatic eletrophilic substitution reactions
- Get fresh knowledge on addition and elimination reactions
- Known about the pericyclic reaction and its rearrangements
- Identify the reagents involved in organic synthesis

Text Books

1. S.H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, Organic chemistry, McGraw Hill, 4th Ed., 1980.
2. T.H. Lowry and K.S. Richardson, Mechanism and Theory in Organic Chemistry, Harper and Row, 1976.
3. R.K. Bansal, Reaction Mechanism in Organic Chemistry, Tata McGraw Hill, 1990.

Reference Books

1. J. March, Advanced Organic Chemistry; Reactions, Mechanisms and Structure, 6th Ed., Willey, 2013.
2. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Parts A & B, Plenum, 2015.

SEMESTER-II: CORE COURSE-VIII: ORGANIC CHEMISTRY PRATICAL-II

Course Code :P2R1CHCC8P	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 40**
Credit : 5	**External Marks : 60**

Objectives: To give students practice in

- *Quantitative analysis of organic compounds*
- *Some double stage organic preparations*

A. Quantitative analysis of organic compounds (30 Marks)

Estimation of phenol, aniline, ketone, glucose, nitrobenzene, saponification value of an oil and Iodine value of an oil.

B. Preparation of organic compounds (Double stage) (20 Marks)

a. *p*-bromo acetanilide from aniline (acetylation and bromination).
b. acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation).
c. 1,3,5-tribromobenzene from aniline (bromination, diazotization and hydrolysation).
d. *p*-nitroaniline from acetanilide (nitration and hydrolysis).
e. benzillic acid from benzoin (rearrangement).
f. *p*-amino benzoic acid from p-nitro toluene (oxidation and reduction).
g. benzanilide from benzophenone (rearrangement).
h. *p*-bromoaniline from acetanilide (bromination and hydrolysis).
i. *m*-nitroaniline from nitrobenzene (nitration and reduction).
j. 1,2,4-triacetoxy benzene from hydroquinone (oxidation and acylation).

Course Outcomes: At the end of the course, the learners will be able to

- Perform quantitative separation of binary mixture of organic compounds
- Observe the separation and regeneration of the compounds
- Understand isolation and purification of compounds

Scheme of Valuation:

Record and Viva	- 10 Marks
Estimation	- 30 Marks
Preparation (Double stage)	- 20 Marks

Text Books

1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual,S. Viswanathan Co. Pvt. Ltd, 2007.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.

Reference Book

1. Vogel's Text book of Practical Organic Chemistry, 4thEd., ELBS/Longman, England, 1984**.**

SEMESTER-II: CORE COURSE-IX: INORGANIC CHEMISTRY PRATICAL-II

Course Code :P2R1CHCC9P	**Max. Marks : 100**
Hours/Week : 6	**Internal Marks : 40**
Credit : 5	**External Marks : 60**

Objectives: To give learners practice in

- *Quantitative separation of metal ions in binary mixtures*
- *Simple single stage preparations of some inorganic complex compounds*

Titrimetry and Gravimetry **(35 Marks)**

A mixture of solution(s) should be given for estimation

1. Cu (V) and Ni (G)
2. Cu (V) and Zn (G)
3. Fe (V) and Zn (G)
4. Fe (V) and Ni (G)
5. Zn (C) and Cu (G)

Preparation of the Following Compounds **(15 Marks)**

a. Tetramminecopper (II) sulphate.
b. Potassium trioxalatochromate (III).
c. Potassium trioxalatoaluminate (III).
d. Trithioureacopper (I) chloride.
e. Trithioureacopper (I) sulphate.
f. Dibenzyltindichloride

Course Outcomes: At the end of the course, the learners will be able to

- Perform qualitative separation of binary mixtures and individual quantitative estimation adapting volumetric and gravimetric methods
- Well versed in advanced methods of estimation of metal ions through complexation
- Apply suitable techniques to obtain maximum yield of the dried product without any wastage

Scheme of Valuation:

Record and Viva	- 10 Marks
Complex Preparation	- 15 Marks
Volumetric Estimation	- 20 Marks
Gravimetric Estimation	- 15 Marks

Text Books

1. G. H. Jeffery, J. Bassett, J.Mendham, R.C. Denney, Vogel's 's Textbook of Quantitative Chemical Analysis; 5th Ed., ELBS,1989.
2. J. D., Woollins, Ed., Inorganic Experiments; VCH: Weinheim, 1994.
3. G. Pass, H. Sutcliffe, Practical Inorganic Chemistry; Chapman Hall, 1965.
4. W. G. Palmer, Experimental Inorganic Chemistry; Cambridge University Press, 1954.

SEMESTER-II: ELECTIVE COURSE-III: INDUSTRIAL CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 3	**External Marks : 75**

Objectives: To make students understand

- *Leathers, dyes and their constituents*
- *Fuels and their varieties*
- *About oil, fats, soaps and their applications*
- *the preparation of synthetic perfumes*
- *the functions of drugs*

UNIT-I: Tanning of Leather and Dyes (12 Hrs)

1.1. Introduction-Animal skin,manufacture of leather-preparation of hides-vegetable tanning-chrome tanning- finishing-oil tanning.

1.2. Dyes: Introduction-senation of colour-colour and constitution-nomenclature-basic operations in dyeing classification of dyes according to the mode of application – synthesis, reaction an applications of diphenylmethane dyes-triphenylmethane dyes-phthalein dyes-xanthene dyes-acridine dyes-sulphur dyescyanine dyes.

UNIT-II: Fuels (11 Hrs))

2.1. Fossil fuels- classification and unique features- Coal, Petroleum, natural gas.

2.2. Biofuels: Biomass- biodiesel. Nuclear fuels: for various types of nuclear reactors.

2.3. Hydrogen as fuel in the future-Hydrogen storage materials. Fuel cells – basic principle.

UNIT-III: Oils, Fats, Waxes and Soaps (12 Hrs)

3.1.Introduction-Distinction between oils and fats-properties and its classifications-animal fats and oilsdifference between, animal, vegetable and mineral oils-isolation of essential oils and their usessaponification value-ester value-acid value-iodide value-wijs method – Reichert meissel value-Henher value-elaident test-hydrogenation of oils.

3.2. Soaps and its manufacture-general consideration in soap making – manufacture of toilet and transparent soaps – oil to be used for soap – cleansing action of soap.

UNIT-IV: Synthetic Perfumes (11 Hrs)

4.1.Introduction-Esters-alcohols – ketones–aionones – nitromusks – aldehydes – dipheny-production of natural perfumes-flower perfumes-fruit flavours-artificilal flavours.

UNIT-V: Drugs **(11 Hrs)**

5.1.Antibiotics: Definition, structure-uses of chloramphenicol, ampicillin, streptomycin,tetracycline, rifamycin – Erythromycin – Properties, uses.

5.2. Sulpha drugs: Definition and drug action of sulphadrugs. Preparation and uses of sulphadiazine, sulphapyridine, sulphathiazole and sulphafurazole.

5.3.Anasthetics: Definition – classification – general volatile anaesthetics – ethers, nitrousoxide, chloroform, trichloro ethane, storage – advantages – disadvantages – intravenous anaesthetics: thiopental sodium, methohexitone – local anaesthetics – cocaine, procaine,benzocaine – uses – advantage – disadvantages.

Unit -VI: Latest Learning's (For CIA only) **(03 Hrs)**

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Undertake dyeing, tanning and related processes
- Understand the classification of fuels and their importance
- Fresh knowledge on isolation and properties of oils, fats and soaps
- Identify the commercial perfumes and their applications
- Easily differentiate antibiotics and anesthetics

Text Books

1. Chemical Process Industries – Norrish Shreve, R. and Joseph A. Brink Jr. McGraw Hill, Industrial Book Company, London.
2. Mathew George and Lincy joseph, Text book of pharmaceutical chemistry, 2009.
3. JayashreeGhose – Text book of Pharmaceutical chemistry, 2nd Ed., 2003.
4. S. Lakshmi, Pharmaceutical Chemistry, 3rdEd.,Sulthan Chand and Sons, New Delhi,2004.

References Books:

1. Production and Properties of Industrial Chemicals – Brain A. C. S. Reinhold – New York.
2. Petroleum Products Hand Book. Guthrie V., McGraw Hill, Tokyo.
3. Industrial Chemistry (Including Chemical Engineering) – B. K. Sharma 10thEd.,
4. Outlines of Chemical Technology – For the 21stCentury – M. Gopala Rao &Matshall S. Sittig, 3rd Ed.,
5. Charles E. Carraher, Polymer chemistry, 6th Ed, Marcel Dckker, Brijbasi Art Pvt.Ltd, 2003.
6. V.R.Gowariker, N.V. Viswanathan and JayadevSreedhar, Polymer Science, New Age Publishers,New Delhi, 2010.

SEMESTER-II: ELECTIVE COURSE-IV: GREEEN CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 3	**External Marks : 75**

Objectives: To introduce learners to

- *the basic concepts of green chemistry*
- *Microwave Assisted Organic Synthesis*
- *Ionic liquids and phase transfer catalyst*
- *Bio-Catalysts for Green Chemistry*
- *Alternative Reagents for synthesis*

UNIT-I: Introduction to Green Chemistry (11 Hrs)

Green chemistry-relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

UNIT-II: Microwave Assisted Organic Synthesis (MAOS) (12 Hrs)

Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions _ Functional group transformations – condensations reactions – oxidations – reductions reactions – multi-component reactions.

UNIT-III: Ionic Liquids and PTC (11 Hrs)

Introduction – synthesis of ionic liquids – physical properties – applications in alkylation – hydroformylations – expoxidations – synthesis of ethers – Friedel-craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications.

UNIT-IV: Supported Catalysts and Bio-Catalysts for Green Chemistry (12 Hrs)

Introduction – the concept of atom ecomomy – supported metal catalysts – mesoporoussilicas – the use of Biocatalysts for green chemistry - modified bio catalysts – fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

UNIT -V: Alternative Synthesis, Reagents and Reaction Conditions (11 Hrs)

A photochemical alternative to Friedel-crafts reactions - Dimethyl carbonate as a methylating agent – the design and applications of green oxidants – super critical carbon dioxide for synthetic chemistry.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- understand the basic concepts of green chemistry and Microwave Assisted Organic Synthesis
- Work for Reducing the pollution in the environment
- Synthesize the new material using green chemistry
- Understand the uses of green solvents

Text Book

1. Rashmi Sanghi & M. M. Srivastava, Green Chemistry – Environment friendly alternatives, Narora Publishing House, 2003.
2. V.K.Ahulwalia, A text book of green chemistry, Narosa publishers, Reprint, 2013.
3. K.R.Deasi, A text book of green chemistry, 2nd Revised Edition 2014.

Reference Books

1. V. K. Ahluwalia, Green Chemistry – Environmentally benign reactions, Ane Books India, 2006.
2. Green Chemistry – Designing Chemistry for the Environment – edited byPaul T. Anastas& Tracy C. Williamson. Second Edition, 1998.
3. Green Chemistry – Frontiers in benign chemical synthesis and processes- edited byPaul T. Anastas& Tracy C. Williamson. Oxford University Press, 1998.

SEMESTER-III: CORE COURSE-X: PHYSICAL CHEMISTRY-II

Course Code :P3R1CHCC10	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To makre learners understand

- *electrical conductance and electro kinetic phenomena*
- *principles and applications of polarography*
- *third law of Thermodynamics*
- *About surface adsorption isotherm*
- *To understand quantum chemistry and their applications in spectroscopy*

UNIT – I: Electrochemistry-I (11 Hrs)

1.1. Electrolytic conductance- Debye-Huckel-Onsager theory – Debye Falkenhagen and Wien effect. Electrode – electrolyte equilibrium, electrode potential – concentration cells – liquid junction potentials.Processes at Electrodes-.

1.2.The rate of charge transfer - current density – Butler – Volmer Equation –Tafel equation – Electrical double layer potential – Theory of multiple layers at electrode – electrolyte interfaces – Double layer capacity –Electrokinetic phenomen,Applications: Fuel cells and power storage.

UNIT – II: Electrochemistry-II (11 Hrs)

2.1.Principles and applications of polarography – Instrumentation, Types of cells, advantages of droppingmercury electrode, interpretation of current voltage curves, tests for reversibility, determination of 'n' values(usefulness of Ilkovic equation), polarographic maxima, current time curves.

2.2. Modern developments-Oscillographic polarography, AC polarography –Cyclic Voltammetry, advantages over polarographic techniques–test of reversibility of electron transfer reactions.

2.3. Chronopotentiometry–apparatus used advantages over polarography–controlled potential coulometry.

UNIT – III: Molecular Thermodynamics-II (12 Hrs)

3.1. Third law-thermodynamics-Need for it-Nernst heat theorem and other forms of stating the third law.Thermodynamic quantities at absolute zero–Apparent exceptions to the third law.

3.2. Thermodynamics of systems of variable composition–partial molar properties–chemical potential –relationship between partial molar quantities – Gibbs Duhem equation and its applications (the experimental determination of partial molar properties not included).

3.3.Thermodynamic properties of real gases – fugacity concept – calculation of fugacity of real gas–Activity and activity coefficient – concept – definition – standard states and experimental determinations of activity and activity coefficient of electrolytes.

UNIT – IV: Surface Phenomena (11 Hrs)

4.1. Gibbs adsorption isotherm–solid- liquid interfaces–contact angle and wetting–solid-gas interface–physisorption and chemisorptions –Langmuir, BET isotherms– surface area determination.

4.2. Kinetics of surface reactions involving adsorbed species–Langmuir-Hinshelwood mechanism, Langmuir–Rideal mechanism-Rideal–Eley mechanism. Some interfacial aspects on Micelles, Reverse micelles, Micro emulsions and Membranes.

UNIT – V: Quantum Chemistry (12 Hrs)

5.1. Applications of Wave mechanics- the rigid rotator, harmonic oscillator – Hydrogen atom solution –Shapes and nodal properties of orbitals – Space quantisation – electron spin – Many electron atoms – oneelectron orbitals – Pauli principle – determine form of wave function, Helium atom and effective nuclearcharge.

5.2. Approximation methods – Variation methods, application to Hydrogen and Helium atoms– Perturbation method for nondegeneratesystems. Angular momentum in many electron systems – Spin orbit interaction, L-S and j-j coupling schemes.Atomic Structure Calculation – Self consistent field method for atoms – Hartree and HartreeFock method for atoms.

5.3.Vibrational spectra – symmetry properties of normal molecules – Symmetry co-ordinates – Selection rulesfor fundamental vibrational transition – IR and Raman activity of fundamentals in CO_2, H_2O, N_2F_2 – The rule of mutual exclusion and fermi resonanc

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- *Understand electrolytic conductance and chronopotentiometry*
- *Know about Molecular Thermodynamics and surface phenomena*
- *Get knowledge on various adsorption isotherm models*
- *Understand quantum chemistry and its applications in spectroscopy*

Text Book

1. F.A. Cotton, Chemical Applications of group Theory, 3rd Ed., Wiley Eastern 1990
2. A.K. Chandra, Introductory Quantum Chemistry, 4th Ed., Tata McGraw Hill, 1994
3. D.A. Mcquarrie, Quantum Chemistry, University Science Books, 1983.
4. J.P. Lowe, Quantum Chemistry, Academic Press, 1978.
5. I.N. Levine, Quantum Chemistry, Allyn and Bacon, 1983.
6. S.Glasstone, Introduction to Electrochemistry, Affiliated East-West Press, 1968.
7. J.Albery, Electrode Kinetics, Clarendon Press, Oxford Chemical Series, 1979.
8. Ira N.Levine Quantum Chemistry, 7th Edition,2016.

References Books:

1. P.W. Atkins, Physical Chemistry, ELBS and Oxford University Press, Oxford, 1983.
2. D.R.Crow, Polarography of Metal Complexes, Academic Press, New York.
3. Daniel C Harris, Quantitative Chemical Analysis, 4th ed., W. H. Freeman and Company, New York, 1995
4. J. Rajaram and J.C.Kuriacose, Thermodynamics for Students of Chemistry – Classical, Statistical andIrreversible, ShobhanLalNagin, New Delhi, 1981.
5. G.W.Castellan, Physical Chemistry, Narosa, New Delhi, 1986.
6. M. Klotz and P.M.Rosenberg, Chemical Thermodynamics: Basic Theory and Methods, 3 Edn. W.A.Benjamin, New York, 1974.
7. K.J. Laidler, Chemical Kinetics, 3rd Ed., Tata McGraw Hill, 1980.

SEMESTER-III: CORE COURSE-XI: INORGANIC CHEMISTRY-II

Course Code :P3R1CHCC11	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To make learners understand

- *The principles of bioorganic chemistry*
- *About cobalamine and Heme protein*
- *Medicinal bioorganic chemistry*
- *Metallocene and organometallic reaction*

UNIT – I **(12 Hrs)**

1.1.Occurrence and availability of Inorganic elements in biological systems- Biomineralisation-Control and assembly of advanced materials in Biology - Nucleation and crystal growth –various biominerals – calcium phosphate – calcium carbonate – Amorphous silica, Ironbiominerals – strontium and barium sulphate.

1.2. Function and Transport of Alkali and Alkaline Earth Metal Ions: Characterization of K^+, Na^+, Ca^{2+} and Mg^{2+} - complexes of alkali and alkaline earth metal ions withmacrocycles - Ion channels – ion pumps. Catalysis and regulation of bioenergetics processes by the Alkaline Earth Metal ions Mg^{2+} and $Ca^{2+.}$

1.3. Metals at the Center of Photosynthesis: Primary Processes in Photosynthesis – Photosystems I and II - Light Absorption (EnergyAcquisition) – Exciton transport (Direct Energy Transfer) – Charge separation and electron transport – Manganese catalyzed oxidation of water to O_2.

UNIT – II **(12 Hrs)**

2.1.Cobalamines-Reactions of the alkyl cobalamins – One-electron Reduction and Oxidation – Co-C BondCleavage – coenzyme B12 – Alkylation reactions of methylcobalamin.

2.2. Heme and Non-Heme Proteins-Hemoglobin and Myoglobin – Oxygen transport and storage – Electron transfer and Oxygen activation.Cytochromes, Ferredoxins and Rubredoxins – Model systems, mononuclear non-heme ironenzymes.

2.3.Copper Containing Proteins Classification and examples - Electron transfer – Oxygen transport - Oxygenation – oxidases and reductases – Cytochrome c oxidase – Superoxide dismutase (Cu, Zn).**Nickel containing Enzyme:** Urease.

UNIT – III **(11 Hrs)**

3.1. Medicinal Bioinorganic Chemistry: Bioinorganic Chemistry of quaint essentially toxic metals. Lead, Cadmium, Mercury, Aluminum,Chromium, Iron, Copper, Plutonium. Detoxification by metal chelation. Drugs that act bybinding at the metal sites of Metalloenzymes.

3.2. Chemotherapy-Chemotherapy with compounds of certain non-essential elements. Platinum complexes in Cancer therapy – *Cis* platin and its mode of action – Cytotoxic compounds of other metals – Gold containing drugs as anti-rheumatic agents and their mode of action - Lithium in Pschycopharmocological drugs. Raadio pharmaceuticals – Technetium.

UNIT IV **(11 Hrs)**

4.1. Hapticity-Ligand classification, synthesis and structure – The 18 electron rule – application andlimitation-isolobal concept and its usefulness. Uses of typical organomettallics in organic synthesis such as metal alloys and organometallic hydrides. Structure and bonding in metalcarbonyls (simple and polynuclear)

4.2. Nitrosyl complexes – bridging and terminal nitrosyls, bent and linear nitrosyls, Dinitrogen complexes.

4.3. Metallocene and arene complexes-Metalcarbenes, carbynes, carboxylate anions.

UNIT – V **(11 Hrs)**

5.1. Organometallic reactions – Ligand association and dissociation – oxidative addition and reductive elimination – Insertion reactions.

5.2.Reactions of coordinated ligands in organometallics- Hydrogenation, hydroformylation, epoxidation, metathesis, polymerization of olefins, olefin oxidation (Wacker process) and carbonylation of methanol.

Unit -VI: Latest Learning's (For CIA only) **(03 Hrs)**

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the source and functions of important metal ions
- Know the metabolism and structure of biological compounds
- Get fresh knowledge on cytotoxic compounds and their action
- Understand the importance of medicinal bioorganic chemistry and nitrosyl compounds

Text Books and Reference Books

1. J. E. Huheey, Inorganic Chemistry, Principle, structure and reactivity 4thEd., Harper & Row Publishers,2006
2. Purcell and Kotz, Inorganic Chemistry, Saunders Golden Sunburst Series, W. B. Saunders Company, Philadelphia.
3. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, Panima Publishing Company, New Delhi, 1997.
4. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, New York, USA.
5. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6thEd., Wiley Interscience Publication, John Wiley & Sons, New York, USA.2007.
6. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, John Wiley & Sons, NewYork 6th edition.2014.
7. B. Douglas, D. H. McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Ed, John Wiley & sons, New York. 1994.
8. J. P. Collman, L. S. Hegedus, J. R. Nortan and R. G. Finke, Principles and Applications of Organotransition Metal Chemistry, University Science Books. Mill Valley, California, 2nd edition, 1987.

SEMESTER-III: CORE COURSE-XII: PHYSICAL METHODS IN CHEMISTRY – II

Course Code :P3R1CHCC12	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To make learners aware of

- *The principles of electronic and vibrational spectroscopy and their applications*
- *The principles of NMR, EPR and Mossbauer Spectroscopy and their applications*
- *IR and Raman spectroscopy and the concepts behind them*
- *The factors to be considered in the interpretation of IR and Raman spectra*

UNIT-I: Electronic Spectroscopy (12 Hrs)

1.1. Electronic Configuration-terms, states and microstates. Derivation of term symbols(p^2,d^2) and arranging the various terms according to their energies. Spectroscopic terms-effect of inter electronic repulsion and spin-orbit coupling-Racah parameter B and C.R-S coupling and jjcoupling. selection rule and breakdown of selection rules-Group theoretical explanation.

1.2. Ground states of free ion for d^n system-octahedral and tetrahedral system and the corresponding energy level diagrams-mixing of orbitals.Orgal diagram-characteristics-prediction and assignment of transition for d^n weak field cases. Tanane-sugano diagrams-characteristics-prediction and assignment of transition for weak field and strong field d^nsystems.

1.3. Band widths-band shape, band intensity-Effect of distortion and spin-orbit coupling on spectra – Evaluation of 10Dq and B for octahedral complexes of cobalt and nickel – charge transfer spectra.

UNIT – II: Infrared and Raman Spectroscopy (12 Hrs)

2.1. Vibrations in simple molecules- (H_2O, CO_2) and their symmetry notation for molecular vibrations – Group vibrations and the limitations- combined uses of IR and Raman Spectroscopy in the structural elucidation of simple molecules like N_2O, ClF_3, NO_3^-, ClO_4^- –effect of coordination on ligand vibrations.

2.2.Uses of groups vibrations in the structural elucidation of metal complexes- urea, thiourea, cyanide, thiocyanate,nitrate, sulphate and dimethyl sulfoxide–Effect of isotopic substitution on the vibrational spectra of molecules–vibrational spectra of metal carbonyls with reference to the nature of bonding, geometry andnumber of C-O stretching vibrations (group theoretical treatment)–Applications of Raman Spectroscopy–Resonance Raman Spectroscopy.

2.3. Mass Spectrometry: Principles and presentation of spectra–molecularfragmentation–ion reactions–Inorganic applications.

UNIT–III: NMR Spectroscopy (11 Hrs)

3.1.Examples for different spin systems – chemical shifts and coupling constants (spin-spin coupling)involving different nuclei (^{1}H, ^{19}F, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds – Effect of quadrupolar nuclei (^{2}H, ^{10}B, ^{11}B) on the ^{1}H NMR spectra, Satellite spectra.

3.2.Systems with chemical exchange - evaluation of thermodynamic parameters in simple systems – studyof fluxional behavior of molecules – an elementary treatment of second order spectra – examples.

3.3.NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions – Lanthanide shift reagents.

UNIT-IV: EPR spectroscopy (11 Hrs)

4.1.Theory of EPR spectroscopy-Spin densities and McConnell relationship–Factors affecting themagnitude of g and A tensors in metal species - Zero-field splitting and Kramers degeneracy–Spectra ofVO(II), Mn(II), Fe(II), Co(II), Ni(II) and Cu(II) complexes – Applications of EPR to a few biologicalmolecules containing Cu(II) and Fe(III) ions.

4.2.Magneticproperties: Types of magnetism–Dia–para–ferro and anti-ferro magnetism. Magnetic properties of free ions – firstorder Zeeman effect – Second order Zeeman effect – states KT – states<<KT. Determination of Magneticmoments and their applications to the elucidation of structures of inorganic compounds – temperature independent paramagnetism. Magnetic properties of lanthanides and actinides. Spin crossover in coordination compounds.

UNIT-V: Mossbauer Spectroscopy (11 Hrs)

5.1. Isomer shifts–Magnetic interactions–Mossbauer emission spectroscopy–applications to iron and tincompounds.

5.2. NQR spectroscopy: Characteristics of quadrupolar nucleus–effects of field gradient and magnetic field upon quadrupolarenergy levels–NQR transitions–applications of NQR spectroscopy.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Use various spectroscopic principles to characterize inorganic and organometallic compounds
- Interpret the spectroscopic data of simple inorganic compounds
- Identify the electronic transitions in various d^n system

Text Books

1. R.S. Drago, Physical Methods in Inorganic Chemistry, 3rd Ed., Wiley Eastern Company.
2. R.S.Drago, Physical Methods in Chemistry, W.B. Saunders Company, Philadelphia, London.
3. F.A. Cotton and G.Wilkinson, Advanced Inorganic Chemistry, 6th Ed., Wiley-Eastern Company, New Delhi, 2007.
4. E.A.V.Ebsworth, Structural Methods in Inorganic Chemistry, 3rd Ed., ELBS, Great Britain, 1987.
5. 5. D.W.H. Rankin, Norbert Mitzel and Carol Morrison, Structural methods in molecular Inorganic Chemistry, John wiley publishers,2013.

SEM-III: ELECTIVE COURSE-V: QUALITY CONTROL AND ENVIRONMENTAL CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 3	**External Marks : 75**

Objectives: To make learners understand

- Food adulteration and its impact on human health
- Pollution and recycling techniques
- The application of chemistry in quality control measures
- About the energy sources

UNIT – I: Quality Control Measurements (12 Hrs)

1.1. Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate.

1.2. Food adulteration – common adulterants in food, contamination of food stuffs– Microscopic examination of foods for adulterants – Pesticides analysis in food products – analysis of toxic metals in food (Mercury, cadmium, cobalt, tin and chromium).

1.3. Determination of iodine, Saponifiction and acid value of an oil – Food standards – ISI and Agmark.

UNIT – II: Energy Sources – Non Conventional (12 Hrs)

2.1. Solar energy – Technologies based on capture of heat from sun light – solar water heating systems – solar air conditioning. Technologies for converting solar energy to electricity – heat engines, photo voltaic – principle and operation.

1.2. Wind energy – wind mills – wind farm sitting and properties – storage. Tidal energy – advantages and limitations of tidal power generation. Environmental impact of renewable energy sources.

1.3. Bio mass energy sources – advantages –Fuel cell – hydrogen-oxygen fuel cell, Hydrocarbon-oxygen fuel cell

UNIT –III: Water Pollution and its Control Analysis of Water Pollution (11 Hrs)

3.1. Sources of water pollution – domestic – industrial – agricultural – soil and radioactive wastes as sources of pollution.Water pollutants and their effects.

3.2.Objectives of analysis – parameter for analysis-colour – turbidity – total solids – conductivity – acidity – alkalinity – hardness – chloride -sulphate – fluoride – silica – phosphates, different forms of nitrogen, DO, BOD, COD.

3.3. Heavy metal pollution-public health significance of cadmium – chromium – copper – lead – zinc– manganese –mercury and arsenic- Prevention and control its measures.

UNIT –IV: Radioactive and Thermal Pollution (11 Hrs)

4.1. Radioactivity and kinds of radiation – Sources of radioactive pollution – Radio waste generated by nuclear power plants – Harmful effects of radiation – Dangerous from nuclear power plants –Disposal methods of radioactive wastes.

4.2. Source of thermal pollution – Thermal power plant pollution – Hazardous effect – Prevention and control of thermal pollution.

UNIT – V: Wealth from Waste (Recycling) (11 Hrs)

5.1. Introduction – Recycling Technique – Construction materials from waste – Medicines from agricultural waste – Liquid fuels from agricultural – Urban waste and bagasses for electricity.

5.2. Agriculture waste for biomass into cheap and efficient fuel – Bacteria for paper making – Waste into objects of daily use – Garbage into fuel – How to use garbage to generate power.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcome: At the end of the course, the students will be able to

- Identify the adulterants in food.
- Understand energy sources using various methods
- Understand about radioactive and thermal pollution and their control methods
- Understand about recycling process

TEXT BOOKS:

1. B.K. Sharma and H. Kaur, "Environmental chemistry" ,Goel Publishing House, Meerut, 2008.

2. B.K. Sharma - "Instrumental Methods of Chemical Analysis",Goel Publishing House, Meerut. 2001.

3. B.K. Sharma – "Industrial Chemistry", Goel Publishing House, Meerut, 2015.

UNIT I: Text Book 1,2
UNIT II: Text Book 1,3
UNIT III: Text Book 1,2,3
UNIT IV: Text Book 3
UNIT V: Text Book 2,3

REFERENCES:

1. S.A. Abbasi and Naseema Abbasi – "Renewable energy sources and their environmental impact", Prentice-Hall, New Delhi,2002.

2. H. Kaur, Pragati Prakashan, Meerut – "Instrumental Methods of Chemical Analysis", 2001.

SEMESTER-III: ELECTIVE COURSE-VI: NATURAL PRODUCTS CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 5	**Internal Marks : 25**
Credit : 3	**External Marks : 75**

Objectives: To enable students to understand

- *Some important natural pigments and their isolation*
- *The separation and structural elucidation of alkaloids*
- *About synthesis and structural elucidation of terpenoids*
- *The biosynthesis of natural products and steroids*
- *The constitution and functions of steroids and harmones*

UNIT-1: Natural pigments (12 Hrs)

1.1. Carotenoids and Anthocyanins -Introduction-Classification-Isolation and Seperation of carotenoids-Characteristics-function-elucidation of constitution-synthesis.

1.2. Flavones and Xanthones- Introduction-properties –Isolation-Separation and purification-Elucidation of structure-synthesis.

UNIT-II: Alkaloids (11 Hrs)

2.1. Definition-Occurrence, extraction of alkaloids from plants, general properties, determination of the chemical constitution of the alkaloids, functional group analysis, estimation of groups, degradation and synthesis.

2.2. Structural elucidation: Coniine, Piperine, nicotine and ephedrine.

UNIT-III: Terpenoids (12 Hrs)

Introduction-Nomenclature-properties-Isolation-Isoprene rule-Gem-dialkyl rule-Determination of structures of terpenoids. **Myrcene**-Introduction-Elucidation of constitution-Synthesis. **Citral-** Introduction-Isolation-Elucidation of constitution-Synthesis.**Menthone-**Introduction-Elucidation of constitution-Synthesis.Irones- Introduction-Elucidation of constitution-Synthesis.**Carone-** Introduction-Elucidation of constitution-Synthesis.

UNIT-IV: Bio Synthesis of Some Natural Products (11 Hrs)

Introduction, Bio synthesis of Terpenoids, Steroids,Oestrogens, Gestrogens,Corticoids,Alkaloids.

UNIT-V: Steroids and Hormones (11 Hrs)

Cholesterol-Introduction-Elucidation of constitution. **Stigmastero**l -Introduction-Elucidation of constitution. **Ergosterol-**Introduction-Elucidation of constitution.Sexharmones-Introduction-

Oestrogen- Oestrone- Introduction-Elucidation of constitution.**Progesterone**- Introduction-Elucidation of constitution. **Androsterone-** Introduction-Elucidation of constitution.

Unit -VI: Latest Learning's (For CIA only) **(03 Hrs)**

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- ❖ Understand the basic concepts of natural products
- ❖ Identify natural pigments and their uses
- ❖ Apply their knowledge of alkaloids, terpenoids and steroids in medicinal chemistry
- ❖ Apply their knowledge in separation and purification of natural products

Reference Book

1. I. L. Finar, Organic Chemistry, VolI & II, 6th Ed., England, Wesley Longman Ltd. 2002.
2. GurdeepChatwal and Anand, Chemistry of Natural Products, Himalayan Publishing Co, 2001
3. O. P. Agarwal, Chemistry of Natural Products, Vol-1, 2 ,Goel Publishing House, 2015
4. Sujatha V Bhat, Bhimson A, Nagasamba and Meenakshi Sivakumar, Chemistry of Natrual Products, Narosa publishers, 2006.

SEMESTER-III: CORE COURSE-XIII:PHYSICAL CHEMISTRY PRACTICAL-I

Course Code :P3R1CHCC13P	**Max. Marks : 100**
Hours/Week : 6	**Internal Marks : 40**
Credit : 5	**External Marks : 60**

Objective: To give students practice in

- *Some non-electrical physical chemistry experiments*
- *The kinetics of some reactions and in generating the phase diagram of some binary systems*
- *Methods to determine the physical constants of substances*

Any ten experiments out of the following experiments.

1. Kinetics- Acid hydrolysis of Ester- Comparison of strengths of acids.
2. Kinetics- acid hydrolysis of Ester- Determination of energy of activation (Ea).
3. Kinetics- Saponification of Ester- Determination of Ea by conductometry.
4. Kinetics- Persulphate- Iodine reaction- Determination of order, effective of ionic strength on rateconstant.
5. Determination of molecular weight of substance by Transition Temperature method.
6. Determination of molecular weight of substances by Rast method.
7. Determination of Critical Solution Temperature (CST) of phenol- water system and effect ofimpurity on CST.
8. Study of phase diagram of two components forming a simple eutectic.
9. Study of phase diagram of two compounds forming a compound.
10. Study of phase diagram of three components system.
11. Determination of molecular weight of substances by cryoscopy.
12. Determination of integral and differential heat of solutions by colorimetry.
13. Polymerization- Rate of polymerization of acrylamide.
14. Distribution law- Study of Iodine- Iodine equilibrium.
15. Distribution law- Study of association of benzoic acid in benzene.
16. Adsorption- Oxalic acid/Acetic acid on charcoal using freundlich isotherm.

Course Outcomes: At the end of the course, the learners will be able to

- Apply phase rule to predict the eutectic composition temperature
- Identity the inter dependence of temperature, pressure and phase transitions
- Identify the liphophilic, liphophophlic character of compounds
- Calculate the molecular weight of unknown substances
- Determine the parameters which are helpful to predict the reaction pathway

Scheme of Valuation:

Record and Viva	- 10 Marks
Procedure and Formula	- 10 Marks
Up to 5%	- 40 Marks
05 to 10%	- 30 Marks
10 to 15%	- 20 Marks

> 15% - 10 Marks

Gravimetric Estimation - 15 Marks

Reference books

1. J.B.Yadav, " Advanced Practical Physical chemistry", 20th Ed., GOEL publishing House, KrishnaPakashan Media Ltd., (2001).
2. Findlay's "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th ed., Longman,London, 1985.
3. J.N. Gurtur and R.Kapoor, "Advanced Experimental chemistry", Vol.I. Chand & Co., Ltd, New Delhi.

SEMESTER-III: CORE COURSE-I:PHYSICAL CHEMISTRY PRACTICAL-II

Course Code :P3R1CHCC14P	**Max. Marks : 100**
Hours/Week : 6	**Internal Marks : 40**
Credit : 5	**External Marks : 60**

Objectives: To train students in

- *Some electro analytical experiments*
- *The processes the principles of conductometry and potentiometry*

Any ten experiments out of the following experiments.

a. Conductometry- Acid- alkali titrations.
b. Cuctometry- Precipitation titrations.
c. Conductometry- Displacement titrations.
d. Conductometry- Determination of dissociation constant of weak acids.
e. Conductometry- solubility product of sparingly soluble silver salts.
f. Verification of Onsager equation- conductivity method.
g. Determination of degree of hydrolysis and hydrolysis constant of a substance.
h. Potentiometric titrations- Acid alkali titrations.
i. Potentiometric titrations- Precipitation titrations.
j. Potentiometric titrations- Redox titrations.
k. Potentiometry- Determination of dissociation constant of weak acids.
l. Potentiometry- Determination of solubility of silver salts.
m. Potentiometry- Determination of activity and activity coefficient of ions.
n. *pH* titration of *ortho*-phosphoric acid.
o. To determine the relative strength of two acids by conductance measurements.
p. To determine the pH of a buffer solution using a quinhydrone electrode.

Course Outcomes: At the end of the course, the learners will be able to

- Discuss the concept of eletrochemistry
- Apply the concepts of electrochemistry to make new discoveries
- Measure various electrochemical parameters
- Plan and perform experimental procedures

Scheme of Valuation:

Record and Viva	- 10 Marks
Procedure and Formula	- 10 Marks
Practical	- 40 Marks
<1%	- 40 Marks
1-2%	- 30 Marks
2-3%	- 20 Marks
> 3%	- 10 Marks

Reference books

1. J.B.Yadav, "Advanced Practical Physical chemistry", 20th Ed., GOEL publishing House, KrishnaPakashan Media Ltd., (2001).
2. Findlay's "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th ed., Longman,London, 1985.
3. J.N. Gurtur and R.Kapoor, "Advanced Experimental chemistry", Vol.I. Chand & Co., Ltd, New Delhi.

SEMESTER-IV: ELECTIVE COURSE-VII:ADVANCED TOPICS IN CHEMISTRY

Course Code :	**Max. Marks : 100**
Hours/Week : 6	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To enable students to understand

- *The concepts of supramolecular chemistry and various non-bonded interactions*
- *The principles of solid state chemistry*
- *The methods of electro organic synthesis*
- *About Nano-materials and biological synthetic methods*
- *The various characterization techniques of nanomaterials*

UNIT-1: Concepts of Supramolecular Chemistry (12 Hrs)

1.1. Concepts of supramolecular chemistry-Various types of non-covalent interactions. Hydrogen bonds, C-H…X interactions, Halogen bonds. π – πinteractions,non – bonded interactions.Various types of molecular recognition.

1.2. Crystal engineering of Organic solids: Hydrogen bonded supramolecular patterns involving water/carboxyl/halide motifs. Concepts of different types of synthons based on non-covalent interactions. Principles of crystal engineering and non-covalent synthesis. Polymorphism and Pseudopolymorphism. Supramolecularisomorphism / polymorphism. Crystal engineering of pharmaceutical phases.

UNIT-II: Preparative methods in solid state chemistry (12 Hrs)

2.1.Principles of solid state chemistry-Experimental procedure, Co-precipitation as a precursor tosolid state reaction, Other precursor methods, Kinetics of solid state reactions - Crystallizations of solutions ,melts, glasses and gels,

2.2.Solutions and gels : Zeolite synthesis, Melts, Glasses - Vapour phase transport methods - Modification of existing structures by ion exchange and intercalation reactions,Graphite intercalation compounds, Transition metal dichalcogenide and other intercalation compounds, Ion exchange reaction, Synthesis of new metastable phases by 'ChimieDouce' - Electrochemical reduction methods - Preparation of thin films, Chemical and electrochemical methods, Physical methods - Growth of single crystals, zochralskimethod, Bridgman and stockbarger methods, Zone melting.

2.3.Comparison of different methods - High pressure and hydrothermalmethods, Hydrothermal methods, Dry high pressure methods.

UNIT-III: Basic concepts of electro organic synthesis (11 Hrs)

3.1. Fundamental aspects of electron transfer reaction: oxidation, reduction reactions vs electron transfer reactions in organic chemistry and electrochemistry

3.2.Standard potentials: Mechanism and theory of outer sphere electron transfer reactions – Fundamental aspects of electrode phenomena, monitoring a half-reactions, general view of an electrode reaction, adsorption phenomena – Mass transfer in electrochemistry, fundamental aspects, steady state electrochemical methods, Transient electrochemical methods.

UNIT-IV: Nanomaterials – An Introduction and Synthetic methods (11 Hrs)

4.1. Definition-Historical milestones - unique properties due to nanosize, Quantum dots, Classification of Nanomaterials.

4.2. General methods of synthesis of nanomaterials –Hydrothermal synthesis, Solvothermal synthesis, Microwave irradiation, sol – gel and Precipitation technologies, Combustion Flame-Chemical Vapor Condensation Process, gas Phase Condensation Synthesis,Reverse Micelle Synthesis, Polymer – Mediated Synthesis, Protein Microtube – Mediated Synthesis.

4.3. Synthesis of Nanomaterials using microorganisms and biological agents: Sonochemical Synthesis, Hydrodynamic Cavitation.Inorganic nanomaterials – Typical examples –nano TiO2 / ZnO/CdO/CdS,Organicnanomaterials – examples – Rotaxanes and Catenanes.

UNIT-V: Techniques for Characterization of nanoscale materials (11 Hrs)

5.1.Principles of Atomic force microscopy (AFM)-Transmission electron microscopy (TEM)-Resolution and scanning transition electron microscopy (STEM)

5.2.Scanning Tunneling Microscopy (STM), Scanning nearfield optical microscopy (SNOM),Scanning ionconductance microscope, scanning thermal microscope, scanning probe microscopes and surface plasma spectroscopy.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Understand the importance of solids in crystal engineering
- Know the modern methods of preparation of solid state elements
- Learn about the importance of electro organic synthesis by individual effort
- Understand the basic principles of nano chemistry
- Apply the modern analytical technique for nanomaterial

Reference Books

1. Solid state chemistry and its applications by Anthony R.West, John Wiley & sons
2. Lehn, J.M. Supramolecular Chemistry, VCH, Wienheim, 1995.
3. Desiraju, G.R. Crystal Engineering: The Design of Organic Solids,Elsevier, Amsterdam, 1989.\
4. Jonathan W.Steed, Jerry L and Atwood, Supramolecular Chemistry 2nd Edition, Wiley publishers, 2013.

Journals:

1. Crystal Growth and Design,http://www.pubs.acs.org/journals/cgdefu/index.html
2. Crystal Engineering Communication,http://www.rsc.org/Publishing/Journals/ce/index.asp
3. Nano letters -http://pubs.acs.org/journals/nalefd/index.html

SEM-IV: ELECTIVE COURSE-VIII:INSTRUMENTAL METHODS OF ANALYSIS

Course Code :	**Max. Marks : 100**
Hours/Week : 6	**Internal Marks : 25**
Credit : 5	**External Marks : 75**

Objectives: To train students in the theories behind

- *Spectroscopy*
- *Data analysis*
- *Chromatography*
- *Analytical data*
- *Electro analytical and thermo analytical techniques*

UNIT-I: Absorption and Turbidimetry (13 Hrs)

1.1. Principles and Applications of Extended X-ray absorption fine structure (EXAFS)–Surface extended X-ray absorption (SEXAFS).

1.2. Atomic Absorption Spectroscopy (AAS)-Flame Emission Spectroscopy (FES).

1.3. Turbidimetry–Theory and Applications.

UNIT-II: Data and Error Analysis (14 Hrs)

2.1.Various types of Error–Accuracy, precision, significant figures–Frequency distributions, the binomial distribution, the Poisson distribution and normal distribution–Describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements–Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, Paired t-Test.

2.2.Analysis of variance (ANOVA) – Correlation and Regression – Curve fitting , Fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – General polynomial equation fitting , linearizing transformations, exponential function fit–r and its abuse – multiple linear regression analysis, elementary aspects.

UNIT-III: Chromatography (14 Hrs)

3.1. Solvent extraction – principles of ion exchange, paper, thin layer and column Chromatography techniques– Columns, adsorbents, methods, R_f values, McReynold's constants and their uses.

3.2. HPTLC, HPLC techniques – Adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques: methods, principles and uses.

UNIT-IV: Thermo Analytical Methods (14 Hrs)

4.1.Principles-factors affecting thermogram, instrumentation and thermal decomposition of $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$.

4.2.Differential technique: Instrumentation,experimental,instrumental factors of DTA and DSC.Thermal studies of $CuSO_4.5H_2O$ by DTA and determination of purity of pharmaceuticals and phase transition studies by DSC – evaluation and thermodynamic parameters.

4.3.Electrogavimetry: Principle,instrumentation, deposition and separation.Electrolysis at constant. Thermometric titrations.

UNIT-V: Electroanalytical Techniques and Fluorescence Spectroscopy (14 Hrs)

5.1.Electrochemical sensors- ion sensitive electrodes, glass – membrane electrodes, solid liquid membrane electrodes – ion-selective field effect transistors (ISFETs) – Sensors for the analysis of gases in solution.

5.2. Amperometric gas sensors – Amperometric titrations: Principles- Apparatus –techniques – applications. Basic aspects of synchronous fluorescence spectroscopy – Spectral hole burning – flow cytometry–Instrumentation on fluorescence ratio.

Unit -VI: Latest Learning's (For CIA only) (03 Hrs)

Latest development related to the course during the semester concerned

Course Outcomes: At the end of the course, the learners will be able to

- Substantiate understand the accuracy, precision and errors in measurement
- Know about solvent extraction and recycling techniques
- Understand the principles, instrumentation, working and uses of various chromatography technique
- Know the basic concepts of electro analytical techniques

References Books

1. Analysis for chemistry, Oxford University Press, 2006.
2. R. Stock and C. B. F. Rice, Chromatographic Methods, Chapman and Hall, New York.
3. V.K. Srivastava and K.K. Srivastava, Introduction to Chromatography, S. Chand & Co., New Delhi, 2nd Ed,1981.
4. Willard, Merrit, Dean and Settle, Instrumental methods of Analysis CBS Publishers and Distributors, 7th Ed., 2004.
5. D. A. Skoog, D.M.West, F.J. Holler, F. J., Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore.
6. A.Sharma, S.G. Schulman, Introduction to Fluoresceence Spectroscopy, Wiley-Interscience.New York,1999.

7. C.N.Banwell and E.M.McCash, Fundamentals of Molecular spectroscopy, 4th Ed., TataMcGraw-Hill, New Delhi, 2003.
8. Vogel, A. I., Text book of Quantitative Inorganic Analysis, ELBS 6th ed,2007
9. Daniel C Harris, Quantitative Chemical Analysis, 4th Ed., W. H. Freeman and Company, New York, 1995.
10. S.C.Gupta, Fundamentals of Statistics,6th Ed., Himalaya Publ. House, Delhi, 2006.

SEM-IV: PROJECT WORK

Course Code : P4R1CHCC15PW **Max. Marks : 100**

Hours/Week : 24

Credit : 8

Objectives:

- *To give students an exposure to research methods in chemistry*
- *to make them choose a topic on which chemical research is possible*
- *to make them plan and execute the necessary experiments using the right procedures*
- *to sharper the observation and interpretation skills of the students*
- *to initiate students in proper procedures of documentation*

Course outcomes: On completion of the work students will have

- *Sufficient analytic powers to study issues faring society like pollution resource depletion etc and offer suitable solutions for them*
- *the project work will be a launch for advanced research*

J.J COLLEGE OF ARTS AND SCIENCE (Autonomous)

Re-Accredited by NAAC with Grade 'A' in 3rd Cycle

SIVAPURAM, PUDUKKOTTAI-622422

DEPARTMENT OF CHEMISTRY

PG - PROGRAMME - M.Sc CHEMISTRY

(2019-2020)

PROGRAMME OUTCOMES FOR M.Sc

Post Graduates will be able to

- Gain complete knowledge about fundamental aspects of all branches of Chemistry
- Learn about the potential uses of analytical chemistry, industrial chemistry, Quality control and environmental chemistry.
- Apply the various analytical techniques like IR, Mass, NMR and XRD to structural characterization of unknown compounds
- Obtain knowledge in spectral, Analytical, Qualitative and Quantitative techniques and contribute new scientific insights or innovative applications of chemical research to the next generation.