PSG College of Arts & Science

An Epitome of Quality Learning

Since 1947

M.Sc. CHEMISTRY

2016 - 2018

MSc CHEMISTRY PROGRAMME

SCHEME OF EXAMINATIONS

(For students admitted in June 2014-15 onwards)

Code No.	Subject	Dura-tion (Hrs)	Max. Marks			Credit Points
			CA	CE	TOT	
First Semester						
14CHP01	Organic Chemistry – I	3	25	75	100	5
14CHP02	Inorganic Chemistry –I	3	25	75	100	5
14CHP03	Physical Chemistry –I	3	25	75	100	5
14CHP04	Basic Electronics for chemists (Allied)	3	25	75	100	4
-	Organic Chemistry Practical – I*	-	-	-	-	-
-	Inorganic Chemistry Practical–I*	-	-	-	-	-
-	Organic Chemistry Practical– II*	-	-	-	-	-
-	Inorganic Chemistry Practical-II*	-	-	-	-	-
Second Semester						
14CHP05	Organic Chemistry – II	3	25	75	100	5
14CHP06	Inorganic Chemistry –II	3	25	75	100	5
14CHP07	Physical Chemistry –II	3	25	75	100	5
14CHP08A 14CHP08B	**Core Elective-I** Nano and Green Chemistry OR Polymer Chemistry	-	100	-	100	5
14CHP09	Organic Chemistry Practical– I*	6	40	60	100	2*
14CHP10	Inorganic Chemistry Practical–I*	6	40	60	100	2*
14CHP11	Organic Chemistry Practical– II*	6	40	60	100	2*

14CHP12	Inorganic Chemistry Practical-II*	6	40	60	100	2*
14SBP01	**Skill Based Subject** Cyber Security	-	100	-	100	2
Third Semester						
14CHP13	Organic Chemistry – III	3	25	75	100	5
14CHP14	Inorganic Chemistry –III	3	25	75	100	4
14CHP15	Physical Chemistry –III	3	25	75	100	5
14CHP16	Molecular Spectroscopy and applications	3	25	75	100	4
14CHP17	Physical Chemistry Practical – I	6	40	60	100	2
14CHP18	Physical Chemistry Practical – II	6	40	60	100	2
14CHP19A 14CHP19B 14CHP19C 14CHP19D	**IDC** - Cluster –Theory** Food Chemistry & Quality Control (ND) OR Clinical Biochemistry (BC) OR Clinical Microbiology (MB) OR Environmental Pollution and Management (ES)	3	25	75	100	2
14CHP20A 14CHP20B	**IDC** - Cluster –Practical** Food Chemistry & Quality Control (ND) OR Clinical Biochemistry (BC) OR Clinical Microbiology	3	40	60	100	2

14CHP20C 14CHP20D	(MB) OR Environmental Pollution and Management (ES)					
	Fourth Semester					
14CHP21	Analytical Chemistry	3	25	75	100	5
 14CHP22A 14CHP22B	**Core – Elective-II** Environmental Chemistry OR Industrial Chemistry	3	25	75	100	5
14CHP23	Project Work***	-	80	120	200	5
				Total		**90**

CLUSTER IDC :

14NDP15A/14BCP15A/ Pharmaceutical Chemistry -Theory

14MBP19A/14ESP17A (Cluster IDC for Foods & Nutrition, Biochemistry, Microbiology, and Environmental Science)

14NDP16A/14BCP16A/ Pharmaceutical Chemistry (Practical)

14MBP20A/14ESP18A (Cluster IDC for Foods & Nutrition, Biochemistry, Microbiology, and Environmental Science)

14CHP01 Organic Chemistry I (60 Hours) Semester-I

Objectives

- To learn scientific methods to synthesize organic natural products
- To understand the stereochemistry of the molecules
- To enable the students to know about the mechanistic pathway of reactions

UNIT-I

Mechanistic Studies (12 Hrs)

Inductive and field effects – Bond distances and bond energies – Delocalised bonds – Cross conjugation – Rules of resonance – the resonance effect – steric inhibition of resonance – Hyper conjugation – hydrogen bonding

Methods of determining reaction mechanism – Kinetic methods. Primary and secondary kinetic isotope effects. Non-kinetic methods of study of reaction mechanism. Structure and activity relationship. Hammett equation and Taft equation. Hammond postulate. Principle of microscopic reversibility.

Effect of structure on the dissociation constants of acids and bases. Factors affecting the strength of acids and bases – Bronsted and Lewis concepts of acids and bases.

UNIT-II

Stereochemistry And Conformational Analysis (12 Hrs)

Concept of chirality. Recognition of symmetry elements and chiral structure. Diastereoisomerism in acyclic and cyclic systems - interconversion of Fischer, Newman and Sawhorse projection formulae - calculation of number of stereoisomer – erythro and threo nomenclature - Optical isomerism due to restricted rotation- biphenyl, terphenyl, alkylidine cycloalkane, spirane systems. Molecular overcrowding. R-S system of nomenclature. Stereochemistry of sulphur and nitrogen compounds.

Conformational analysis and stereochemistry of cyclohexane and disubstituted cyclohexane. Reactivity in cyclohexane ring- saponification of esters, solvolysis of tosylates and chromic acid oxidation of alcohols.

Geometrical isomerism- E-Z- system of nomenclature - configuration in aldoxime and ketoxime. - methods of determining configuration - Methods of asymmetric synthesis, stereospecific and stereo selective synthesis.

UNIT-III

Nucleophilic Substitution (12 Hrs)

Aliphatic nucleophilic substitution reactions- SN_1, SN_2 and SNi mechanisms- Factors affecting the rate of nucleophilic substitution - solvent, substrate, unsaturation, leaving group and nuclophilicity. Stereochemistry of nucleophilic substitution reactions.

Substitution at allylic carbon,vinyllic carbon and aliphatic trigonal carbon. Neighbouring group participation, Hydrolysis of esters.

Aromatic nucleophilic substitution – Structure - activity relation. Benzyne mechanism, SN_I SN_2 mechanism.

Ambident nucleophiles, ambident substrates. Zeigler alkylation and Chichibabin reaction.

UNIT-IV

Natural Products Chemistry (12 Hrs)

Alkaloids- structure elucidation and synthesis of the following- quinine, morphine and reserpine.

Terpenoids- structure elucidation of zingiberene and cadenine.

Vitamines – Thiamine, riboflavin, retinol.

Alkaloids- structure elucidation and synthesis of tylophorine. Structure and configuration and conformation of sucrose and maltose. A brief study of starch and cellulose.

UNIT-V

Heterocyclic Chemistry (12hrs)

Nomenclature of Heterocyclic compounds having more than 2 hetero atoms such as oxygen, nitrogen and sulphur. Synthesis reactivivty and applications of the following heterocyles: pyrazoles, oxazole. Structure and synthesis of flavones and isoflavones. Chemistry of luteoline.

Anthocyanins- isolation, detection and structure of cyanin chloride. Chemistry of kaemferol

Text Books

1. Advanced Organic Chemistry Reaction Mechanism and Structure, Jerry March, Mcgraw Hill Book Company, 1968.

2. Advanced organic reaction mechanisms, Bruckner, Reinhard Academic press, New Delhi, 2003.

3. Stereochemistry of Carbon Compounds, E.S. Eliel, Mcgraw Hill Book Company, 1962.

4. Chemistry of Natural Products, Vol. I& II, O.P.Agarwal, Goel Publishing House, Meerut, 2nd edition 1975.

Reference books

1. Principles of Organic Synthesis, R.Norman J.M. Coxon, Chapman and Hall, 3rd edition 1993.

2. Mechanism & Structure in Organic Chemistry. E.S.Gould, Brooklyn, NewYork, 1959.
3. Organic Chemistry, Vol. I& II, I..L. Finar, Pearson education, Asia, Singapore, 6th edition, 2003
4. Stereochemistry of Organic Compounds, P.S Kalsi, Willey Eastern Lt., New Dehi, 1998.
5. Natural Products Chemistry, Nakanishi et.al., Vol I, Kodansha Lt., Academic Press, Inc, New York.
6. Stereochemistry of organic compounds, Principles and applications, D.Nasipuri, New Age and International Pvt Lt. Publishers, New Delhi, 2nd edition, 2005.
7. Organic Chemistry, Pine, 5th Edition, Mcgraw Hill, New York, 2006.
8. Essential Organic Chemistry, P.Y. Bruice, K.J. Rajendra Prasad, Pearson Education, New Delhi, 2008.
9. Mechanism and theory in Organic chemistry J.H.Lowry and K.S.Richardson, Haper and Row, Newyork, 1976.
10. Reaction mechanism in Organic Chemistry, S.M. Mukherjee, S.P. Singh, Macmillan, 3rd edition, 1999.
11. Medicinal Chemistry, Ashutosh Kar, willey Eastern Lt., New Delhi, 1993.
12. Medicinal chemistry, Ahluwalia. V.K. Ane Books, New Delhi, 2008.

14CHP02 Inorganic Chemistry I (60 Hours) Semester-I

Objectives

- To inculcate in-depth knowledge in coordination chemistry
- To enable the students to know the theories of acid base concepts

UNIT-I

Theories of Coordination Complexes (12 Hrs)

18-electron rule – EAN rule. Theories of coordination compounds – valence bond theory- crystal field theory. Splitting of d-orbitals in different symmetries. Crystal field stabilization energy – factors affecting magnitude of 10 Dq. Evidence for crystal field stabilization energy. Spectrochemical series- site selection in spinels. Tetragonal distortion from octahedral symmetry – John teller distortion. Molecular orbital theory. π - bonding and M.O. theory – experimental evidence for π bonding in octahedral complexes.

Sigma and Pi bonding in tetrahedral complexes

UNIT-II

Spectral and Magnetic Properties (12 Hrs)

Term states of d^n-ions-electronic spectra of coordination compounds. Term symbol - Selection rules-band intensities and band widths- energy level diagrams. Orgel and Tanabe Sugano-spectra of Ti^{3+}.V^{3+}, Ni^{2+}, Cr^{3+},Co^{2+} and Fe^{2+}. Calculation of 10Dq for V^{3+} (oh) and Ni^{2+} (oh) complexes. Magnetic properties of coordination compounds – types of magnetic properties. Effect of spin orbit coupling on magnetic properties.

Determination of magnetic susceptibility – Guoy method –Temperature and magnetic behaviour-Ferro magnetism and antiferro magnetism.

UNIT-III

Reaction Mechanisms (12 Hrs)

Nucleophilic substitution reaction in square planar complexes – the rate law for nucleophilic substitution. The trans effect – theories of trans effect. Mechanism of substitution in octahedral complexes – influence of acid and base on rate of reaction – Racemisation and isomerisation – mechanisms of redox reaction – outer sphere mechanisms-excited state outer sphere electron transfer reaction. Inner sphere mechanisms.

Two electron – transfer reactions - complementary and non complementary electron transfer reaction.

UNIT-IV

Structures and isomers (12 Hrs)

Isomerism – steroisomerism –Four coordinate complexes – Chirality constitutional isomers - Experimental separation and modification of isomers. Low coordination numbers (CN = 1,2 and 3). Complexes with coordination number 4 – complexes with coordination number five- coordination number six – Distortion from perfect octahedral symmetry – Trigonal prism – geometrical isomerism in octahedral complexes – Optical isomerism in octahedral complexes. Stereoisomers - six coordinate complexes.

UNIT-V

Theories Of Acid – Base Concept (12 Hrs)

Acid –Base Concepts – Bronsted-Lowery concept – Solvent system concept – Usanovich concept – strength of hydracid – Frontier – orbitals – Acid base reaction – Hydrogen bonding. Theory of Hard and soft acids and bases(HSAB) Pearson's principle. Symbiosis-Electronegativity of hardness and softness. Acid base strength – Measurement of Acid-Base interactions –proton affinity- strength of oxyacids.

Non aqueous solvents and acid-base strength-super acids

Text Books

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson, Wiley Easter Private Lt., New Delhi, 2nd Edition, 1969.
2. Inorganic Chemistry - Principle of structure and reactivity, James.E.Huheey, Pearson Education, Singapore, 4th edition, 2002.

Reference Books

1. M.C.Day and J.Selbin, Theoretical Inorganic Chemistry, Reinhold Book Corporation, 1967.

2. R.D.Madan, Malik and Tuli, Selected Topics in Inorganic Chemistry, S.Chand and Com., 1999.

3. F.Basalo and R.G.Pearson, Mechanism of Inorganic Reactions, University of London Press, 1968.

4. R.B.Heslop and P.L.Robinson, Inorganic Chemistry, Elsevier Scientific Pub. Cor., 1967.

5. B.N. Figgis, Introduction of Ligand Fields, University of London Press, 1966.

6. R.S.Drago, Physical Methods in Chemistry, Reinhold, 1965.

7. B.E.Douglas and DHNC Danial, Concepts and Models of Inorganic Chemistry, Syndey, M.C.Graw Hill, 1965.

8. Therald Moeller, Inorganic Chemistry, An Advanced Text Book, Bombay, Asia Pub Com., 1968.

9. W.E. Jolly, Modern Inorganic Chemistry, NewYork, M.C.Graw Hill, 1984.

14CHP03 Physical Chemistry I (60 Hours) Semester-I

Objectives

- To make the students to the natural process by knowing third law of thermodynamics
- To know the applications of thermodynamics in chemical equilibrium and phase transfer process
- To gain indepth knowledge in electrochemistry

UNIT-I

Chemical Thermodynamics (12 Hrs)

Thermodynamics of systems of variable composition – Partial molar properties-chemical potential, physical significance – Gibbs Duhem equation – variation of chemical potential with T and P. Fugacity –Variation of fugacity with P and T. Determination of fugacity of a real gas and vander Waals gas – fugacity components in ideal solutions – Duhem Margules equation. Activity – definition – choice of standard states of gases, pure liquids, solids and components of solutions – dependence of activity coefficient on temperature and pressure. Activity coefficient – determination of activity coefficient of nonelectrolytes. Mean ionic activity coefficient of electrolyte and its determination by freezing point depression method and emf method.

UNIT-II

Third Law and Chemical Equilibrium (12 Hrs)

Thermodynamic derivation of equilibrium constant – temperature and pressure dependence of the free energy and the equilibrium constant – van't Hoff equation. Equilibrium constant for equilibrium involving ideal and real gases, equilibrium constant for heterogeneous equilibrium. Lechatlier – Braun principle and its applications.

Third law of Thermodynamics – purpose – formulation (Planck, Lewis and Randall). Thermodynamic properties at absolute zero- calculation of absolute entropies – apparent exceptions to the third law.

UNIT-III

Electrochemistry-I (12 Hrs)

Theory of electrolytic conductance – Dybye –Huckel theory- Derivation od thickness of ionic atmosphere- Debye –Huckel-Onsagar equation (Derivation not necessary) and its experimental verification. Deviation from Onsager equation –evidences for the ionic theory of electrolytic conductance - Debye – Huckel limiting Law – Huckel Bronsted equation.

Electrodes – origin of different types of potential, EMF of cells, their determination and applications – determination of equilibrium constant, dissociation constant and solubility product - potentiometric titrations.

UNIT-IV

Electrochemistry-II **(12 Hrs)**

Kinetics of electrode processes, energy barriers at electrode surface – electrolyte interface, over potential, Butler-Volmer equation, Tafel equation. Electrolysis – current potential curves. Hydrogen overvoltage –Theories of overvoltage – factors affecting overvoltage –Electrokinetic phenomenon – electrical double layer – Electro-osmosis – Derivation of Zeta potential of electro-osmosis – Electrophoresis- derivation of Zeta potential of electrophoresis – Streaming potential –Deviation of Zeta potential of streaming potential –Sedimentation potential – Membrane potential –Lippmann's potential. Electrochemical energy conversion – Storage battery – acid and alkaline accumulators.

UNIT-V

Phase Equilibrium **(12 Hrs)**

Gibbs phase rule - its thermodynamic derivation. Study of two component systems- solid-liquid equilibria - simple eutectic system, congruent and incongruent melting systems – manganese and alumina system. Cu and Zn system – a detailed study of iron - carbon system. Three component systems – formation of one, two and three pairs of partial miscible liquids – system composed of two solids and a liquid. Crystallization of pure component only, formation of binary and ternary compounds; formation of solid solutions and partial miscibility of solid phase.

Text Books

A text book of physical Chemistry, S.Glasstone, Macmillan and company Lt., London, 2nd edition, 1962.

Thermodynamics for Chemists, S.Glasstone, Van Nostrand Reinhold company, 11th edition, 1969.

Reference Books

1. An Introduction to Electrochemistry, S.Glasstone, Van Nostrand Reinhold Company, New York,10th edition, 1965.
2. Theoretical Electrochemistry, Antropov, Mir Publishers, Moscow, 1st edition, 1972.
3. Modern Electrochemistry, J.O.M.Bockris and A.k.N.Reddy,Kluvar Academic/Plenum Publishers, New York, 2000.

14CHP04 **BASIC ELECTRONICS FOR CHEMISTS** *I Semester*

(For MSc Chemistry)

Unit – I Semiconductor Devices (9 Hrs)

Introduction – AC and DC – Passive component – Ohm's Law - Semiconductor -Intrinsic semiconductor – Extrinsic semiconductor - PN junction diode and its characteristics - Half wave , full wave rectifier – Zener diode and its characteristics – Zener voltage regulator - Transistor characteristics – Transistor biasing - Principle of transistor amplifier.

Unit – II Operational Amplifier (9 Hrs)

Op-amp and it's parameters – Non-inverting amplifier – Inverting amplifier – Adder – Subtractor - Comparator – Integrator – Differentiator – Optoelectronics devices – Automatic street light – 555 timer - Astable multivibrator – Monostable multivibrator.

Unit – III Digital Electronics (9 Hrs)

Number system - Binary – Octal and hexadecimal – Logic gates:- AND, OR, NOT, NAND & NOR gates - Half and full Adder – Four bit binary adder – Flip flops:- RS – clocked RS , D & JK types – JK master slave flip flop – Flip flop as frequency divider – Digital clock.

Unit – IV Counters (9 Hrs)

Synchronous and asynchronous counters – Binary up/down counter – Decade counter - Ring counter – D/A converter:- Weighted resister - A/D converter:– Counter type – Accuracy – Resolution.

Unit – V Instruments (8 Hrs)

Ammeter – Voltmeter – Potentiometer – pH meter – Conductivity bridge – Electrophoresis – Photoelectric colorimeter – Spectrophotometer – Flame photometer – Atomic absorption spectroscope – Electronic single pan balance digital thermometer.

Text Books

1. V. K. Mehta, "***Principles of Electronics***", S.Chand & Company, New Delhi, 4th Edition, 1995
2. K. R. Botkar, "***Integrated Circuits***", Khanna Publishers, New Delhi, 8th Edition.
3. Albert Paul Malvino and Donald P Leach, "***Digital Principles and Applications***", McGraw Hill, 4th Edition, 1986.
4. R. Gopalan "***Elements of Analytical Chemistry***".
5. A. K. Srinivasthav and P. L. Jain, "***Chemical analysis an Instrumental Approach***".
6. C. S. Rangan, G. R Serma,V. S. V. Mani., "***Instrumentation Devices and Systems***".

14CHP05 Organic Chemistry- II (60 Hours) Semester-II

Objectives

- To understand the mechanisms of various types of organic reactions and their applications in synthesis
- To learn the use of organic reagents in the synthesis of organic compounds
- To gain a basic knowledge in bio-organic chemistry

UNIT-I

Electrophilic Substitutions (12 Hrs)

Aliphatic electrophilic substitution SE^1, SE^2 and SE^i mechanisms- Structural and solvent effects – SE^1, and SE^2, – Friedal Crafts acylation at olefinic carbon – Stork enamine reaction. Metals as electrophiles in substitution reactions

Aromatic electrophilic substitution – mechanism, orientation and reactivity - Typical reactions such as nitration, nitrosation , diazoamino coupling, sulphonation, halogenation. Friedal Craft alkylation and acylation.

Formylation – Gatterman, Gatterman Koch, Riemer Tieman reactions, Kolbe Schmidt carboxylation, Hofmann- Martius reaction. Carbenes– Structure, generation and reactions.

UNIT-II

Elimination, Oxidation and Reduction Reactions (12 Hrs)

Mechanisms of eliminations E_1, E_2, E_1cB and E_i. Orientation rules- Hofmann and Saytzeff rules. Stereospecificity of E_2 elimination. Cis and pyrolytic eliminations.Typical reaction such as Chugave, Cope and Hofmann degradations. Bredt's rule.

Oxidation and reduction –Chromic acid oxidation and SeO_2 oxidation, Meerwein Pondroff Verley and Birch reductions.

Oppenaur oxidation, Clemmenson and Wolff Kishner reductions.

UNIT-III

Addition Reactions (12 Hrs)

Addition across carbon – carbon multiple bonds - Electrophilic, nucleophilic and free radical mechanisms of addition to double and triple bonds. Orientation and reactivity – Markownikov rule, peroxide effect, epoxidation, Michael addition, hydroboration, hydroxylation.

Addition to carbonyl compounds: Mechanism of nucleophilic addition- Mannich Reaction, Aldol, Claisen, Stobbe, Wittig, Knoevenegal and Benzoin condensations.

UNIT-IV

Bio-Organic Chemistry **(12 Hrs)**

Synthesis of peptides – Use of carbobenzyloxy chloride, p-nitrophenyl ester, triethyl and ethylchloro formate as protecting groups in the synthesis of peptide – Merrifield resin – synthesis- N-terminal, C-teminal residue analysis-– Nucleic acids – nucleotides, nucleosides and nucleic acids, RNA. DNA – functions of nucleic acids.

Enzymes, mechanism of enzyme catalysis, Factors influencing enzyme action. Enzyme catalysed addition, elemination, condensation, carboxylation, decarboxylation and R A reactions.

UNIT-V

Reagents in Organic Synthesis **(12 Hrs)**

Uses of following reagents in organic synthesis and functional group transformations – DDQ, Phase transfer catalysts, trimethyl silyl iodide, Crown ethers, Wilkinson catalyst and dicyclohexyl carbodiimide - 1,3 dithiane, Li-di-isopropyl amide,

Tributyl tin hydride, Ozone. Gilmans reagent and Petersons synthesis. Sodium borohydride and Lithium Aluminium Hydride.

Reference Books

1. Advanced Organic Chemistry Reaction Mechanism and Structure, Jerry March, Mcgraw Hill Book Company, 1968.
2. Organic Chemistry, Vol. I& II, I..L. Finar, Pearson education, Asia, Singapore, 6th edition, 2003
3. Principles of Organic Synthesis, R.Norman J.M. Coxon, Chapman and Hall, 3rd edition 1993.
4. Reaction mechanism in Organic Chemistry, S.M. Mukherjee, S.P. Singh, Macmillan, 3rd edition, 1999.
5. Advanced Organic chemistry A & B, F.A. Carry, R.J. Sundberg, Plenu Press, 1977.

14CHP06 Inorganic Chemistry II (60 Hours) Semester-II

Objectives

- To create indepth knowledge in organometallic chemistry
- To inculcate knowledge in photochemistry
- To understand the fundamentals of bio inorganic and supramolecular chemistry

UNIT-I

Organometallic Compounds – I (12 Hrs)

Definition of organometallic compounds – classification of organometallic compounds - The metal carbon bond types – ionic bond, sigma covalent bond, electron deficient bond – delocalized bond – dative bond – The metal alkyl complexes – stability and structure – synthesis- by alkylation of metal halides by oxidative addition by nucleophilic attack on co-ordinated ligands – metal alkyls and 18 electron rule – reactivity of metal alkyls – M-C bond cleavage reactions – Insertion of CO to M-C bonds – double carbonylation, insertions of metals with C-H bonds.

UNIT-II

Organometallic Compounds – II (12 Hrs)

Alkene complexes – synthesis of alkene complexes by ligand substitution by reduction and by metal atom synthesis - Bonding of alkenes to transition metals – Bonding in diene complexes – reactivity of alkene complexes – Ligand substitution reactions with nucleophiles – olefin hydrogenation, hydrosilation – Wacker process-

C- H activation of alkenes and alkynes. Reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reactions). Ziegler – Natta polymerization of olefins

UNIT-III

Organometallic Compounds – III (12 Hrs)

Cyclopentadienyl complexes – synthesis of metallocenes – Bonding in metallocenes – properties - bent sandwich complexes - metallocene halides and hydrides – Half sandwich complexes. Arene complexes – synthesis, structure, properties – Arene half-sandwich complexes – synthesis, property, reactivity - η^2 to η^4 coordinate arenes – seven and eight membered ring ligands – Hetero arene complexes – Multi decker complexes. Allyl and dienyl complexes – synthesis, properties, reactivities.

UNIT-IV

Photochemistry of Complexes and Chemistry of Carboranes (12 Hrs)

Photochemical reactions of coordination compounds – photoreduction, photooxidation, photosubstitution and photoisomerisation reactions. – preparation and properties of carbonylate anions – carbonyl hydrides, isolobal fragments – chemistry of carboranes – closo and Nido carboranes – their preparation, reactions, structures and differences.

Complexes of pi acceptor ligands – carbonyls, structure of carbonyls and polynuclear carbonyls – applications of IR spectroscopy to identify the terminal and bridging CO

UNIT-V

Bioinorganic Chemistry And Supramolecular Chemistry (12 Hrs)

Bio inorganic chemistry of toxic metals – Lead, Mercury, Cadmium and plutonium – detoxification by metal chelation - chemotherapy – Pt complexes in complex 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.

Supramolecular chemistry – Introduction – Properties of covalent bond –bond length, inter-bond angles, force constant, bond and molecular diploe moment. Molecular and bond polarizability, bond dissociation enthalpy, entropy. Inter molecular forces, hydrophobic effect. Electrostatic, induction, dispersion and resonance energy. Magnetic interaction, magnitude of interaction energy, force between macroscopic bodies, medium effects, hydrogen bond. Molecular and chiral recognition –Self assembly, self organization and preorganization - Inclusion complexes – Host Guest chemistry.

Text Books

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson, Wiley Easter Private Lt., New Delhi, 2nd Edition, 1969.
2. Inorganic Chemistry - Principle of structure and reactivity, James.E.Huheey, Pearson Education, Singapore, 4th edition, 2002.

Reference Books

1. Basic Organo metallic Chemistry, Haiduc and Zuckerman,
2. M.C.Day and J.Selbin, Theoretical Inorganic Chemistry, Reinhold Book Corporation, 1967.
3. R.D.Madan, Malik and Tuli, Selected Topics in Inorganic Chemistry, S.Chand and Com., 1999.
4. F.Basalo and R.G.Pearson, Mechanism of Inorganic Reactions, University of London Press, 1968.
5. R.B.Heslop and P.L.Robinsosn, Inorganic Chemistry, Elsevier Scientific Pub. Cor., 1967.
6. B.N. Figgis, Introduction of Ligand Fields, University of London Press, 1966.
7. R.S.Drago, Physical Methods in Chemistry, Reinhold, 1965.

8. B.E.Douglas and DHNC Danial, Concepts and Models of Inorganic Chemistry, Syndey, M.C.Graw Hill, 1965.
9. Therald Moeller, Inorganic Chemistry, An Advanced Text Book, Bombay, Asia Pub Com., 1968.
10. W.E. Jolly, Modern Inorganic Chemistry, NewYork, M.C.Graw Hill, 1984.

14CHP07 Physical Chemistry II (60 Hours) Semester-II

Objectives

- To Know the behaviour of micro particles.
- To understand the Different class of objects in the Universe

UNIT-I

Quantum Mechanics-I (12 Hrs)

Introduction to quantum mechanics –Wave-particle dualism. Heisenberg's uncertainty principle.

Time dependent Schrodinger equation-deriving time independent equation using separation of variables procedure. Wave functions –Born's interpretation – well-behaved wave functions. Postulates of quantum mechanics. Orthogonility and normalization of wave functions. Orthonormal set of wave functions. Operators –sum and product of operators, commutator. Linear operators. Eigen functions and eigen values. Deriving operators for energy and angular momentum from known operators.

Hermitian operators-eigen functions and eigen values-Schmidt orthogonalisation process. Commuting operators –eigen functions and eigen values. Commutator of two operators – uncertainty principle.

UNIT-II

Quantum Mechanics-II (12 Hrs)

Application of wave mechanics – Particle in a1D box-eigen functions and eigen values. Zero point energy and uncertainty principle. Correspondence principle. Average values of energy, position and momentum. Particle in a 3D box-cubical and rectangular- Degeneracy.

One dimensional simple harmonic oscillator. Harmonic oscillator model of a diatomic molecule. Zero point energy and uncertainty principle. Correspondence principle and tunneling. Odd and even function. Orthogonality of harmonic oscillator wave functions.

Rigid rorator –rigid rotator as a model for a rotating diatomic molecule. Hydrogen atom or H-like species-energy levels. Quantum numbers. Radial factors, real wave functions of H-atom. Orbitals and their shapes. Probability density – radial distribution functions.

UNIT-III

Quantum Mechanics-III (12 Hrs)

Electron spin and Pauli exclusion principle. Antisymmetric nature of wave functions. Slater determinants. Approximation methods – need for approximation methods –perturbation theory(first

order only). Application to anhormonic oscillator and helium atom. Variation method – illustration – application to anharmonic oscillator and helium atom.

Linear variation method – Born-Oppenheimer approximation – Hydrogen molecule ion and hydrogen molecule – LCAOO-MO treatment.

Huckel's molecular orbital theory – salient features. Application to ethylene and butadiene, hexatriene and benzene.

UNIT-IV

Group Theory (12 Hrs)

Group theory –point groups-space groups-symmetry elements and symmetry operations – Classification of groups – definition, theorems and grammar of group theory – classes and similarity transformation – point group classifications – isomorphism. Matrix representation of symmetry operations – rotations – reflection – reducible and irreducible representations –decomposition of reducible representation into irreducible ones – Notation for irreducible representations – construction character table for C_{2v} and C_{3v} point group. Direct product representation – Great Orthogonality theorem.

UNIT-V

Group Theory and its Applications (12 Hrs)

Hybrid orbitals in non linear molecules (BF_3 and NH_3). Determination of vibrational modes in non linear molecules (H_2O,NH_3,$POCl_3$ and $PtCl_4^{2-}$). Symmetry selection rules for infrared and Raman spectra. Classification of vibrational modes for SO_2 and $POCl_3$)

Text books

Quantum Chemistry, I.N.Levine, Pearson Educatio, Prentice Hall, 5th Edition, 2007. .

Group theory and its application to chemistry, K.V.Raman,Tata Mcgraw Hill Publishing Company Lt, 1st Edition, 1990.

Reference Books

1. Introductory Quantum Chemistry, A.K.Chandra,at Megraw Hill Publishing Company, New Delhi, 4th Edition.
2. Quantum Mechanics, D.A.Mc Quarrie,Viva Books Private Lt., Bangalore, 1st Edition, 2003.
3. Physical Chemistry – A Molecular Approach, D.A.Mc Quarrie and J.D.Simon, Viva Books Private Lt., Bangalore, 1st Edition, 2004.
4. Symmetry and Spectroscopy of Molecules, K.Veera Reddy, Willey estern Lt., New Delhi, 1998.
5. Group Theory in Chemistry, V.T.Ramakrishnan and M.S.Gopinathan, Vishal Publications, New Delhi, 1988.


PSG
CAS
Since - 1947

Core Elective - I

14CHP08A Nano and Green Chemistry (50 Hours) Semester-II

Objectives

- To enable the students to know the importance of nano and green chemistry
- To understand the reterosynthetic strategies in the synthesis of organic compounds

UNIT-I

Synthetic methods of nanoparticles (10 Hrs)

Nanoparticles - characterization of nanomaterials -stability of colloidal solutions. Synthesis of metal nanoparticles – Physical methods – Laser ablation, physical vapour deposition (PVD) (evaporation and sputtering) and solvated metal atom dispersion (SMAD). Chemical methods – thermolysis, sonochemical approach, reduction of metal ions by various methods. Biosynthesis of nanoparticles. Nanocomposites- composites and nanocomposites. Nano fillers- clays- kaolinite- smectites- fibrous clays.

UNIT-II

Properties and applications of nanomaterials (10 Hrs)

Nanosized semiconductors-synthesis-precipitation methods, thermal decomposition of complex precursors, method for the fabrication of nanosized metal fluorides, synthesis in organized media, synthesis in inverse or reverse micelles. Ceramics-physical methods of preparation-gas condensation and laser methods. Chemical methods – sol-gel- synthesis. preparation of nitrides and carbides.

Properties of nanomaterials – optical, electrical and magnetic properties. Applications. Carbon nanotubes, carbon nanoclusters- buckyballs, building nanodevices with bucky balls- carbon catalyses with bucky balls.

UNIT-III

Principles and synthesis of green chemistry (10 Hrs)

Introduction – principles-methods employed to achieve the goals of green chemistry – solvent –free reactions. Utility of solvent free conditions- controlling solvent free reactions. Thermal reactions – oxidation – Benzilic – Benzilic acid rearrangement – Reduction. Michael addition – Aldol addition – addition and coupling reactions of C_{60} – pericyclic reactions .

Photochemical reactions- Dimerization of cinnamic acid – photo – Fries rearrangement, Cis –Trans isomerzation.

UNIT-IV

Catalytic approach and renewable resources in green chemistry (10 Hrs)

Microwave assisted synthesis-Oxidation-Reduction-Condensation – Heck reaction. Pinacol-Pinacolone –Beckmann Rearrangements. Synthesis of heterocyclic compounds – conversion of oximes, semicarbazones and phenyl hydrazones to carbonyl compounds(Deprotection) Self assembled monolayer on Gold surface – cleaner technology with supercritical liquids.Catalytic approach to green chemistryApplication of zeolites in green chemistry- Clay materials in green chemistry

Waste water treatment by oxidation technology at ambient condition – photochemical and photocatalytic oxidation – ozone/uv process – Sonophotocatalytic destruction of organic contaminants. Renewable resources, waste minimization techniques.

Remediation methods for textile effluents – biocatalytic reaction in green chemistry.

UNIT-V

Retro Synthesis –Goals and its Strategies (10 Hrs)

Organic synthesis –Goals and criteria for good synthesis – Types of synthesis- rational –irrational-total-partial and biological modes of synthesis – reterosynthetic analysis-terminology in reterosynthesis. Types of transforms – Reterosynthetic tree advantages of reterosynthetic analysis. Carbon-carbon bond disconnection, synthesis and synthetic equivalents-functional group interconversion – synthesis of enamine –α,β – unsaturated carbonyl – regioselectivity.

Functional group interconversion. Conversion of tertiary alcohol into primary and secondary alcohol – inter conversion of compounds with nitrogen function.

Reference Books

1. Kenneth, J.Klabunde, Nanoscale Materials in Chemistry, Wiley inter science, 2001.
2. Furthhop, Penzlin, Organic Synthesis Concepts, Methods and Starting Materials, Varlag Chemie, 1983.
3. R.Sanghi and M.M.Srivcastva, Green Chemistry, Narosa, 2003.
4. M.M.Srivastava and R.Sanghi Chemistry for green environment, Narosa, 2003.
5. S.Delvin, Green Chemistry, IVY publishing House, 2006.
6. C.P.Jrand F.J.Ownes, Introduction to Nano Technology, John Wiley and sons, New Jersey, 2003.
7. H.S.Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, Sandiego, 2000.
8. C.N.R. Rao, et al., “Metal Nano Particles and their Assemblies”, Chem. Soc. Rev., 29, 27, 2000.
9. H.Weller, “Colloidal Semiconductor Q-Particles-Chemistry in the transition between solid state and molecules, Angrew. Chem. Int . Ed, 32,41,1993.
10. Stuart Warren, Organic Synthesis, The Disconnection Approach, John Wiley and sons, 1992.
11. C. Brechignac P. Houdy M. Lahman, Nanomaterials & Nanochemistry, Springer

12. Geoffery A Ozin, Andre C Arsenault and Ludovico Cademartiri Nanochemistry-A Chemical approach to nanomaterials, RSC publishing 2nd edition.
13. Rashmi sanghi, M M Srivastava,Green chemistry Environment friendly alternatives, Narosa publishing house
14. Mike Lancaster Green chemistry An introductory text

Core Elective - I

14CHP08B **Polymer Chemistry (50 Hours)** **Semester-II**

Objectives

- To develop basic knowledge in polymers.
- To gain basic knowledge in the preparation characterization and uses of polymers.

Unit I Classification of Polymers and polymerization mechanisms (10 Hrs)

Classification of polymers - natural polymers-synthetic polymers- mechanism of polymerization –step reaction polymerization, poly condensation, polyaddition, chain polymerization, ionic, radical and coordination polymerization with examples. Polymerization techniques – emulsion, bulk, suspension polymerization. Introduction and types of copolymerization, Trade name of polymers.

Unit II Molecular Weight Determination of Polymers (10 Hrs)

Molecular weight determination by following methods-number average and weight average methods – osmometry (membrane), osmometry (vapour pressure) viscometry, light scattering method, ultra centrifugation, cryoscopy, ebullioscopy end group analysis. Mark-Howlink relationship.

Unit III Polymer structure, properties and stereochemistry (10 Hrs)

Structure property relationship. Mechanical properties - thermal stability - glass transition temperature - states of aggregation- factors influencing glass transition temperature flame resistance chemical resistance and electrical conductivity. Primary and secondary bond forces in polymers – coherence energy. Stereo chemistry of polymers- Isotactic, atactic, syndiotactic polymers polyethylene, polypropylene.

Unit IV Industrial importance of synthetic and natural polymers (10 Hrs)

Importance of natural polymers – application and structures of starch – cellulose and cellulose derivatives.

Important industrial polymers-preparation and application of polyethylene, polystyrene, Polyvinyl alchohol, polypropylene, polyamides, polyvinyl chloride, polymethyl methacrylate, polycarbonates, polyesters, polyurethanes, poly formaldehyde, poly vinyl acetals.

Unit V Degradation and Kinetics of Polymerization (10 Hrs)

Degradation – degradation agents – mechanism of degradation, Thermal degradation, mechanical degradation, photodegradation, degradation by ultrasonic waves, high energy radiation– antioxidants – stabilizers – flame retardants – colourants – plasticizers – inhibitors – initiators. Kinetics of polymerization – kinetics of chain polymerization – kinetics of condensation polymerization.

Text Books

1. F.W.Billmeyer, Text Book of Polymer Science, 3rd Edition, John Willey and Sons, New York, 1962.

2. V.R.Gowarikar, Polymer Science, University of London press, 1992.

Reference Book

1. A.Tager, Physical Chemistry of Polymers, MIR publications 1972.
2. R.H.Seymour and C.E.Charaher, Polymer Chemistry, 6th Edition, Marcel Dekker Inc., 2003.

14CHP09 Organic Chemistry Practical I(60 Hours) Semesters-I&II

Objectives

- To enable the student to prepare organic reagents
- To know the techniques in the separation of binary organic mixtures. in the separation and analysis of organic mixture
- To develop practical skill in the preparation of organic compounds

UNIT-I

Preparation of Reagents and Analysis (12 Hrs)

Preparation of reagents – alcoholic potash, alcoholic silver nitrate, neutral ferric chloride. Fehling's solutions A and B, Tollen's reagent, Schiff's reagent, Borsche's reagent, Barfoed's reagent, bromine in CCl_4, bromine in acetic acid and bromine water.

Determination of physical constants-melting and boiling points. Analysis of simple organic substances(2 or 3 substances)

UNIT-II

Organic Mixture Analysis I (12 Hrs)

Separation and analysis of ether soluble binary mixtures – $NaHCO_3$, NaOH and HCl separations.

UNIT-III

Organic Mixture Analysis II (12 Hrs)

Separation and analysis of binary mixtures in which one component is soluble and the other insoluble in ether.

Separation and analysis of bionary organic mixtures without using ether solvent.

UNIT-IV

Organic Preparations-I (12 Hrs)

Single stage preparations – preparations of benzopinacol, glucose pentaacetate, nerolin, antraquinone and dibenzal acetone.

UNIT-V

Organic Preparations II (12 Hhrs)

Preparation of res-acetophenone, 3-methyl-1-phenylpyrazolone, picric acid, any one dye(methyl orange, methyl red, or orange II) and aspirin.

Text Book

1. Vogel's Text book of Practical Organic Chemistry, B.S.Furniss et al., Pearson education, 5th edition, 2004.

Reference Book

1. B.B.Dey and M.V.Sitaraman, Laboratory manual of Organic Chemistry, Allied PublishersLtd, Madras, 4th Edition, 1992.

Note: For examination, one binary organic mixture for analysis and one single stage preparation are to be given.

14CHP10 Inorganic Chemistry Practical I(60 Hours) Semesters-I&II

Objectives

- To develop knowledge in the analysis of inorganic mixture
- To develop practical skill in the preparation of inorganic complexes
- To train the students in the colorimetric estimations of metal ions

UNIT-I

Qualitative Analysis of Known Common Cations (4 Hrs)

Analysis of known common ions – lead, copper, bismuth, cadmium, antimony, iron, aluminium, manganese, nickel, zinc, calcium, strontium, barium, magnesium and ammonium.

UNIT-II

Analysis of Known Rare Cations (6 Hrs)

Analysis of known rare cations – tungsten, selenium, molybdenum, cerium, vanadium, titanium, zirconium, uranium and lithium.

UNIT-III

Analysis Of Mixtures (20 Hrs)

Analysis of inorganic mixtures containing not less than two common cations and two rare cations. Minimum of five mixtures must be analyzed.

UNIT-IV

Inorganic Preparations (20 Hrs)

1. lead tetraacetate, 2. thiourea copper(II) chloride, 3. potassium trioxalato chromate (III), 4. Tetrammmine copper(II) sulphate, 5. potassium trioxalato ferrate(III) 6. Potassium trioxalato aluminate(III), 7. Trithiourea copper (II) sulphate,

UNIT-V

Colorimetric Estimations (10 Hrs)

Colorimetric estimation of copper, nickel, iron (III) and chromium.

Text Book

1. V.V. Ramanujam, Inorganic Semi Micro Analysis

Reference Book

1. G.G. Schilessingar, Inorganic Laboratory Preparation

Note: For examination, one mixture containing two common cations and two rare cations for the analysis, one preparation of complex and one colorimetic estimation are to be given.

14CHP11 Organic Chemistry Practical II(60 Hours) Semesters-I&II

Objectives

- To develop practical skill in the two stage preparation of organic compounds
- To train the students in the extraction of organic compounds
- To know various methods in the estimation of organic compounds

UNIT-I

Organic Preparations Involving Two Stages –I (12 Hrs)

1. p-nitroaniline from acetanilide
2. p-bromoaniline from acetanilide
3. o-chlorobenzoic acid from anthranilic acid.

UNIT-II

Organic Preparations Involving Two Stages II (12 Hrs)

1. m-nitrobenzoic acid from methylbenzoate
2. 1,3,5-tribromobenzene from aniline
3. succunanil from succinic acid

UNIT-III

Organic Estimations –I (12 Hrs)

1. Phenol by bromination
2. Aniline by bromination
3. Glucose by Betrand's method

UNIT-IV

Organic Estimations – II (12 Hrs)

1. Glucose by iodometric method
2. Ethyl methyl ketone by iodoform formation
3. Amino acid by formal titration

UNIT-V

Extraction of Organic Compounds and Studies on oils
(12hrs)

1. Caffein from tea leaves
2. Lactose from milk
3. Ascorbic acid from a tablet
4. Iodine value of an oil
5. Saponification value of an oil

Text Book

1. Vogel's Text book of Practical Organic Chemistry, B.S.Furniss et al., Pearson education, 5th edition, 2004.

Reference Book

1. B.B.Dey and M.V.Sitaraman, Laboratory manual of Organic Chemistry, Allied PublishersLtd, Madras, 4th Edition, 1992.

Note: For examination, one estimation and one double state preparation are to be given.

14CHP12 Inorganic Chemistry Practical II(60 Hours) Semesters-I&II

Objectives

- To develop knowledge in the estimation of metal ions by complexometric, volumetric and cerimetric methods
- To train the students in the estimation of metal ions gravimetrically
- To inculcate knowledge in the quantitative separation and analysis of inorganic mixture

UNIT-I

Complexometric Titrations **(12 Hrs)**

1. Estimation of Zinc
2. Estimation of Calcium
3. Estimation of Magnesium
4. Estimation of Copper
5. Estimation of Nickel

UNIT-II

Cerimetry **(12 Hrs)**

1. Estimation of Ferrous Iron
2. Estimation of Oxalic Acid
3. Estimation of Potassium Nitrite

UNIT-III

Volumetric Analysis

1. Estimation of Ferric Iron
2. Estimation of Copper
3. Estimation of Arseneous Oxide

UNIT-IV

Gravimetric Analysis **(12 Hrs)**

Estimation of Calcium as Calcium Oxalate

Estimation of Magnesium as Magnesium Oxinate

Estimation of Lead

UNI V

Quantitative Analysis Involving Mixture Of Cations **(12 Hrs)**

1. Estimation of Copper and Nickel
2. Estimation of Barium and Calcium

Text Book

1. A Text Book of Quantitative Inorganic Analysis, A.I.Vogel,

Note

For examination one volumetric and one gravimetric estimation may be given separately or a mixture may be given from which one cation is estimated volumetrically and other gravimetrically.

14CHP13 Organic Chemistry III (50 Hours) Semesters-III

Objectives

- To know the mechanisms of various types of organic rearrangements
- To learn aromaticity
- To gain knowledge photochemistry

UNIT-I

Aromaticity **(10 Hrs)**

Concept of aromaticity- aromaticity of benzenoid and heterocyclic compounds-effect of aromaticity on bond length, resonance energies, electronic absoption spectra and induced ring currents – use of Frrost and Musulin diagram. Nonbenzenoid aromatic compounds-Huckel's rule and Craig's rule – study of the following systems: cyclopropenium cation, cyclopentadienyl anion, ferrocene, diazo cyclo-pendadiene,sydnones, azulene, tropolone, tropylium ion, annulenes (synthesis not expected).

UNIT-II

Organic Photochemistry **(10 Hrs)**

Introductory theory - Jablonski diagram, MO view of excitation – photochemistry of carbonyl compounds – photoreduction, Norrish type 1 and type II reactions. Paterno-buchi reaction. Photo reactions of cyclic ketones and α,β unsaturated ketones. Di-π-methane rearrangements. Reactivity of inactivated centres - Barton and related reactions. Photocyclo additions and photolytic rearrangements of cyclohexadienone.

UNIT-III

Molecular Rearrangements **(10 Hrs)**

Mechanism of the following rearrangements –Wagner Meerwein, Beckman, Hoffman, Curtius, Wolff, Baeyer-Villiger oxidation, Stevens, Favorskii and Sommelet Hauser. Demzenov, dienone-phenol, Fries, Benzidine.

UNIT-IV

Pericyclic Reactions **(10 Hrs)**

Electrocyclic reaction – electrocyclic reaction of 1,3 dienes and 1,3,5 trienes. Analysis of reaction stereochemistry using Woodward-Hoffmann rules. Cycloadditions: Diel's Alder reaction and its stereochemistry. Sigmatropic Rearrangements: Claisen and Cope rearrangements.

Antibiotics – mode of action Chloromycetin, penicillin and tetracyclin – structure elucidation.

UNIT-V

Steroids **(10 Hrs)**

Classification, conformation aspects of A/B cis and a/B trans steroids. Chemistry of Cholesterol, Ergosterol.

Chemistry of Hormones - Male sex hormones - Androsterone and testosterone. Female sex hormones - Oestrone, equilinin, oestreol. Bile acids, adrenocortical hormones.

Text books

1. Chemistry of Natural Products, Vol. I& II, O.P. Agarwal, Goel Publishing House, Meerut, 2nd edition 1975.

2. Organic Chemistry of Natural Products, Vol. I& II, Gurdeep Chatwal, Himalaya Publishing House, 2002.

Reference Books

1. Aromatic Character and Aromaticity, G.M.Badger, Campridge University press, 1969.
2. Aromaticity, Garrat, Campridge University press, 1969.
3. Advanced Organic Chemistry Reaction Mechanism and Structure, Jerry March, Mcgraw Hill Book Company, 1968.
4. Principles of Organic Synthesis, R.Norman J.M. Coxon, Chapman and Hall, 3rd edition 1993.
5. Mechanism & Structure in Organic Chemistry. E.S.Gould, Brooklyn, NewYork, 1959.
6. Molecular Rearrangement, P.D.Mayo,John Wiley and Sons, New York, 1963. .
7. Reaction mechanism in Organic Chemistry, S.M. Mukherjee, S.P. Singh, Macmillan, 3rd edition, 1999.
8. Organic Chemistry, Vol. I& II, I..L. Finar, Pearson education, Asia, Singapore, 6th edition, 2003.
9. Mechanism and theory in Organic chemistry J.H.Lowry and K.S.Richardson, Haper and Row, New York, 1976.

14CHP14 Inorganic Chemistry III (50 Hours) Semester-III

Objectives

- To develop knowledge in the field of solid state chemistry
- To enhance knowledge in nuclear chemistry and radioactivity

UNIT –I

Diffraction Methods (10 Hrs)

Generation of X-Rays - X-Ray diffraction-Bragg equation – derivation. Experimental methods-X ray diffraction pattern-X-ray scattering factor – application of X-Ray diffraction.

Neutron diffraction – principles- neutron scattering factor – experimental method – application – structural elucidation.

Electron diffraction – principles- electron diffraction pattern – application – structural elucidation. Distinction between X-ray, neutron and electron diffractions, structure factor – definition, factors influencing structure factor-uses of structure factor. Fourier synthesis – definition – application of Fourier synthesis in crystal structure analysis of s-tetrazine.

Structure of zinc blende, wurtzite, Diamond and graphite

UNIT-II

Metallic State and Metallic Compounds (10 Hrs)

Metallic state- metallic bond- free electron theory, properties of metals-electrical and mechanical properties. Interstitial compounds – substituted solid solution – interstitial solid solution – Hume Rothery ratio – different phases of Cu-Zn systems. Order – disorder transformation – super lattice.

Crystal defects – types of defects – stoichiometric defect – Schotsky and Frenkel defects and its influence on the properties of solids. Industrial compounds – clathrates, spinel, antispinel, graphitic compounds and metal cluster compounds.

Semiconductor – types of semiconductor. Band theory. Structure of semiconductor. Effect of temperature on semiconductors.

UNIT-III

Nuclear Chemistry - I (10 Hrs)

Nucleus-subatomic particles-stable subatomic particles and unstable subatomic particles – properties – nuclear mass – measurement of atomic mass – atomic mass unit – mass defect and binding energy – Importance of binding energy and stability of nucleus. Packing fraction – nuclear radii – nuclear

forces – meson field theory – nuclear models – Liquid drop model – independent particle model – Fermi gas model- collective model Q- value – Coulomb barriers – Nuclear cross section – threshold energy.

UNIT-IV

Nuclear Chemistry - II **(10 Hrs)**

Radioactivity – natural radioactive elements – radioactive emanation – characteristics of the rays – experimental methods. Deduction and determination by cloud chamber – bubble chamber – spark chamber and nuclear emulsion. Methods based on photon collection- scintillation counter and cherenkov counter. Multiplicative ion collection – G.M. counter - proportional counter. Particle accelerators – LINAC, cyclotron, synchrotron, betatron and beretron.

UNIT-V

Nuclear Chemistry - III **(10 Hrs)**

Nuclear reactions – projectile capture, Pair production and poritron emission, particle emission, spallation, Fission characteristics of fission – atom bomb. Nuclear reactors, types and classification. Isotopes – fissile and fertile isotopes – Nuclear fusion and stellar energy, synthetic elements – Trans uranic elements. Indian atomic energy programme.

Nuclear transmutations – transmutation by alpha particle, transmutation by protons, transmutation by neutron and disintegration by electrons.

Application of isotopes – Neutron activation analysis and isotopic dilution analysis – uses in structural and mechanistic studies. Dating of objects.

Text Books

1. B.K.Sharma, Nuclear Chemistry, Meerut Goel, 1972.
2. D.C.Tayal, Nuclear Physics, 4th Edition, Himalaya Publishing House, New Delhi, 1981.

Reference Books

1. W.J.Moor, Seven Solid State, John Wiley and sons, 2002.
2. N.B.Hanney, Solid State Chemistry, Prentice Hall of India Pvt Ltd, New Delhi, 1976.
3. A.F.Wells, Structural Inorganic Chemistry.
4. L.V.Littel, Introduction to Solid State Physics.
5. S.Glasstone, Source Book of Atomic Energy.
6. D.D. Sood, Fundamentals of Nuclear and Radiochemistry.
7. H.J. Amikar, Fundamentals of Nuclear Chemistry.

14CHP15 Physical Chemistry III (50 Hours) Semester-III

Objectives

- To understand various theories of chemical kinetics and their applications
- To acquire knowledge in surface chemistry
- To develop indepth knowledge in the field of statistical thermodynamics

UNIT-I

Chemical Kinetics I (10 Hrs)

Collision theory and Lindemann's theory. Absolute reaction rate theory (ARRT). Statistical thermodynamic approach to ARRT. Application of ARRT to reaction between atoms and the reaction between molecules. Comparison between collision theory and ARRT. Modification of Lindemann's theory – RRK approach. Transmission coefficient. Kinetic isotope effects. Isokinetic relationships – isokinetic temperature. Steady state principle, chain reactions- characteristics – study of kinetics of chain reactions – H_2-Br_2 thermal reaction, organic decompositions- Rice –Herzfeld mechanisms. Autooxidations – explosions.

UNIT-II

Chemical Kinetics-II (10 Hrs)

Kinetics in solutions – application of ARRT to solution kinetics – Effect of internal pressure, dielectric constant, hydrostatic pressure on reaction rates. Primary and secondary salt effects.

Homogeneous catalysis – acid-base catalysis – Arhenius and van't Hoff intermdediate complexes – prototropic and protolytic mechanisims. Bronsted relations. Enzyme catalysis – mechanisim of single substrate reaction – Michaelis – Menten Law. Effect of substrate concentration, pH and temperature on rate.

Fast reaction techniques- Relaxation theory –relaxation methods – temperature and pressure jump methods. Flow methods-stopped flow and continuous flow methods- Flash photolysis.

UNIT-III

Chemical Kinetics III (10 Hrs)

Adsorption isotherms – Langmuir and BET – measurement of suface area. Kinetics and mechanism of unimolecular and bimolecular reactions. Langmuir-Hinshelwood and Langmuir –Rideal mechanism. Radiation chemistry – sources of high energy – interaction of high energy radiation with matter. Radiolysis of water – definition of G-Value. Mode of reactions of hydrated electrons, OH and H. Experimental techniques – Fricke dosimeter.

Photochemistry - Photo chemical mechanism and kinetics of H_2-Cl_2 reactions. Elementary aspects of radiation chemistry in biology and industry.

UNIT-IV

Statistical Thermodynamics-I (10 Hrs)

Combination and permutation laws – microstate and macrostate. Microstate for distinguishable and induistingushable objects. Maxwell Boltzmann statistics – its limitations. Partition function – evalution of translational, rotational and vibrational partition function. Evaluation of E, C_v and entropy from the partition functions.

UNIT-V

Statistical Thermodynamics II (10 Hrs)

Derivation of equilibrium constant. Heat capacity of solids – Einstein and Debye model. Phase-space, Bose-Einstein and Fermi-Dirac statistics. Negative absolute temperature. Heat capacity of diatomic gases.

Text Books

1. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformation, Mcmillan, Newyork, 1993.
2. K.J. Laidler, Chemical Kinetics McGraw Hill Publishing Company Ltd., New Delhi, 1975.

Reference Books

1. R.G.Frost and Pearson, Kinetics and Mechanism, 2nd Edition, John Wiley and Sons, New York, 1961.
2. M.C.Gupta, Statistical thermodynamics, Willey Eastern Ltd., New Delhi, 1990.
3. K.K.Rohatgi Mukherjee, Fundamentals of photochemistry, University of London Press, 1992.
4. Lee and Sears, Statistical thermodynamics,
5. Swallow. A.J., Radiation Chemistry, Longman, London, 1973.

14CHP16 Molecular spectroscopy and its applications (50 Hours)

Semester-III

Objectives

- To enhance knowledge in the field of UV, IR, Raman, NMR and ESR spectral studies
- To apply the acquired knowledge in solving organic and inorganic problems

UNIT-I

UV Visible Spectroscopy (10 Hrs)

Absorption laws- Formation of absorption bands – theory – electronic excitations – types of transitions – Transition probability – Chromophores and auxochromes – absorption and intensity shifts – Types of adsorption bands – solvent effects – conjugated systems – extended conjugation – aromatic systems – Woodward Fisher rules for calculating adsorption maximum in dienes – enones and aromatic systems –Fischer Kuhn rules for calculating adsorption maximum in polyenes – Instrumentation – applications of UV-visible spectroscopy to organic compounds.

Topic for Self study

UV and visible – charge transfer spectra of inorganic compounds – spectra of molecules of addition compounds of iodine – spectra of transition metal complexes.

UNIT-II

IR and Raman Spectroscopy (10 Hrs)

Vibrational rotational spectroscopy- molecular vibrations- vibrational frequency- factors influencing vibrational frequency – number of fundamental vibrations – selection rules – calculation of force constant – Fermi resonance – fingerprint region – instrumentation-FTIR – applications of IR to organic compounds.

Raman Spectroscopy

Principle-stoke and anti stoke lines – polarized and depolarized Raman lines – Difference between IR and Raman spectroscopy – instrumentation – applications to organic compounds.

UNIT-III

^{1}H NMR Spectroscopy (10 Hrs)

Theory – chemical shifts. Factors influencing chemical shift –inductive effect, anisotrophic effect, ring current and solvent effects. Spin- spin coupling. – Geminal, vicinal,cis, trans and aromatic coupling. Relaxation process. Conversion of non first order spectra to first order spectra –Increase in

field strength, spin decouplinf and chemical shift reagents. Introduction to pulse NMR technique. Typical applications to organic compounds.

Topic for self study

Double resonance- Nuclear overhauser effect

UNIT-IV

^{13}C NMR Spectroscopy (10 Hrs)

Off-resonance decoupling –^{13}C NMR spectra –chemical shift – factors influencing chemical shift, coupling constant. Applications of NMR – structure determination – boranes – complexes of WF_6, structure of BOF_4 determination of activation, energy studies of exchange reaction between ligands and metal ions – intra molecular conversion-possible structure of AsF_3, SO_3.

Topic for Self study

Elementary idea of 2D NMR

UNIT-V

ESR spectroscopy (10 Hrs)

ESR Spectroscopy - theory – presentation of spectrum – factors affecting magnitude of g value – zero field splitting and Kramer's degeneracy – hyperfine splittings – isotopic and anisotrpic systems – Nuclear quaraupole interactions – Instrumentation.

ESR – Hyperfine splitting – structural determination of complexes like $CuSiF_6$ $6H_2O[(NH_3)_5Co\text{-}O\text{-}Co(NH_3)_5]^{5+}[NO(SO_3)_2]^{2-}$, $Fe(CN)_5NO\}^{3-}$

Topic for self study

Moss Bauer Spectroscopy: Theory – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine splitting - application of MB spectroscopy to inorganic compounds.

Text Books

1. Q.Chatwal and S.Anand, Spectroscopy, 5th Edition, Himalaya Publishing, Nagpur, 2004.
2. Willium Kemp, Organic spectroscopy, 2nd Edition, Macmillan, London, 1975.
3. C.N.Banwell, Fundamentals of Molecular Spectroscopy, 2nd Edition Mc Graw Hill, New York, 1972.

Reference Books

1. Spectrometric Identification of Organic Compounds, R.M.Silverstein, G.C.Bassler and T.C.Morrill, 2nd Edition, John Wiley and Sons, New York, 1967..
2. Physical Methods in Inorganic Chemistry, R.S.Drago, Reinhold Book Corporation, New York, 1965.
3. Introduction to molecular spectroscopy, G. Barrow, Megraw Hill, New York, 1962.
4. Electronic Spectra of Transition Metal Complexes – An Introductory Text,Mc.Grow,
5. Organic spectroscopy, Y.R. Sharma, New Delhi, S. Chand and Co., 1986.

14CHP17 Physical Chemistry Practical –I (60 Hours) Semester-III

Objective

- To acquire practical knowledge in chemical kinetics
- To enhance knowledge in conductivity studies

UNIT-I

Chemical Kinetics First Order Reactions (12 Hrs)

1. Rate constant of the hydrolysis of methyl acetate catalyzed by N/2 HCl at room temperature.
2. Evaluation of Arrhenious parameters using acid hydrolysis of methyl acetate.
3. Determination of relative strength of acids in the hydrolysis of methyl acetate.

UNIT-II

Chemical Kinetics Second Order Reaction (12 Hrs)

1. Saponification of ethylacetate by NaOH
2. Determination of rate constant for the kinetics of the reaction between potassium persulphate and potassium iodide.
3. The influence of ionic strength(salt effect) of K_2SO_4 for the above reaction

UNIT-III

Distribution Studies and Molecular weight determination (12 Hrs)

1. Determination of equilibrium constant of the reaction $KI + I_2 \rightarrow KI_3$
2. Determination of unknown concentration of KI
3. Determination of molecular weight by Rast and micro method

UNIT-IV

Conductometric Titrations (12 Hrs)

1. HCl - NaOH –HCl (unknown)
2. CH_3COOH - NaOH - CH_3COOH (unknown)
3. HCl-NaOH – HCl + CH_3COOH (unknown)
4. CH_3COOH+ CH_3COONa -HCl and with NaOH

UNIT-V

Applications of Conductivity Measurements (12 Hrs)

1. Solubility product of sparingly soluble salt
2. Dissociation constant of weak acid.
3. Verification of DHO equation.

Text Book

1. S.R.Palit and S.K.De, Practical Physical Chemistry.

Reference Book

1. R.G.Sharma, Advanced Experimental Physical Chemistry.
2. A.Findely, Practical Physical Chemistry.

14CHP18 Physical Chemistry practical II (60 Hours) Semester-III

Objective

- To acquire practical knowledge in EMF measurements
- To impart practical skill in the field of surface chemistry
- To develop knowledge in the area of phase equilibrium

UNIT-I

Potentiometric Titrations (Acid-Base Titrations) (12 Hrs)

1. HCl-NaOH –HCl (unknown)

2. CH_3COOH – NaOH - CH_3COOH (unknown)

3. HCl - NaOH – HCl + CH_3COOH (unknown)

UNIT-II

Potentiometric Titrations (Redox Tirations) (12 Hrs)

1. MnO_4^- Vs Fe^{2+}
2. Cr_2O_7- vs Fe^{2+}
3. Ce^{4+} vs Fe^{2+}

UNIT-III

Applications of EMF Measurements (12 Hrs)

1. Determination of solubility of sparingly soluble salt (AgCl) in H2O
2. Dissociation constant of weak acid
3. pH of buffer solution
4. Thermodynamics data from EMF measurements
5. DC polarography (demonstration purpose only)

UNIT-IV

Phase Equilibrium (12 Hrs)

1. Determination of CST of phenol-water system.
2. Effect of electrolyte(NaCl, KCl or succinic acid) on CST of phenol water system
3. Determination of % concentration of unknown electrolyte
4. Determination of transition temperature of salt hydrate.

UNIT-V

Phase Rule Studies and Surface Chemistry (12 Hrs)

1. Two component system-simple eutectic formation.
2. Compound formation.
3. Verification of Freundlich adsorption isotherm using oxalic acid on charcoal.
4. Adsorption of acetic acid on charcoal.

Text Books

1. S.R.Palit and S.K.De, Practical Physical Chemistry

Reference Books

1. R.G.Sharma, Advanced Experimental Physical Chemistry.
2. A.Findely, Practical Physical Chemistry.

14NDP15A/14BCP15A/ **Pharmaceutical Chemistry –Theory (40 Hours)**

14MBP19A/14ESP17A (Cluster IDC for Foods & Nutrition, Biochemistry,

Microbiology, and Environmental Science) **Semester-III**

Objectives

- To know about the basic terminologies in pharmaceutical chemistry
- To develop knowledge in the field pharmaceutical Inorganic chemistry
- To enhance the knowledge about blood and cardiac diseases

UNIT-I **(8 Hrs)**

Introduction to pharmaceutical chemistry-Nature and sources of drugs. Pharmacy, Pharmacology, Medicinal chemistry, Pharmacodynamics, Pharmacokinetics, Molecular pharmacology, Pharmacophore, Antimetabolities, Actinomycetes, Bacteria, Virus, Fungi, Mutation, Chemotherapy, Pharmacopoeia, Pharmacognosy, Toxicology, Pharmacotherapeutics (Terminologies and examples only). Classification of drugs – Biological, Chemical classification, Classification of drugs according to commercial consideration, Terminology used by the public.

UNIT – II **(8 Hrs)**

Mechanism of action – Actions at extracellular site, Action at cellular sites- Drug receptors and Biological responses. The Chemistry of Drug Receptor Binding – Covalent bond, The hydrogen bond, van der Walls Forces- time response relationship, Dose-response relationship, Potency, Therapeutic index, Maximum effect. Metabolism of Drugs – Chemical Pathways of Drug Metabolism or Biotransformation- Phase I and Phase II. Absorption of Drugs: routes of Administration Factors affecting absorption. Digestion and absorption of protein – Digestion of Fats –Absorption of Fats

UNIT III **(8 Hrs)**

Classification and mode of action of Antiamoebic drugs, Antihelminthic drugs, Antitubercular drugs, Antimalarial drugs, Diuretics and Antihypertensive drugs, Sulphonamides (Two examples only).

UNIT IV **(8 Hrs)**

Analgesics, Antipyretic and Anti-inflammatory drugs: Aspirin, sodium salicylate, paracetamol and analgin, CNS – Stimulant drugs: Amphetamine, CNS – Depressant drugs: Phenelzine, Anti-Convulsant Agents: Barbiturates (Synthesis only).

UNIT V **(8 Hrs)**

Cancer and Antineoplasic Drugs: Cancer - Types,symptoms, causes of cancer, Treatment of Cancer-Surgery, radiation, Chemotherapy (Alkylating agents, Anti metabolites, Plant products, Hormones, Adrenocorticosteroids, Antibiotics, Radio active isotopes). Recent developments in cancer therapy.

Diabetes and Hypoglycemic Drugs- Classification, Control – Insulin (Chemical structure, preparation and Dosage). Oral Hyperglycaemic drugs.

Text Books

1. Bentley, Text book of Pharmaceutics.
2. Jayashree,A Text book of Pharmaceutical Chemistry.
3. P.P.Singh and D.W.Rangnekar, An Introduction to Synthetic Drugs.

Reference Books

1. A.Burger, Medicinal Chemistry.
2. O.Wilson, O.Giswold and F.Gearge, Text Books of Organic, Medicinal, Pharmaceutical Chemistry
3. Bentlya and Driven T.B, Pharmaceutical Chemistry, revised by Arthenden.
4. S.Lakshmi, Pharmaceutical Chemistry.
5. A.Gringuage, Introduction to Medicinal Chemistry.
6. S.S.Pandeya and I.R.Dimmock, An Introduction to Drug Design.

14NDP16A/14BCP16A/ Pharmaceutical Chemistry (Practical)

14MBP20A/14ESP18A (Cluster IDC for Foods & Nutrition, Biochemistry, Microbiology, and Environmental Science)

(25 Hours) Semester-III

Objective

- To enhance the knowledge in the preparation of Pharmaceutical compounds
- To develop skills in the preparation of Pharmaceutical compounds
- To know the quantitative estimation

Extraction of Natural products

a. Caffeine from tea leaf
b. Piperine from pepper
c. Casein from milk

Preparation of certain drugs

a. Aspirin
b. Paracetamol
c. Sulphanilamide
d. Benzocaine
e. Sulphanilide

Estimations

a. Ascorbic acid from lemon
b. Estimation of iron from tablets

Estimation of calcium from tablets

14CHP21 Analytical Chemistry (60 Hours) Semester-IV

Objectives

- To develop knowledge in the field of chromatography
- To gain knowledge in mass spectrometry
- To provide indepth knowledge in the AAS
- To create awareness in the application part of thermal and electrochemical analysis

UNIT-I

Chromatography I **(12 Hrs)**

Gas chromatography GSC and GLC – principle – instrumentation – application.

Ion exchange chromatography – definition, introduction to cation and anion exchanges – ion exchange column used in chromatographic separations – applications of ion exchangers.

Counter current chromatography and gel permeation technique - paper electrophoresis.

HPLC – principle – Instrumentation – experimental details – general.

UNIT-II

Mass Spectrometry **(12 Hrs)**

Mass spectrometry – theory – molecular ions- isotopic abundance – meta stable ions – fragmentation – Mclafferty rearrangement –Nitrogen rule - ortho effect negative ion- Retro Diels Alder cleavage- isotopic clusters - fragmentation pattern to hydrocarbons, aldehydes, ketones, ester and acids. FAB mass spectra.

UNIT-III

Atomic Spectroscopy **(12 Hrs)**

Atomic absorption spectroscopy – principle – Instrumentation – single and double beam absorption spectrometer. Detection limits and sensitivity – applications.

Atomic emission spectroscopy – Types of emission spectra – excitation energy requirements – Instrumentation – spectrographs –applications. Comparison between atomic absorption and emission spectroscopy.

UNIT-IV

Thermal Methods of Analysis **(12 Hrs)**

Introduction – Different types of thermo analytical methods

Thermogravimetric analysis (TGA) – principle – factors affecting the thermograms. Instrumentation – precautions to be followed for using thermobalance.

Derivative thermogravimetry (DTG) – principle – factors influencing the thermograms.

Differential thermal analysis (DTA). Principle – Instrumentation – applications – thermometric titration.

Differential scanning calorimetry (DSC).

UNIT-V

Electroanalytical Techniques (12 Hrs)

Voltametry and polarography – current –voltage relationships – the dropping mercury electrode – advantages – residual current – diffusion current – migration current – kinetic current – factors affecting diffusion current – instrumentation – Half wave potential – significance of half wave potential – applications of polarography – voltametry –cyclic voltametry. Fundamental principle of coulometric methods. Instrumentation – constant current and controlled potential method. Primary and Secondary titrations.

Amperometric titrations –dead stop end point method

Text Books

1. R. Gopalan, P.S. Subramanian and K. Rangarajan, Elements of Analytical Chemistry.
2. Chatwal Anand, Instrumental Methods of Analysis, 4th Edition, Bombay Himalaya Publishinh house, 1988.

Reference Books

1. D.A.Skoog, D.M.West, F.J.Holder and S.R.Grouch, Analytical Chemistry- An Introduction, 6th edition, Harcourr. Breu., 1994.
2. H.Williams, L.I.Meurit and J.J.A.Dean and F.A.Settle, Instrumental Methods of Analysis, Princeton, D Van Nostrand, 1948.
3. D.A.Skoog and D.M.West, Instrumental Methods of Analysis, 4th edition, New York, Holt, Rinehard and Winston, 1971.
4. R.C.Kapoor and B.S.Agarwal, Principles of Polarography, Willey Eastern Ltd., New Delhi, 1991.
5. Willium Kemp, Organic spectroscopy, 2nd Edition, Macmillan, London, 1975.
6. Y.R.Sharma, Organic Spectroscopy, 3rd Edition, S.Chand and Company, 1998.

14CHP22A Core Elective - II

Environmental Chemistry (60 Hours) Semester-IV

Objectives

- To understand the segments and importance of environment
- To study various pollutions and their impact on ecosystem
- To develop problem solving ability towards sustainable development

UNIT-I

Environment (12 Hrs)

Introduction – components of environment of experiment – factors affecting environment – types of environment – Environmental Management – Objectives and components of environmental management. Segments of environment – environmental pollution – introduction origin of pollution – pollutant – classification of pollutant – types of pollution.

Gaseous and sedimentary cycles – nitrogen cycle, oxygen cycle, carbon cycle, sulphur cycle and phosphorous cycle

Environmental education-objectives-principle of environmental education – environmental educational programmes – health and environment – women and environment- Environmental protection action.

UNIT-II

Chemistry of the Pollution of Atmosphere (12 Hrs)

Introduction – composition of Air – Sources of air pollution – gaseous pollutants – sources and effects of the oxides of nitrogen sulphur and carbon.-sources and effects of hydrocarbon. Particulate matter – automobile emission. Control of CO_x, NO_x, So_x, hydrocarbons and particulates.

Ozone layer – formation of ozone – mechanism of ozone depletion- effects of ozone depletion – ozone hole.

Acid rain- introduction – effects of acid rain – control.

Analysis of CO, $NO_{x,}$ SO_x and hydrocarbons.

Photolytic cycle of NO_2, green house effect. Natural sources of green house effect – Global warming.

UNIT-III

Chemistry of the Pollution of Hydrosphere (12 Hrs)

Introduction – classification of water pollution –physical pollution – chemical pollution – biological pollution and physiological pollution. Ground water, surface water, lake water, river water, sea water pollution – sources and effects. Classification of water pollutants – inorganic pollutants – organic pollutants-effects of organic pollutants – oxygen demanding waste – disease causing agents, land nutrients, sediments, oil.

Eutrophication – introduction – types of eutrophication effects and control of eutrophication.

Thermal pollution – sources and effects – control of thermal pollution – water control of thermal power plant – prevention of thermal pollution – measurement of thermal pollution.

UNIT-IV

Water Treatment and Sewage Treatment (12 Hrs)

Water treatment – introduction – softing of water – clark's – lime soda process – ion exchange process – demineralization of water – determination of hardness – treatment of water for municipal purpose. Chemical methods of sterilization – physical method for sterilization – terms of chlorination – desalination – electrodialysis method – reverse osmosis method- coagulation of water flocculants.

Sewage treatment – municipal waste water – sewage and its composition – methods of sewage and its composition – methods of sewage treatment – preliminary or mechanical treatment, primary treatment – secondary treatment – activated sludge process – sludge disposal – need for sludge disposal – tertiary treatment.

UNIT-V

Chemistry of Pollution of Lithosphere (12 Hrs)

Soil pollution – sources – industrial waste, urban waste, radioactive waste, agricultural practices, chemical & metallic pollutants- effects of industrial pollutants and urban waste.

Pesticides- types- environmental effects of pesticide pollution- control pollution of radioactive waste- source and effects somatic and genetic effects- transmission of radiation to man control.

Solid waste- types and sources- effects of solid waste- solid waste- collection- disposal in sanitary land fills- incineration , pyrolysis and composting-recycling solid waste.

Text book

1. B.K.Sharma, Environmental Chemistry, Meerut, Goel Publications House, 1995

Reference books

1. P.C.Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi, 1988.
2. A.K.De, Environment Chemistry,Wiley Eastern, New Delhi, 1987.
3. S.S. Dara, Environment Chemistry, Wiley Eastern, New Delhi, 1987.

14CHP22B **Core Elective - II**

Industrial Chemistry (60 Hours) **Semester-IV**

Objective

- To know the manufacture of Glass, Cement and Ceramics
- To develop the knowledge about fertilizers and their importance
- To create knowledge in the manufacture of paper and soap

Unit I **(12 Hrs)**

Chemistry of Glass, Cements and Ceramics

Physical and chemical properties of glass. Manufacture of glass-raw materials-methods of manufacturing. Choice of furnace- pot furnace and tank furnace. Formation of batch materials, shaping of plate glass- annealing – finishing. Special types of glass – lead glass-soda lime glass-coloured glass-glass wool-glass laminates. Indian glass industry.

Portland cement- composition of cement and types of Portland cement-raw materials for the manufacture of cement. Manufacture of cement- dry and wet process and various steps involved in the manufacture of cement. Chemistry of setting cement- functions of compounds-heat requirement – factors affecting quality. Cement industries in India.

Ceramics-definition-subdivision of ceramics-general properties of ceramics – classification – raw materials and other ingredients used in manufacture of ceramics.

Unit II **(12 Hrs)**

Fertilizers and Insecticides

Fertilizers – plant nutrients – nutrient functions – need for fertilizers – essential requirements fertility of soil – pH value of the soil. Classification of fertilizers – natural organic fertilizers – natural inorganic fertilizers. Artificial fertilizers- ammonium nitrate – ammonium sulfate – urea manufacturing process. Phosphate fertilizers – normal super phosphate- triple super phosphate – ammonium phosphate. Potassium fertilizers- nomenclature in fertilizer industry.

Insecticides – classification according to their mode of action-inorganic insecticides- lead arsenic calcium arsenate – Paris green.

Insecticides –Sulphur and sulphur compounds. Natural plant insecticides – nicotine –rotenone – allethrin.

Unit III **(12 Hrs)**

Chemistry of Paints, Pigments and Varnishes

Pigments – white pigments – white lead, zinc oxide, lithopone. Blue pigment-ultramarine blue and iron bleu. Red pigments – red lead. Green pigments – chrome green. Reinmann's green.

Pints – constitutions of paints – extenders or fillers-film forming materials-driers-thinners or diluents-antiskinning agents – plasticizers – resins. Manufacture of paints – setting of the paint emulsion paints- constitution of emulsion paint – method of manufacture – advantages.

Adhesives – Introduction – animal glue, other protein adhesives – starch adhesives- synthetic resin adhesives – rubber based adhesives – cellulose and silicate adhesives.

Varnishes- spirit varnishes – oleoresinous varnishes – manufacture of varnishes. Paint and varnish industries in India.

Unit IV Sugar & Paper (12 Hrs)

Sugar – manufacture of sugar – extraction of juice. Defection – carbonation- sulphitation. Crystallization – separation of crystals drying-refining – recovering of sugar from molasses. Manufacture of sugar from beet-root. Sugar industries in India.

Fermentation – conditions favorable for fermentation. Enzymes-characteristics. Manufacture of spirit, wine and vinegar. Ethyl alcohol from molasses. Wash distillation-properties. Distilleries in India.

Paper and Pulp -Manufacture of pulp- chemical process – sulphate pulp, soda pulp, sulphite rage pulp. Various steps involved in the manufacture of paper.

Calendaring paper, industry in India.

Unit V Soap, Detergent & Leather (12 Hrs)

Soaps- soaps and its manufacture. The hor and cold process-batch process- continuous process. Types of soaps-laundry soap-toilet soap – transparent soap-other soaps. Oils to be used in soaps-cleansing action of soaps. Recovery of glycerin from spent lye.

Detergents – introduction – principle groups of synthetic detergents. Classification of surface active agents – anionic detergents – oxo-process –alsol process – Waebsh process. Cationic detergents – nonionic detergents amphoteric detergents –fillers-additives –corrosion inhibitors.

Tanning of leather – manufacture of leather – preparation of hides for tanning – vegetable tanning chrome tanning –finishing – byproducts.

Small scale unit- safety matches – agarbattis naphthalene balls, wax candles – chalk crayons.

Reference Books

1. B.K. Sharma, Industrial Chemistry, Goel Publications House, Meerut, 1995.
2. P.C.Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi, 1988.
3. R.C.Prafuul, K.Goel and R.k.Gupta, Insecticides, pesticides and agro-based industries

14PHP09 **Group Theory and** **Semester: II**

Molecular Spectroscopy-IDC (50Hrs)

UNIT-I

Group Theory **(10 Hrs)**

Symmetry operations and Symmetry elements – Group multiplication table – sub groups and class – reducible and irreducible representation – Great orthogonality theorem – construction of character table.

UNIT-II

Group Theory in molecular vibrations **(10 Hrs)**

Normal modes of vibration – activity and inactivity of IR and Raman frequencies (XY_2 bent symmetrical and XY_3 pyramidal) –construction of character table XY_2 bent symmetrical type molecules .

UNIT-III **(10 Hrs)**

IR Spectroscopy

Theory and principle – Instrumentation (single beam) – sampling methods – Interpretation of IR spectrum of some functional group vibrations – FTIR spectroscopy – ATR Technique – FTIR micro spectroscopy.

UNIT IV

Raman Spectroscopy **(10 Hrs)**

Principle and theory – Instrumentation (single beam) – Degree pf depolarization – surface enhanced Raman spectroscopy.

Applications of IR and Raman Spectroscopy **(10 Hrs)**

Molecular structural determination of $XY_2(C_{2v},)$ $XY_3(C_{3v})$ type molecule – construction of G matrix elements – FG matrix method – Force field calculations.

UNIT-V

UV Visible Spectroscopy **(10 Hrs)**

Absorption laws- Formation of absorption bands – theory – electronic excitations – types of transitions – Transition probability – Chromophores and auxochromes – absorption and intensity shifts – Types of adsorption bands – solvent effects – conjugated systems – extended conjugation – aromatic systems – Woodward Fisher rules for calculating adsorption maximum in dienes – enones

and aromatic systems –Fischer Kuhn rules for calculating adsorption maximum in polyenes – Instrumentation – applications of UV-visible spectroscopy to organic compounds.

NMR Spectroscopy

Theory – chemical shifts. Factors influencing chemical shift –inductive effect, anisotrophic effect, ring current and solvent effects. Spin- spin coupling. – Geminal, vicinal, cis, trans and aromatic coupling. Relaxation process. Conversion of non first order spectra to first order spectra –Increase in field strength, spin decoupling and chemical shift reagents.

Text Book

1. Symmetry and Spectroscopy of molecules, K. Veera Reddy, New Age International Ltd. Publishers, 1998.