ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN (AUTONOMOUS), PALANI

Nationally Reaccredited with B++ by NAAC in 3rd Cycle

Run by Hindu Religious and Charitable Board under the Aegis of Arulmigu Dhandayuthapani Swami Thirukovil, Palani)

(Affiliated to Mother Teresa Women's University, Kodaikanal)

Chinnakalyamputhur, Palani -624 615.

DEPARTMENT OF CHEMISTRY

M.Sc., Chemistry - Syllabus

OUTCOME BASED EDUCATION

EFFECTIVE FROM THE ACADEMIC YEAR 2022-2023 ONWARDS

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN (AUTONOMOUS), PALANI

M.Sc Chemistry Syllabus

OBE (Outcome Based Educational System)

Effect from the Academic Year 2022-2023 onwards

Common Academic Structure in Autonomy

For the Academic Year 2022-2023

Semester	Hours	Subject	Internal	External	Total	Credit
I	5	**Core – I** - Organic Chemistry –I	**25**	**75**	100	5
	5	**Core – II** - Inorganic Chemistry - I	**25**	**75**	100	5
	5	**Core – III** - Physical Chemistry – I	**25**	**75**	100	5
	5	**Core – IV** - Organic Chemistry Practical	**25**	**75**	100	4
	5	**Major Elective – I** **Option – I** Medicinal Chemistry and Drug Design **Option – II** Clinical Micro Biology and Biochemistry	**25**	**75**	100	4
	25	**TOTAL**			**500**	**23**
II	5	**Core – V** Organic Chemistry – II	**25**	**75**	100	5
	5	**Core – VI** Inorganic Chemistry – II	**25**	**75**	100	5
	5	**Core – VII** Physical Chemistry – II	**25**	**75**	100	5
	5	**Core – VIII** Inorganic Chemistry Practical	**25**	**75**	**100**	**4**
	5	**Major Elective – II** **Option – I** Analytical Techniques **Option – II** Reaction kinetics and Electro Chemistry	**25**	**75**	**100**	**4**
	25	**TOTAL**			**500**	**23**

III	5	**Core – IX** Organic Chemistry – III	**25**	**75**	100	5
	5	**Core – X** Inorganic Chemistry –III	**25**	**75**	100	5
	5	**Core – XI -**Physical Chemistry – III	**25**	**75**	100	5
	5	Core – XII Physical Chemistry Practical	**25**	**75**	100	4
	5	**Major Elective – III** **Option – I** Environmental Chemistry and Green Chemistry **Option – II** Supra Molecular Chemistry and Chemo informatics	**25**	**75**	100	4
	25	**TOTAL**	**25**	**75**	**500**	**23**
IV	5	**Core – XIII** Chemistry of Natural Products and Bioinorganic Chemistry	**25**	**75**	100	5
	5	Core – XIV - Nano Chemistry	**25**	**75**	100	5
	5	**Major Elective – IV** **Option – I -** Industrial Chemistry **Option – II** – Dairy and Leather Chemistry	**25**	**75**	100	4
	5	**Core – XV -** Project Work	**25**	**75**	100	7
	20	**TOTAL**			**400**	**21**

PROGRAMME OUTCOMES

The Students will be able to

PO1. Explain the scientific principles in various fields.

PO2. Display practical skills in their career, intellectual analysis of problems and lead a team, apply entrepreneurial skills and develop a leadership quality.

PO3. Enrich the academic career by doing higher education and have a successful attitude to do research.

PO4. Handle standard equipments and to analyze the data.

PO5. Gain skills in spectral, analytical, qualitative and quantitative techniques which will be useful in industry

PROGRAMME SPECIFIC OUTCOMES

On Successful Completion of the Programme, Our Students will be able to

PSO-1 Have appropriate knowledge in the main areas of chemical sciences.

PSO-2 Analyse and understand the experimental problems, design a problem solving method, carrying out the suitable experimental solutions.

PSO-3 Effective communication skill, develop critical thinking, be confident in carrying out all challenges.

PSO-4 Get exposure and involve in modern trends in chemical research.

PSO-5 Achieve employment in chemical related industries, public administration, academic fields and empower new avenues.

PSO-6 gain skill in problem solving, critical thinking as applied to scientific problems.

SEMESTER - I

Semester - 1

ORGANIC CHEMISRY- I

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To understand the importance the different types of reactive intermediates in organic reactions and their mechanisms.
2. To acquire knowledge about the basic concepts of stereochemistry.
3. To make the students to understand the concept of aromaticity, aromatic, non-aromatic and anti-aromatic compounds.

Unit 1:

Reactive intermediates and Aromaticity

Carbocations, carbanions, carbenes, benzyncs and nitrenes - Generation, stability and reactivity.

Aromatic character: Six-, five-, seven-, and eight- membered rings Other systems with aromatic sextets Huckel's theory of aromaticity, concept of homoaromaticity and antiaromaticity, Electron occupancy in MO's and aromaticity - NMR concept of aromaticity and antiaromaticity, systems with 2,4,8 and 10 electrons, systems with more than 10 electrons, alternant and non-alternant hydrocarbons (azulene type). Bonding properties of systems with (4n+2) electrons and 4nDelectrons, Heteraromatic molecules. Annulenes, heteroannulenes, Sydnones and fullerenes. Craig's rule, Hammond's postulate

Unit II

Substitution reactions

Nucleophilic Substitution

1. Aliphatic nucleophilic substitution: S_N1 and S_N2 mechanism - Kinetic stereochemical characteristics effects of substrate structure, nature of the nucleophile and and leaving group on the rate solvent effects examples of Si substitution - Neighbouring group participation-Anchimeric assistance

2. Aromatic nucleophilic substitution: Benzyne and Meisenheimer intermediates.

Electrophilic Substitution

1. Mechanism of aliphatic electrophilic substitution reaction - Sel, S2, Sei reaction.

2. Mechanism of aromatic electrophilic substitution reactions complexes - nitration, halogenation, sulphonation, Friedel Craft alkylation and acylation - Reimer Tiemann reaction. Linear free energy relationship - Hammett equation - Significance of the σ and ρ parameters: Taft equation.

Unit III

Addition and Elimination reactions

Addition reactions

Regio and stercochemistry of addition of halogens and halogens acids to carbon carbon multiple bonds hydroboration addition to carbonyl bonds mechanism of Aldol, Perkin, Stobbe, Dieckmann condensation, Reformatsky and Grignard reaction, Michael addition reaction and Mannich reaction - Formation and Synthetic application of enamines - Stork enamine reaction.

Elimination reactions

E1, E2, E1CB mechanism - structural and solvent effect on these mechanisms- orientation of double bonds (regio and stereoselectivities) - competition between substitution and elimination reaction - cis elimination, pyrolytic eliminations.

Unit IV

Rearrangements

Definition nucleophilic, electrophilic and free radical rearrangements - intramolecular and intermolecular rearrangements migratory aptitude - Wagner - Meerwin, Benzil - Benzilic acid, Schmidt, Lossen, Curtius, Beckmann, Frics, Bacyer Villeger, Favorski, Stevens and Neber rearrangements.

Unit V

Introduction to Stereochemistry

Concept of chirality: specification on configuration by Cahn, Ingold and Prelog system of notation, compounds with more than one chiral centre - calculation of number of stereisomers erythro and threo nomenclature; interconversions of Sawhorse, Fisher and Newman's Projections.

The concept of prochirality: Topicity and prostereoisomerism equivalent, enantiotopic and diasteriotopic ligands and faces. Atropisomerism concept of axial chirality R and S nomenclature of some axially chiral molecules.

Geometrical isomers E & Z nomenclature determination of configuration of geometrical isomers by physical and chemical methods.

Reference Books:

1. Advanced Organic Chemistry reactions and mechanisms – Jerry March.
2. Reaction mechanism in Organic chemistry – S.M.Mukherji and S.P.Singh
3. Modern Organic Chemistry – M.K.Jain and S.C.Sharma
4. A Text Book of Organic Chemistry – B.S.Bahl and Arun Bahl. S.Chand & company LTD, Ram Nagar, New Delhi.20th Revised Edition – 2011.
5. A Text Book of Organic Chemistry – P.L.Soni.
6. Organic Chemistry, Vol. I and II – Finar I.L.

7. Text Book of Organic Chemistry – Morrison and Boyd.
8. P.Sykes, A Guide book to Mechanisms in Organic Chemistry.
9. Stereochemistry of Carbon Compounds – E.L.Eliel.
10. Organic Reaction Mechanism – R.K.Bansal.
11. Sterochemistry of Organic Compounds – D.Nasipuri.

Co Number	Co Statement	Knowledge Level
CO1	To Remember different types of reactive intermediates	**K1**
CO2	To understand aromatic, non –aromatic and anti aromatic compounds	**K2**
CO3	To describe various mechanism of organic reactions	**K4 , K5**
CO4	To get knowledge about molecular rearrangements	**K3**
CO5	To apply the concepts stereochemistry	**K3**

Mapping with Programme Outcomes

PSO / CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

Semester - 1

Inorganic Chemistry – I

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To understand principles of various bonding theories.
2. To acquire knowledge about the structure and bonding of molecules.
3. To recognize the various types of solids state and the types of chemical forces.

Unit I: Natural of Chemical bonds

Covalent bond: Hybridization – Calculation of s and p characters – Bent's rule – VSEPR theory – VBT applied to odd electron molecules like ClO_2 NO, NO_2 etc., M.O. theory; LCAO approximation – application of MOT to heteronuclear molecules like NO, CO, $BeCl_2$, Beh_2 and H_2O - Walsh diagram (diatomic & triatomic molecules) – concept of multicentered bond as applied to electron deficient molecules like diborane and metal alkyls.

Unit II: Bond properties and ionic bonding

Ionic radii- covalent radii- van der Waals radius- bond length, bond order, bond energy, bond polarity- partial ionic character of covalent bonds- electronegativity & electron affinity and their applications- lattice energy – Born Haber cycle- Covalent character in Ionic compounds – Fajans rule – Different types of electrostatic interactions- Hydrogen bond and their applications.

Unit – III: Solid State Chemistry

Crystal systems and lattices, miller planes, crystal packing – Evaluation of crystal parameters (density, Avogadro number) – Crystal defects – point , line and plane defects – colour centers – Electronic structure of solids- Free electron and band theories- Electrical conductivity and superconductivity – High temperature superconductors- Types of Semiconductors- Thermo-electric power and hall effect – Photovoltaic effect – Semiconductors in solar energy conversion.

Unit – IV: Inorganic Chains – Rings and Cages:

Silicates: Various silicate structures- Structure, Property, correlation- Silicones.

Poly acids: Poly acids: Classification – Isopoly acids polymolybdate, Polyvanadate and polytungstate – their structures- heteropolyacids: 12A, 12B, 9 and 6 heteropolyacids- preparation and structures.

Phosphazenes and its polymer- Phosphonitrillic compounds- S_4N_4 – Polymeric sulphur nitride(Polythiazyl) Cage compounds: Nomeclature of Boranes and Carboranes – Wade's rule – Stylx number – preparation an structure of B_4H_{10}, $C_2B_{10}H_{12}$, $(B_{12}H_{12})^2$ - borazine.

Unit V: Metallurgy

Occurrence, isolation, purification, properties and uses of the following metals as well and their important compounds : Be, Ge, Ti, Zr, Th, V, Pu , U and plantium metals and compounds like BeCl2, Beryllium acetate, $TiCl_4$, Titanates, TiO_2, ZrO_2, Thoria, VF5, $VOSO_4$, V_2O_5, Uranyl halides, Uranyl nitrate, Plutonium halides.

References Books:

1. James E.Huheey, Ellen A.Keitleer and Richard L.Keitler, Inorganic Chemistry, 4th End. Harper Collins college Publishers, New York, 1993.
2. Asim K ds , Fundamentals concepts of Inorganic Chemistry , Vol 1,2 and 3,2nd edition, CBS publisher and Distribution PVT Ltd. 2016.
3. Text Book of Inorganic chemistry – R.D.Madan.
4. P.W.Atkins, D.K.Shriver and C.K.Shriver and C.H.Langfood, Inorganic Chemistry, Oxford – ELBS, U.K.1990.
5. F.A.Cotton and G.Wilkinson, "Advances Inorganic Chemistry", 5th Edn, John Wiley &Sons, Singapore, 1998.
6. Principles of Inorganic Chemistry – Puri & Sharma, Kalia.
7. A Text Book Inorganic Chemistry – P.L.Soni.
8. Advanced Inorganic Chemistry – Gurudeep Raj.
9. Advanced Inorganic Chemistry Vol–I – Satyaprakash ,Tuli, Basu and Madan.

Co Number	Co Statement	Knowledge Level
CO1	To apply VBT, MOT, VSEPR to molecules	K3
CO2	To Acquire knowledge about bond properties and ionic bonding	K1
CO3	To Analyze crystal system and crystal defects	K4
CO4	To Explain various silicate structures	K4
CO5	To Remember metallurgy of various metals	K1

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

Semester – 1

PHYSICAL CHEMISTRY- I

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Understand the laws of thermodynamics.
2. To Appreciate the concepts of chemical kinetics.
3. To get Knowledge about the topic Electro chemistry and photo chemistry.

Unit I

Thermodynamics Chemical and Phase Equilibrium

The second law of thermodynamics - Entropy thermodynamics of systems of variable compositions partial molar quantities and their determination chemical potential - Gibbs Duhem equation Activity and Fugacity- determination of fugacity, Nernst equation, Third law of thermodynamics, exceptions and applications. Chemical equilibrium temperature dependence, Vant-Hoff equation, Non-equilibrium thermodynamics postulates and methodology. Phase equilibrium-Application to three component system - CH_3COOH, H_2O and $CHCl_3$, system.

Unit II

Chemical Kinetics

Derivation of rate constant for opposing, consecutive and parallel reaction-steady state approximation. Chain reactions: kinetics of decomposition of N_2O, Non stationary chain. reaction: H_2O_2 reaction and explosion limits. Grunewald - Weinstein equation on reaction. rates. Concept of Lincar Free Energy Relationships-derivation of Hammett equation-significance of substituent and reaction rate constants Taft equation thermodynamic implications of LFER. Experimental methods for the study of fast reaction-flow method-relaxation methods.

Unit III

Electrochemistry-I

Mean ion activity and activity coefficient of electrolytes in solution - Ion association - Ionic strength - Debye-Huckel theory - Debye-Huckel limiting law - its validity and limitations -Strong and weak electrolytes - Debye theory of electrolytic conductance - Debye – Huckel Onsager equation Verification and limitations Electrochemical cells and applications of Batteries-Primary and secondary fuel cells – Corrosion and corrosion inhibition.

Unit IV

Electrochemistry - II

The Electrical double layer - Polarizable and non-polarizable interfaces - Structure of electrical double layer - Electrocapillary and double layer capacity measurements - Double layer models-Helmholtz, Guoy-Chapman and Stern models.

Electro kinetic phenomena: Zeta potential Electrophoresis Electroosmosis, sedimentation potential and streaming potential, Kinetics of electrode processes - Current potential curve Butler-Volmer relation and its approximations - Tafel equation - Charge transfer resistance - Nernst equation from Butler-Volmer equation -Multistep processes - Symmetry factor and transfer coefficient - Electrocatalysis-Hydrogen evolution reaction as a case study.

Unit V

Photochemistry

Absorption of light by molecules, reaction paths of electronically excited molecules-de excitation pathways, Fluorescence and Phosphoresence Jablanski diagram Physical properties of the electronic excited molecules excited state dipole moments, excited state pKa and redox potentials - Stern - Volmer equation and its application - photosensitization - Chemi Luminescence - Quantum Yield and actinometry.

Reference Books:

1. Principles of Physical Chemistry – Puri B.R.Sharma L.R and Madan S. Pathania.
2. Text Book of Physical Chemistry – Soni P.L. and Dharmarha O.P.
3. Physical Chemistry - P.W.Atkins
4. Advanced Physical Chemistry – Gurdeep Raj.
5. Introduction to Electrochemistry – S.Glasstone.
6. Chemical Kinetics – K.J.Laidler
7. Fundamentals of Photo Chemistry – K.K.Rohatgi – Mukherjee.

Co Number	Co Statement	Knowledge Level
CO1	To Recollect fundamentals of Thermodynamics.	K1
CO2	To Appreciate the concepts of chemical kinetics.	K3
CO3	To get Knowledge about Electro chemistry.	K2
CO4	To Interpret the Structure of electrical double layer.	K4
CO5	To Explain Fluorescence and Phosphorescence.	K4

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Medium	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Medium	Strong	High	Strong	Strong
CO4	Strong	High	High	Strong	Medium
CO5	Strong	Medium	Strong	High	Strong

SEMESTER - I

ORGANIC CHEMISTRY PRACTICALS

Sub Code: Hours : 5 Credit: 4 Max Marks: 75 (Ext); 25 (Int)

1. Purification techniques of organic compounds and their spectroscopic identifications
    a) Purification of binary mixtures by Thin Layer Chromatography (TLC) and Column chromatography
    b) Purification of tertiary mixture of amino acids by paper chromatography (Both Experiments demonstration only)
2. Extraction of natural products such as Caffeine, Caesin
3. Organic preparation: Any 4 preparations (involving two or more than two steps) Involving the following representative reactions
    1) Bromination
    2) Hydrolysis
    3) Nitration
    4) Condensation

5) Oxidation

4. Qualitative analysis - Separation of two component mixture and identification of components by chemical methods (about 4-5 mixtures)
5. Quantitative Analysis
    a) Estimation of ascorbic acid
    b) Estimation of glucose

SEMESTER - I

Major Elective – I

Option - 1

MEDICINAL CHEMISTRY AND DRUG DESIGN

Sub Code: **Hours : 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Understand Bio Inorganic compounds in medicine.
2. To Impart knowledge on molecular modeling and drug design.
3. To gain knowledge about vitamins.

Unit I:

Molecular modeling and Computer aided drug design.

Basic features of molecular modeling-Simulation for conformational analysis : Molecular mechanics, Ab initio, DFT and semi-empirical methods - Energy minimization; Local and global energy minima, saddle point-Electronic descriptors-Force fields - Monto Carlo simulation-QSAR Regression methods-Function modules of molecular softwares. Molecular docking- Molecular Dynamics; Introduction, basic principles, conformation analysis, Mechanics and dynamics of Bio-macromolecules.

Stages in drug development-conventional approach-Rational drug design-Target identification Sequence to structure Protein structure prediction Homology modeling-Active sites-Lead structure identification, Target Substrate Docking Scoring-molecular descriptors - High throughout screening and combinatorial chemistry-Structure-activity relationship (SAR) Toxicity, Patents

Unit II:

Medicinal Bioinorganic Chemistry

Bioinorganic Chemistry of quintessentially toxic metals. Lead, Cadmium, Mercury, Aluminum, Chromium, Iron, Copper, Plutonium. Detoxification by metal chelation.Drugs that act by binding at the metal sites of Metalloenzymes.

Chemotherapy-Chemotherapy with compounds of certain non-essential elements. Platinum complexes in Cancer therapy - Cisplatin and its mode of action - Cytotoxic compounds of other metals Gold containing drugs as anti-rheumatic agents and their mode of action Lithium inPschycopharmocological drugs. Molecular channels and transport processes.

Unit III:

Medicinal Bioorganic Chemistry

Introduction Study of drugs important terminologies in pharmaceutical chemistry - Classification and nomenclature of drugs - Antibacterial drugs Sulpha drugs: sulphanilamide, sulphadiazine

Antibiotics: chloraphenicol, penicillin, Analgesics: morphine, heroin - Anticonvulsant: Barbiturates, oxazolindiones, streptomycin, terramycin

Unit IV

Vitamins: Vitamins A, B_1, B2, C, E and H

Unit V

Drug Action

Mechanism of action of drugs

- Metabolism of drugs-Absorption of drugs, Diabetes: control of diabetes, insulin Cancer and antineoplastic drugs: antimetabolites, plant products Cardio vascular drugs: Antiarrhythemic drugs, antihypertension drugs

Reference Books:

1. Medicinal Chemistry – Dr.B.V.Ramana.
2. Medicinal Chemistry – Ashutoshkar.
3. Medicinal Chemistry – P.Parimoo.
4. Medicinal Chemistry – Kadametal P-I & P.II
5. Fundamentals of medicinal chemistry – G.Thomas
6. Medicinal Chemistry – A.Burger
7. An Introduction to Medicinal Chemistry – G.L.Patrick.
8. Andrew Leach, Molecular Modelling, Principles and Applications.
9. Pharmacology & Pharmatherapeutics Vol I & 2 – R.Satoskar & S.D.Bharkar
10. Medicinal Chemistry – D.Sriram & P.Yogeeswari.

Co Number	Co Statement	Knowledge Level
CO1	To Understand the basic features of molecular modeling	K2
CO2	To Understand Bio Inorganic compounds in medicine.	K2
CO3	To Apply important terminologies in Pharmaceutical Chemistry	K3
CO4	To Explain the structure and uses of vitamins.	K4
CO5	To Know about drugs	K1

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

SEMESTER – I
Major Elective – I
Option - II
Clinical Microbiology & Biochemistry

Sub Code: **Hours : 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To impart knowledge about Identification of microbes.
2. To understand blood analysis.
3. To know about vaccination.

Unit – I

Clinical specimens – collection needle aspiration, Incubation, catheter, handling, transport, Isolation of microbes from specimens- selective media, differential media, enrichment media, characteristic media. Identification of microbes (Virus, bacteria, fungi and parasites) through morphological and biochemical characteristics.

Unit- II

Principles of Clinical Biochemical Analysis

Basis of analysis of body fluids for diagnostic prognostic and monitoring purposes.

Blood Analysis

Composition of blood, blood grouping & matching- physiological function of Plasma protein, role of blood as oxygen carrier , blood pressure- Hypertension & Hypotension, coagulation of blood, Abaemia – causes & control. Urea determination – the urease methods, estimation bile pigment in serum estimation of total protein in serum, estimation of total proteins and albumin based on biuret method and BCG method.

Unit – III

Determination of Glucose in Serum by Folin & Wu's method, Determination of Serum Cholesterol- Sackett's method for total cholesterol. Diagnostic test for sugar in urine. Test for salt in Serum, test for chlorides. Detection of Cholesterol in urine, detection of diabetes. Typical reference ranges for biochemical analyst Viz, Sodium, potassium, urea, creatinum , AST, ALT, AP and cholesterol and their significance , Biological role of sodium , potassium, calcium, iodine, copper and Zinc.

Unit – IV

Electrophoresis, Blotting and Vaccination

Principles, Techniques: Southern, western and northern blotting. Vaccines and immunizations: Active immunization, Passive immunization, type of vaccines- whole organism vaccines, purified macromolecules and vaccines, Recombinant – vector vaccines, DNA vaccines.

Unit – V

Common Diseases & their Treatments

Insect borne diseases: Malaria, Filarisis & Plague. Air Borne diseases: Diaphtheria, Whooping cough, Influenza, Measies numps, Tuberculosis, water borne diseases : Cholera, Typhoid, & Dysentry, Common disease of the digestive system- jaundice, respiratory system – asthma,nervous system – epilepsy. Some other common diseases- piles, leprosy, First aid for accidents. Common poisons & their antidotes – acid poisoning, alkali poisoning, poisoning by disinfectants hallucinogens.

Toxic effects of metals

Toxicity of Iron, Copper, Arsenic, Mercury, Lead, Cadmium, Aluminum & Radionuclide & Wilson's disease.

Reference Books:

1. Applied Chemistry – Jayashree Ghosh.
2. Fundamentals of Biochemistry for Medical Students – Ambika Shanmugam.
3. Text Book of Pharmaceutical Chemistry – Jayashree Ghosh
4. Bio Techniques , Theory and Practice – Rana, S.V.S
5. Medical Bio Chemistry – Mallikarjuna Rao. N
6. Principles of Biochemistry – L.Stryer, Biochemistry D.L.Nelson, M.M.Cox, Lehninger.

Co Number	Co Statement	Knowledge Level
CO1	To acquire knowledge about Incubation, Isolation of microbes from specimens.	K2
CO2	To Estimate Urea and bile Pigment	K4
CO3	Apply methods to Determine glucose and Cholesterol	K3 , K4
CO4	To Understand the vaccination	K2
CO5	To Remember insect borne, Water borne diseases and Toxic effects of metals	K1

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	High	Strong	High	Strong
CO2	Strong	High	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Medium
CO4	High	Strong	High	Medium	Strong
CO5	Strong	Strong	Strong	Medium	High

SEMESTER - II

Semester – II

ORGANIC CHEMISTRY-II

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Apply reagents in organic synthesis.
2. To Understand sigmatropic rearrangements.
3. To Study organic photochemistry.

Unit I

Reagents in Organic Synthesis

Use of the following reagents in organic synthesis and functional group transformations - complex metal hydrides, Gilman's reagent, lithium dimethyl cuprate (LDC), lithium diisopropyl amide (LDA), dicyclohexyl carbodimide (DCC), 1,3-dithiane, tri-n-butyl tin hydride, Osmium tetroxide, DDQ, SeO2, phase transfer catalysts Crown ethers, Wilkinson's catalyst, Baker's yeast.

Unit II

Molecular Rearrangements

Intramolecular 1, 2- shifts, Wagner Meerwein and related rearrangements, Migration to carbonyl carbon: Neber and Baeyer Villiger rearrangement. Rearrangement of electron deficient. nitrogen and oxygen: Dienone-Phenol, Favorskii, Fries, Wolf, Benzidine, Steven's, Demzanov, Sommlet-Hauser, Chapmann and Wallach rearrangements.

Unit III

Pericyclic Reactions.

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1, 3, 5 hexatriene. Classification of pericyclic reactions. Electrocyclic reactions - 4n and 4n+2 systems, Woodward-Hoffmann rules, Correlation diagram, FMO and PMO approach [1, 3-dienes and 1, 3,5-trienes]

Cycloadditions

Antarafacial and suprafacial additions, 4n and 4n+2 systems, 1, 3- dipolar addition, Diel's Alder reaction.

Sigmatropic Rearrangements

Suprafacial and antarafacial shifts of hydrogen, Cope, Claisen and di- methane rearrangement.

Unit IV

Retro Synthesis

Definitions of some terms used in retro synthesis- Guidelines for choosing disconnections - Guidelines 1 to 3. One group C-X disconnections- carbonyl derivatives, alcohols and olefins. Chemoselectivity- Introduction, Guidelines-1 to 7. Reversal of polarity (Umpolung) Definition- Umpolung reagents (Epoxides, a-halo ketones, nitro compounds).

Protecting Groups

Introduction, protection of alcohols principle-protecting group for alcohols acetals/ketals, ethers, protection of carbonyl groups- principle-protecting group for carbonyl compounds- acyclic acetals and ketals, protection of carboxylic acid groups- principle protecting group for carboxylic acid-methyl ester, protection of amino groups- principle - protecting group for amino group- formamide.

Unit V

Organic Photochemistry

Introductory theory of light absorption, photophysical processes- Jablonski diagram, IC, ISC, fluorescence, phosphorescence. Photochemical reactions of Ketones - Norrish type I and II, Paterno Buchi reaction, Photoreduction of Ketones, Photochemistry of α, β -unsaturated ketones, Photochemical reactions of olefins - Cis-trans isomerism, Dimerization reactions, photochemistry of butadiene, Photochemistry of aromatic compounds and photo oxidation.

Reference Books:

1. Modern Organic Chemistry – M.K.Jain & S.C.Sharma
2. Advanced Organic Chemistry – Bahl.B.S. and Arun Bahl.
3. Organic Chemistry, Vol.I and II – Finar I.L.
4. Text Book of Organic Chemistry – Morrison and Boyd.
5. A Text Book of Organic Chemistry – P.L.Soni.

Co Number	Co Statement	Knowledge Level
CO1	To Apply reagents organic Synthesis.	K3
CO2	To Understand molecular rearrangements.	K2
CO3	To recollect pericyclic reactions and cycloaditions.	K1
CO4	To Know about Retro Synthesis.	K2
CO5	To Explain photochemistry of aromatic compounds and photooxidation	K4

Mapping With Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Medium	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Medium	Strong	High	Strong	Strong
CO4	Strong	High	High	Strong	Medium
CO5	Strong	Strong	Strong	High	High

Semester - II

Inorganic Chemistry – II

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Understand Nomenclature, Isomerism, VBT, CFT of Coordination Compounds.
2. To get Knowledge about characteristics of d-d transitions, selection rules.
3. To Explain substitution reactions in square planar and in octahedral complexes.

Unit – I

Coordination Chemistry

Nomenclature of coordination compounds – isomerism, structural & stereoisomerism – octahedral & square planar complexes. bonding in complexes– valence bond theory, crystal field theory – crystal field effects in tetrahedral, octahedral & square – planar symmetries. CFSE – Weak & Strong field effects – Spectrochemical series. Magnetic properties – I row transition metal complexes: Comparison of magnetic properties of Oh, Td & Square planar Fe(II), CO(II), Ni(II) & Cu(II) Complexes. Applications of CFSE. Molecular Orbital Theory – Based on group theoretical approach. M.O diagrams of octahedral complexes with /without pi- bonding- Experimental evidence for pi – bonding.

Unit II

Electronic Spectra of complexes

Characteristics of d-d transitions – selection rules . Energy level diagrams – Orgel diagrams. Sugano – Tanabe diagrams (only for d^2, d^2 & d^6 ions) . Jahn – Teller tetrahedral distortions.

Spin – orbit coupline. Nephelauxetic effect. Charge transfer spectra.

Mossbauer Spectroscopy : Principle, Applications in the characterization of Fe& Sn Complexes.

Unit – III

Reactions of Complexes

Inert and labile complexes – Substitution reactions in square planar and octahedral complexes, SN1 CB mechanism, complementary / non – complementary reactions. Trans effect- mechanism and applications. Theories of

trans effect. Oxidation – reduction reactions – through atom/group transfer, electron transfer. Mechanism of electron transfer reactions in solution phase – outer sphere and inner sphere mechanism.

Unit IV

Organometallic Chemistry I

Basics of Organometallic chemistry – Hapticity – Classification of ligands and its limitations – 18 e^- rule, Metal Carbonyls – preparation, structure, bonding and reactions, Metal Nitrosyls- preparation and Bonding, Dinitrogen complexes – Metal alkenes- Zeise salt – bonding, Cyclopentadienyl complexes (Ferrocene) – Preparation and properties . Concept of Isolobality and Isolobal analogues – ML5, ML4, ML3, Fragments – Examples – $Mn(CO)_5$ $Fe(CO)_4$, $Co(CO)_3$.

Unit – V

Organometallic Chemistry II

Organometallic reactions – Co –ordinative unsaturatin, oxidative addition reaction, Reductive elimination & β – elimination. Insertion reactions, Hydrogenation of alkenes (Wilkinson Catalyst) , Hydroformylation (Oxo Process) , Oxidation of Olefins (Wackers Process) Carbonylation of Methanol (Monsanto Process) , Polymerization of Olefins (Zeigler – Natta Catalysts) Metal clusters- Introduction to metal carbonyl cluster- Wade's rule. WGS (Water Gas Shift) – Synthesis. Cycl – oligomerisation of acetylene (Repps and Wilki's Catalyst)

Reference Books:

1. Text Book of Inorganic Chemistry – Soni. P.L.
2. Principles of Inorganic Chemistry – Puri and Sharma and Kalia.K.C.
3. Selected topics in Inorganic Chemistry – W.D.Malik, G.D.Tuli, R.D.Madan.
4. Inorganic Chemistry – J.E. Huheey, E A Keiter and R.L. Keiter.
5. Advanced Inorganic Chemistry – Gurudeep Raj.
6. Basic Inorganic Chemistry – Cotton and Wilkinson.
7. Advanced Inorganic Chemistry Vol–I – Satyaprakash, Tuli, Basu and Madan.
8. James, E.Huheey, Ellen, A.Keiter , R.Keiter , O.K. Medhi , Inorganic Chemistry – Principles of Structure & Reactivity.
9. R.C.Mehrotra & A.Singh, Organometallic Chemistry – A Unified Approach.
10. J.D.Lee, Concise Inorganic Chemistry.
11. Principles of Organometallic Chemistry – P.Powell.
12. Mechanism of Inorganic Reactions – F.Basolo, R.G.Pearson.

Co Number	Co Statement	Knowledge Level
CO1	To recollect Nomenclature, Isomerism, VBT, CFT of Coordination Compounds.	K1
CO2	To Understand Chartistics about characteristics of d-d transitions, selection rules, energy level diagrams of coordination compounds.	K2
CO3	To apply mechanism of electron transfer reactions in solution phase.	K3
CO4	To explain preparation, structure, bonding and reaction of metal carbonyls and metal nitrosyls.	K4
CO5	To interpret polymerization of olefins, carbonylation of methanol.	K4

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

SEMESTER - II

PHYSICAL CHEMISTRY – II

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Understand postulates of quantum mechanis.
2. To Study Rigid rotator- Harmonic oscillator.
3. To understand surface phenomena and Polymer chemistry**.**

Unit I

Quantum Theory - I

Planck's quantum theory Bohr atom model -Wave Particle duality Uncertainty Principle Operators and commutation relations - Sums and product of operator, commutator, and non-linear operator, Hermitian and Hamiltonian operator, Postulates of quantum mechanics and Schrodinger equation - eigen functions and eigen value, Free particle- Particle in a box- degeneracy-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

Quantum Theory - II

Derivation of angular momentum operator, Rigid rotator-Harmonic oscillator. The hydrogen atom space quantization of electronic orbits angular and radial part, electron spin Approximate methods of solving the Schrodinger equation - The perturbation and variation methods Application to He atom - Angular momentum- spin orbit interaction - vector model of the atom term symbols Pauli exclusion principle Slater determinant. Atomic Structure Calculation.

Unit III

Quantum Theory - III

Molecular Orbital and valence bond theory of molecules: The Born-Oppenheimer approximation, MO treatment of H_2^+, and MO and VB treatment of H_2 molecule - comparison of MO and VB methods. Bonding in homo and hetero nuclear diatomics (HF, CO, NO) polyatomic molecules concept of hybridization -Huckel theory of conjugated systems application ethylene, butadiene.

Unit IV

Surface Chemistry and Catalysis

Surface Phenomena: Physisorption and chemisorptions ,solid- liquid interfaces - contact angle and wetting, Adsorption from solution,, Gibbs adsorption isotherm-solid-gas interface - Freundlich, Langmuir, Temkin, BET isotherms- surface arca determination.

Homogeneous catalysis Acid-base catalysis Acidity function Enzyme catalysis - Michaelis-Menten kinetics.Kinetics of bimolecular surface reactions involving adsorbed species - Langmuir-Hinshelwood mechanism, Langmuir - Rideal mechanism - Rideal – Eley mechanism. Basic aspects of semiconductor catalysis and applications

Solar energy conversion - Photogalvanic cell - Photoelectrochemical cells - Electrolysis of water.

Unit V

Polymer Chemistry

Overview of polymers Structure and classification of polymers Degree of polymerization, Kinetics and mechanism of free radical and ionic polymerizations - Coordination polymerization, Zeigler-Natta catalysis Condensation - Self catalysed and Non catalyzedpolycondensation, Copolymerization Co-polymer Equation and significance, lecular weight of polymers- Determination of molecular weight Light scattering and viscosity methods - Gel permeation chromatography, Stereo regularity of polymers- significance of T_g and T_m.

Reference Books:

1. Advanced Physical Chemistry – Gurdeep Raj.
2. Physical Chemistry - P.W.Atkins
3. Principles of Physical Chemistry – Puri B.R.Sharma L.R and Madan S. Pathania.
4. Text book of Physical Chemistry, S.Glasstone.
5. Text Book of Physical Chemistry – Soni P.L. and Dharmarha O.P.
6. Text Book of Physical Chemistry - W.J.Moore.
7. Introductory Quantum Chemistry A.K.Chandra.
8. Quantum Chemistry – R.K.Prasad.
9. Quantum Chemistry – Donald A.Mc.Quarrie.
10. Quantum Chemistry – Ira.N.Levine.
11. Principles of Polymer Chemistry – P.J.Flory.
12. Physical Chemistry of Polymers – A.Tager.
13. Quantum Chemistry – J.P.Lowe & K.A.Peterson.
14. Molecular Quantum Mechanics- Allyn, Bacon, P.W.Atkins.
15. A Text Book of Polymer Science – F.W.Billmeyer.
16. Polymer Science- V.R.Gowariker, N.V.Viswanadhan, J.Sreedhar.
17. Quantum Chemistry – D.A.Mcquarrie.
18. Elementary Quantum Chemistry – F.L.Pillar.

Co Number	Co Statement	Knowledge Level
CO1	To Understand postulates of quantum mechanics and Schrodinger equation	K2
CO2	To Derive angular momentum of operator.	K4
CO3	To Remember molecular orbital and valence bond theory of molecules.	K1
CO4	To determine surface area.	K5
CO5	To Understand Polymerization.	K2

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	High	Strong	High	Strong
CO2	Strong	High	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Medium
CO4	High	Strong	High	Medium	Strong
CO5	Strong	Strong	Strong	Medium	High

SEMESTER - II

Inorganic Chemistry Practicals

Sub Code: **Hours: 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Practical – A: Qualitative Analysis

Less common metal ions – Mo, Se, Te, Ce, W, Ti Zr, Th, U , V, Li (two metal ions in cationic and anionic forms)

Practical – B: Quantitative Analysis

a) EDTA Titrations : Zn (II) , Mg(II) , Cu(II) and Ni(II)
b) Redox titrations : Fe(II) vs, Ce(IV) , Fe(II) vs. dichromate
   NO2 vs.Ce(IV)
c) Spectrophotometric methods of analysis:
   Fe (II), Cu(II)

SEMESTER – II

Major Elective – II

Option - I

ANALYTICAL TECHNIQUES

Sub Code: **Hours: 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To get knowledge about Terms and Definitions used in HPLC analysis.
2. To study various types of electro analytical techniques.
3. To study surface analysis and XRD.

UNIT I

Chromatography - 1

HPLC: Introduction - Column Packing Materials - Solvent - Detectors - Recorder - Terms and Definitions used in HPLC analysis and applications.

Gas Chromatography: Introduction - Retention Time - Retention Volume - Efficiency - Career Gases Preparation of Columns - Solid Supports Stationary Phases Detectors - Temperature Effect - Quantitative and Qualitative analysis and applications.

UNIT -II

Chromatography - II

Gel Permeation Chromatography: (GPC)

Introduction Types of gels - Selection of gels - Gel Preparation - Drying of gels -Packing of the Column Application of the sample - Resolution-Detectors and Applications.

Gas Chromatography Mass Spectrometry: (GCMS)

Introduction - Separators - Carrier gas-Sample Injection - Analyzer and Applications.

Liquid Chromatography Mass Spectrometry: (LCMS)

Introduction-lonization - Belt Interface - Instrumentation and Applications.

Unit III

Electroanalytical methods

Amperometry -Principles and applications, amperometric titration with examples-comparison with other titration methods-Basic principles of electrogravimetry

Coulometry: principles- coulometry at controlled potential- coulometry at constant current coulometric titrations-advantages and applications

Cyclic Voltammetry: Principles and simple analytical applications Interpretation of cyclic voltammogram.

Unit IV

Spectrometry and thermal methods

Atomic absorption spectrophotometer(AAS)- principle, instrumentations and applications- types of interferences. Flame Emission spectroscopy (FES)- theory, instrumentation and applications, Difference between AAS and FES. Thermal methods of Analysis- principle, instrumentations and applications of TG, DTA and DSC- thermograms of calcium oxalate and $CuSO4.5H_2O$.

Unit V

Surface analysis and XRD

Photoelectron spectroscopy-theory-photo sources-electron analyzers resolution-assignment of bands-Koopman's theorem-principle, instrumentation and applications of UV, XPS and ESCA, Auger effect.

Reference Books:

1. D.C. Harris, Quantitative Chemical Analysis, 4th Ed., W.H. Freeman, 1995.
2. G.D. Christian & J.E.O' Reily, Instrumental Analysis, 2nd Ed., Allyn & Balon, 1986.
3. P.J. Wheatley, The Determination of Molecular structure, (Unit V) Oxford University Press, 1968.
4. M.P. Seah, D.Briggs, Practical Surface Analysis by Augar and X-ray Photo Electron Spectroscopy, 2nd Ed., Wiley, 1992.
5. F.Moulder, W.F.Stickle, P.E.Sobol, K.D.Bomben, Handbook of X-ray Photoelectron spectroscopy, Perkin- Elmer Corp., 1992.
6. Instrumental Methods of Chemical Analysis – Dr.H.Kaur.
7. Analytical Chemistry – Instrumental Techniques.
8. Instrumental Methods of Chemical Analysis – B.K.Sharma.
9. Instrumental Methods of Analysis – H.H.Willard, L.L.Merritt, and J.A.Dean, F.A.Settle.
10. Basic Concepts of Analytical Chemistry – S.M.Khopkar.
11. Analytical Chemistry – An Introduction – D.a.Skoog, F.J.Holler and D.M West.
12. Instrumental Methods of Chemical Analysis – M.S.Yadav.

Co Number	Co Statement	Knowledge Level
CO1	To Explain HPLC and Gas Chromatography.	K4
CO2	To Understand Gas Permeation chromatography, GCMS and LCMS.	K2
CO3	To Apply amperometry, Coulometry in titrations.	K3
CO4	To Analyse spectrometry and thermal methods of analysis	K4
CO5	To get knowledge about the theory of photo electron spectroscopy.	K1

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Medium	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Medium	Strong	High	Strong	Strong
CO4	Strong	High	High	Strong	Medium
CO5	Strong	Strong	Strong	High	High

SEMESTER – II
Major Elective – II
Option – II
Reaction Kinetics and Electrochemistry

Sub Code: **Hours : 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

1. To Understand theories of Electrolytes and reaction rates.
2. To Learn about over voltage.
3. To study about corrosion**.**

Unit – I

Theories of Electrolytes

Arrhenius theory (Basic idea) – Limitation , Debye – Huckel – Onsager equation- calculation of A & B, Physical significance of K, tests of Debye – Huckel. Wein effect, Debye - Falkenhagen effect.

Electrode Electrolytic Interface

Electrical double layer, electrocapillary phenomena- electrocapillary curves – Lippman equation. Electro kinetic phenomena. Zeta potential and its applications. Measurements of double layer capacitances. Theoretical models of double layers - Helmohotz model, Gouy Chapmann model – potential of Zero charge, Stern model – outer & inner Helmohotz planes.

Unit – II

Electrode Kinetics

Kinetics of electron transfer, Butler Volmer equation, Tafel equation, transfer coefficients, charge transfer resistance, Multistep process. Application of Cyclic voltammetry to test reversibility of electron transfer.

Irreversibility in Electrochemical Reactions

Overvoltage – Hydrogen overvoltage, oxygen overvoltage, measurement of Overvoltage, factors affecting and importance of overvoltage.

Unit – III

Chemical Kinetics

Theories of Reaction Rates

The ARRT – Thermodynamic treatment of ARRT – Significance of reaction coordinate- Application of ARRT- Unimolecular & biomolecular processes – Lindemann Christiansen hypothesis, RRKM theory , potential energy surface – kinetic isotopic effects- principles of microscopic reversibility – Steady State Approximation – Third order & termolecular reactions. Primary and secondary salt effects.

Reactions in Solutions

Factors affecting reaction rates in solution – The influence of solvent, ionic strength, dielectric constant, cage effect & pressure on reactions in solutions.

Unit – IV

Catalysis

Acid- base catalysis – specific & general (Bronsted Catalysis law), Enzyme catalysis – Michaelis – Menten equation, effect of pH & temperature on an enzyme catalysed reaction (Single substrate Only)

Adsorption

Differences between physisorption & chemisorphtion – Theories of adsorption- Freundlich, Langmuir, BET & Gibb's Langmuir – Hinshelwood.

Unit V

Batteries

Types, Characteristics. Primary batteries – Dry cells, metal – air batteries, Ag2O-Zn batteries. Secondary batteries – pb- acid battery.

Fuel cells

Classification, H2 - O2 fuel cell, Hydrocarbon – Oxygen fuel cell, phosphoric acid fuel cells.

Corrosion

Types & importance of corrosion. Passivation of metals – Pourbaix diagram – Evans diagram. Electrochemical principles of corrosion- Polarisation of the electrodes – Concentration polarization, Activation polarization, Methods to control corrosion.

Electro deposition: Principles and Applications.

Reference Books:

1. P.W.Atkins, Physical Chemistry, 7th Ed., Oxford University Press, 2002.
2. K.J.Laidler , Chemical Kinetics, 3rd Ed., Pearson Education , 2004.
3. S.Glasstone, Text Book of physical Chemistry, McMillan, 1974.
4. Principles of Physical Chemistry – Puri B.R.Sharma L.R and Madan S. Pathania.
5. Text Book of Physical Chemistry – Soni P.L. and Dharmarha O.P.
6. Theoretical Electrochemistry – L.I.Antropov.

Co Number	Co Statement	Knowledge Level
CO1	To Remember Arrhemicus theory, Electrical double layer and Zeta potential.	K1
CO2	To Interpret kinetics of electron transfer , Charge transfer resistance.	K3
CO3	To Understand and ARRT.	K2
CO4	To Explain various types of catalysis and theories of adsorption.	K4
CO5	To discuss types and importance of corrosion.	K4

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Medium	Medium	Strong	Strong
CO2	Strong	Medium	Strong	Strong	High
CO3	High	Strong	High	Strong	Strong
CO4	Strong	High	Medium	Strong	Strong
CO5	Strong	High	Strong	High	Strong

SEMESTER - III

SEMESTER – III

Organic Chemistry III

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Learn about Uv and visible spectroscopy.
2. To Know about modes of vibrations and Finger print region in IR Spectroscopy.
3. To understand proton NMR Spectroscopy**.**

Unit – I

UV and Visible Spectroscopy

Electronic Excitation, Origin of different bands- Intensity of bands – Selection rules, Laws of Photometry, Instrumentation, correlation of electronic absorption with molecular structure, simple chromophoric groups, Factors affecting transitions – Solvent effect, effect of steric hindrance, effect of conjugation. Woodward's rule for calculating absorption maximum in conjugated dienes, polyenes, α , β - unsaturated carbonyl compounds , benzenoid systems. Applications of UV Spectroscopy.

Unit II

Infrared Spectroscopy

Principle, the modes of stretching and bending vibrations, bond properties and absorphtion trends, Instrumentation – Description of double beam IR Spectrophotometer, IR spectra of polyatomic molecules, Factors affecting the vibrational frequencies, Applications of IR Spectroscopy, Intra and intermolecular hydrogen bonding, Finger Print region, Far IR region, Metal – Ligand stretching vibrations, Application of IR Spectroscopy in differentiation of linkage osomers – cycano and isocyano , notro and nitrito, thiocyanato and isothicyanato complexes.

Unit – III

Proton NMR Spectroscopy

Nuclear spin states , Nuclear magnetic moments , absorption of energy, ^{1}H chemical shift, spin – spin splitting, (n+1rule) , coupling constant – deuterium exchange, first order and non – first order spectra – a review. Chemical and magnetic equivalence, shift reagents, NMR instrumentation, applications of NMR

spectroscopy, NMR spectrum of ethanol, acetaldehyde, 1,1,2 – trichoroethane, cinnamic acid, ethyl acetate, furfuraldehyde and α – chloro propionic acid.

Unit – IV

Carbon -13 NMR Spectroscopy

^{13}C Nucleus, chemical shifts, spin –spin splitting, double resonance techniques – homonulear and heteronuclear decoupling, broad band decoupling , off resonance decoupline, ^{13}C relaxation mechanisms.

FT and 2D NMR Spectroscopy

Principle of FT – NMR , FID Introduction of 2D techniques: COSY and Hetero – COSY.

ESR Spectroscopy

Theory, derivative curves, 'g' shift, hyperfine splitting, Zero field splitting and Kramer's degeneracy, factors affecting the magnitude of the 'g' values, identification of free radicals, EPR spectra of Inorganic compounds.

Unit – V

Mass Spectroscopy

Introduction principle, ion production (EI, CI, FD, and FAB) Presentation of spectral data, molecular ions, meta stable ions, molecular ion peak. Nitrogen rule, isotopic abundance analysis. Fragmentation process, symbolism (scission only) even and odd electron ions, scission with rearrangement. Retro Diels Alder rearrangement, Mc Lafferty rearrangement, double bond and/or ring equivalents implied from a formula. Fragmentation associated with functional groups – aliphatic compounds, aldehydes, Ketones, carboxlic acids, esters, amides, alcohols, thiols, amines, ethers, sulphides and halides, aromatic compounds, elimination due to ortho groups.

Reference Books:

1. Fundamentals of Molecular Spectroscopy – C.N. Banwell.
2. Spectroscopy – William Kemp.
3. Spectroscopy – Pavia.
4. Organic Spectroscopy – J.R. Dyer
5. Elementary Organic Spectroscopy – Y.R.Sharma
6. Spectroscopy – P.S.Kalsi.
7. Organic Spectroscopy – Jag Mohan.
8. Spectroscopy – H.Kaur.

Co Number	Co Statement	Knowledge Level
CO1	Applying woodward's rule for calculating absorption maxima in Uv Spectroscopy.	K3
CO2	To recollect modes of vibrations in IR Spectroscopy.	K1
CO3	Analyse the structure of organic compounds using NMR spectroscopy.	K4
CO4	To Understand carbon -13 NMR Spectroscopy.	K2
CO5	To Explain molecular ion peak, Nitrogen rule in mass Spectroscopy.	K5

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	High	Strong	High
CO2	Strong	Medium	High	Strong	High
CO3	High	High	Medium	Strong	Medium
CO4	Strong	Medium	High	Strong	Medium
CO5	Strong	High	Strong	Strong	Medium

SEMESTER - III

Inorganic Chemistry III

Sub Code: **Hours : 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To apply IR spectroscopy in the structural elucidation of Inorganic molecules.
2. To learn about chemical shifts and coupling constants in NMR spectroscopy.
3. To recollect nuclear chemistry.

Unit – I

Infrared Spectroscopy

Spectroscopy in the structural elucidation of simple molecules like N_2O CIF_3, NO_3, ClO_4 – effect of coordination on ligand vibrations – uses of groups vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate , sulphate and dimethyl sulfoxide.

Unit II

NMR Spectroscopy

Example for different spin systems- chemical shifts and coupling constants (spin – spin coupling) involving different nuclei (1H 19F, 31 P, 13C) interpretation and applications to inorganic compounds – NMR spectra of $P_4S_3H_3PO_3$ H_3PO_2 and HPF2. NMR spectra of Cir3, BrF3 and equimolar mixture of TiF6 and TiF4 in ethanol – effect of quadrupolar nuclei on the 1H NMR Spectra, Satellite spectra. Systems with chemical exchange – study of fluxional behavior of molecules NMR of paramagnetic molecules- isotropic shifts contact and pseudo – contact interactions- Lanthanide shift reagents.

Unit – III

EPR Spectroscopy

Theory of EPR spectroscopy- Spin densities and McConnell relationship – presentation of the spectrum – hyperfine splitting, Applications of EST to some simple systems such as CH3P- benzosemiquinone, Xe_2 – Factors affecting the magnitude of g and A tensors in metal species – Zero – field splitting and Kramers degeneracy – Spectra of VO(II), Mn(III), CO(II), Ni(II) and Cu(I) Complexes.

Mossbauer Spectroscopy

Theory – Doppler effect – isomer shift – quandruple splitting- magnetic hyperfine splitting- application of MB spectroscopy to inorganic compounds.

Unit- IV

Nuclear Chemistry

Properties of nucleus – different types of nuclear forces – liquid drop model, shell model of nucleus – nuclear reactions induced by charged particles – Q value – nuclear reaction cross section, significance and determination – theory of nuclear fission- reactor and its components- production of feed materials for nuclear Reactors – disposal of readioactive wastes – nuclear fusion, stellar energy. Application of readiosotopes in agriculture, industry and medicine- neutron activation analysis – hot atom chemistry.

Unit – V

Inorganic Photochemistry

Elementary ideas on the photo systems I and II – Photochemistry of Cr(III) , Co(III) and Ru(II) – coordination compounds – photo equation – photoanation – photo isomerisation – photo redox reactions – charge transfer photo chemistry – photosensitization – solar energy conversion – photogalvanic cell – splitting of water to evolve hydrogen and oxygen- photochemistry of Pt(II) and Pt(IV) complexes.

References Books:

1. R.S.Drago, Physical Methods in Inorganic Chemistry.
2. K.K.Rohatgi - Mukherjee, Fundamentals of Photochemistry.
3. E.A.V. Ebsworth, Structural Methods in Inorganic Chemistry.
4. Arniger, Nuclear Chemistry.
5. G.J.Ferraido, Inorganic Photochemistry.
6. A.W.Adamson, E.D. Fleischer, Concepts in Inorganic Photochemistry.

Co Number	Co Statement	Knowledge Level
CO1	To apply IR spectroscopy in the structural elucidation of Inorganic molecules.	K3
CO2	To Understand chemical shifts and coupling constants in NMR spectroscopy.	K2
CO3	To Analyse the EPR spectrum of Inorganic metal ion complexes and Mossbauer spectrum of Inorganic Compounds.	K4
CO4	To remember nuclear chemistry.	K1
CO5	To Understand photochemistry of co-ordinate compounds.	K2

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

SEMESTER - III

Physical Chemistry III

Sub Code: **Hours: 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To learn about concepts of group theory.
2. To acquire knowledge about IR and NMR Spectroscopy.
3. To know about statistical thermodynamics.

Unit I:

Group Theory: Concepts

Elements of symmetry - point group classification of molecules - definition and theorems of group - properties of group with examples - symmetry operations as elements of group-group multiplication table - similarity transformations- sub groups - asses representation of groups - reducible and irreducible representations - Great ortho gonality theorem (derivation and proof excluded) - character table for H_{2}*O and J*H_{3}*molecule - format and significance - direct products and simplified procedure for generating and factoring total representations. Symmetry adapted linear combinations - projection operators.

Unit II

Group Theory: Applications

Molecular vibrations and their symmetry types in typical molecules - IR and Raman activity - bonding with central atom and formation of hybrid atomic orbitals in molecules such a B*F_{3} (PtCl 4) 2 CH 4 - sim of MO calculations - naphthalene, benzene - symmetries of molecular orbitals and electronic configurations - group theoretical selection rules - vanishing matrix elements selection rules for electronic transitions - electronic spectra of the carbonyl

Unit III

Spectroscopy - I

General features of spectrum - Experimental techniques - Intensities of spectral lines and linewidths Rotational spectra - Vibrational spectra - Rotation-Vibration spectra of diatomic and polyatomic molecules - Fermi resonance - Basic concepts of FTIR-Raman spectroscopy Rotational Raman and vibrational Raman - Resonance Raman and Laser Raman - Electronic spectra of diatomic molecules Franck-Condon principle Vibrational and rotational fine structure-Fortrat diagram - Predissociation.

Unit IV

Spectroscopy-II

NMR nuclear spins in a magnetic field - Zeeman effect - Larmor precession - Resonance phenomenon - Block equations - Spin lattice and spin-spin relaxation times - Nuclear shielding and chemical shift - Spin-spin coupling - Basic principles of FT NMR Inversion recovery and CPMG sequenced for T, and T_2 measurements-NMR instrumentation.

ESR Electronic Zeeman effect - ESR spectrum of hydrogen atom (first order treatment) – g factors - Hyperfine constants - ESR of organic radicals in solution - McConnell's relation - ESR instrumentation.

Unit V

Statistical Thermodynamics

Thermodynamics probability and entropy-Maxwell-Boltzman, Bose-Einstein and Fermi- Dirac statistics and applications, - partition function and entropies for translating, rotational, vibrational and electronic motions of monoatomic and diatomic molecules - calculations of thermodynamic functions and equilibrium constants-specific heat of solids-Einstein and Debye theories.

References Books:

1. Principles of Physical Chemistry – Puri B.R.Sharma L.R and Madan S. Pathania.
2. Text Book of Physical Chemistry – Soni P.L. and Dharmarha O.P.
3. Physical Chemistry - P.W.Atkins
4. Physical Chemistry – W.J.Moore.
5. Advanced Physical Chemistry – Gurdeep Raj.
6. Group Theory and its Applications to Chemistry – K.V.Raman.
7. Chemical Applications of Group Theory – F.A.Cotton.
8. Statistical Thermodynamics – M.C.Gupta.
9. Classical & Statistical thermodynamics – Ashley.

Co Number	Co Statement	Knowledge Level
CO1	To Understand concepts of group theory.	K2
CO2	To apply group theory to molecules.	K3
CO3	To Explain rotation vibration spectra of diatomic and polyatomic molecules.	K4
CO4	To interpret the significance of NMR Spectroscopy, Zeeman effect.	K3
CO5	To recollect thermodynamics probability and entropy.	K1

Mapping With Programme Outcomes

PSO / CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	High	Strong	Medium	Strong	High
CO2	Strong	High	Strong	Medium	Strong
CO3	Strong	Medium	Strong	High	Strong
CO4	Medium	Strong	High	Strong	Medium
CO5	High	Medium	Strong	Medium	Strong

SEMESTER - III

PHYSICAL CHEMISTRY PRACTICALS

Sub Code: **Hours : 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

(Any twenty experiments out of the following experiments (to be decided by the course teacher):

1. Kinetics - Acid Hydrolysis of Ester - Comparison of strength of acids.
2. Kinetics - Acid Hydrolysis of Ester - Determination of Energy of Activation (En).
3. Kinetics - Saponification of Ester - Determination of E, by conductometry.
4. Kinetics Persulphate - Iodide Reaction - Determination of order, effect of lonic strength on rate constant.
5. Polymerization - Rate of polymerization of acrylamide.
6. Distribution Law - Study of iodine - Iodide equilibrium.
7. Distribution Law - Study of Association of Benzoic Acid in Benzene.
8. Study of phase diagram of two components forming simple eutectic.
9. Study of phase diagram of two components forming a compound.
10. Determination of molecular weight of substances by TT measurements.
11. Determination of Critical Solution Temperature of phenol water system and effect of impurity on SCT.
12. Adsorption-oxalic Acid Acetic Acid on charcoal using Freundlich isotherm.
13. Conductometry - Acid-alkali titrations.
14. Conductometry- precipitation titrations.
15. Conductometry - Displacement titrations.
16. Conductometry - Determination of dissociation constant of weak acids.
17. Conductometry - Solubility product of sparingly soluble silver salts.
18. Verification of Onsager equation - conductivity method.
19. Determination of degree of hydrolysis and hydrolysis constant of a substance.
20. Potentiometric titrations - Acid alkali titrations.
21. Potentiometric titrations - Precipitation titration.
22. Potentiometric titrations- Redox Titrations.
23. Potentiometry - Determination of dissociation constant of week acids.
24. Potentiometry- Determination of solubility product and pKa

SEMESTER – III

Major Elective – III

Option - I

Environmental Chemistry and Green Chemistry

Sub Code: **Hours: 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To acquire knowledge about various types of pollutions and pollutants.
2. To study sources of Air pollution and acid rain.
3. To gain knowledge about treatment of drinking water**.**

Unit 1-Water Pollution

Types of water pollution.- Physical, chemical and biological types, ground water and surface water pollution - sources and harmful effects sources and effects of major water pollutants - inorganic pollutants - oxygen demanding wastes organic pollutants - plant nutrients - detergents - radioactive wastes - nuclear pollution - sources effects of ionizing and non - ionizing radiation. Significance of various water pollutants - thermal pollution.

Unit II-Air Pollution

Atmosphere - structure - functions and photochemical reactions - sources of air pollution natural and man made - acid rain, classification and effects of air pollutants - CO, CO_2, SO_2, SO_3, NO and NO_2 - hydrocarbon as pollutant - reactions of hydrocarbons and effects - particulate pollutants - sources and effects of Organic particulate and Inorganic particulate Green House effect - impact on global climate role of CFC's - ozone holes - effects of ozone depletion-smog-components of photochemical smog-effects of photochemcial smog.

Unit III - Pesticides and Soil Pollution

Soil Pollution: Sources, Types, Pesticides classification, mode of action - toxic effects of chlorinated hydro carbons, organophosphorous compounds and carbamates - alternatives to chemical pesticides - (pheromones, Juvenile harmones, chemosterilization)

Unit IV - Treatment of drinking water

Removal of suspended impurities, removal of micro-organisms, Treatment of Efflunets, 1° treatment,- Filteration, Coagulation, - 2° treatment - oxidation ponds - 3° treatment - reverse osmosis, electrodialysis - Nanofilteration. Treatment of water for Industrial purpose- Hardness-softening methods-Zeolite-Limo-soda-Ion Exchange methods.

Unit V Green Chemistry

Green Chemistry - Definition, principles and requirements, water mediated reactions - solventless reactions - microwave assisted reactions - solid supported reactions - uses of ionic liquids and supercritical carbondioxide reaction in organized media - uses of calixarene, zeolites, cyclodextrin and other supra molecules as media for selection reactions - clay catalysed reactions - definitions and examples of multi components reaction and tandem reactions - atom economy reactions.

References Books:

1. V.K.Ahluwalia, M.Kidwai, New Trends in Green Chemistry.
2. Rashmi Sanghi, M.M.Srivastava, Green Chemistry: Environment Friendly Alternatives.
3. Dr.N.Arumugam, Prof.V.Kumaresan. Environmental Studies.
4. A.K.De, Environmental Chemistry.
5. Asim K.Das, Environmental Chemistry with Green Chemistry.
6. B.K.Sharma, Environmental Chemistry.
7. S.Parsons, B.Jefferson, Introduction to potable water treatment Processes.

Co Number	Co Statement	Knowledge Level
CO1	To remember harmful effects of water pollutants.	K1
CO2	To Understand acid rain, Green house effect and ozone depletion.	K2
CO3	To gain knowledge about pesticides.	K2
CO4	To apply various methods in the treatment of drinking water.	K3
CO5	To Explain different types of reactions in Green Chemistry.	K4

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

SEMESTER – III

Major Elective – III

Option – II

Supra Molecular Chemistry and Chemo informatics

Sub Code: **Hours: 5** **Credit: 4** **Max Marks: 75 (Ext); 25(Int)**

Objectives:

1. To Learn about Supramolecular Chemistry.
2. To Understand Chemoinformatics.
3. To Study about drug design.

Unit – I

Supramolecular Chemistry – I

Introduction to supramolecular chemistry – definitions- concepts – molecular forces- covalent bonding , ion – ion - dipole, dipole – dipole, hydrogen bonding, cation – π, π - π interactions, van der Waals forces, hydrophobic and solvent effects – common motifs in Supramolecular chemistry - Host /Guest Chemistry, cation, anion and neutral molecule binding. Molecular receptors and design principles.

Unit – II

Principles of Molecular association and organization – SAMs, micelles, vesicles and cell membrance – channels and transport processes- Supramolecular reactivity and catalysis- Molecular devices and Nanotechnology.

Unit - III

Introduction to Chemoinformatics

Chemical drawing - three dimensional effect - optical activity - computer packages modeling, molecular structure database - file format - three dimensional display – proteins.

Unit – IV

Applications of Molecular Modeling

Prediction of Properties of Compounds, Linear Free energy relations, Quantitative Structure – Property Relations, Descriptor Analysis, Model Building, Modeling Toxicity, Structure – Spectra correlations, Prediction of NMR, IR and Mass spectra, Computer Assisted Structure elucidations, Computer Assisted Synthesis Design.

Unit – V

Drug Design

Introduction, target identification and validation - lead finding and optimization - analysis of HTS data - virtual screening. Design of combinational libraries, Ligand – Based and structure based Drug design. Application of Chemoinformatics in Drug Design.

References Books:

1. J.W. Steed, J.L. Atwood, "Supramolecular Chemistry", Wiley, 2000.
2. James E. Hubeey, F.A Cotton and G.Wilkenson advances Inorganic chemistry organometallic chemistry R.C.Mehrotra and A.Singh.
3. Principles of Inorganic Chemistry B.R.Puri, L.R.Sharma and K.C.Kalia.
4. Selected Topics in Inorganic Chemistry Wahid U.Malik, G.D.Tuli and R.D.Madan.
5. G.L.Patrick, an Introduction to Chemoinformatics.
6. Andrew Leach, Molecular Modelling , principles and Applications.
7. A.R.Leach, V.J.Gillet, An Introduction to chemoinformatics.
8. Supramolecular Chemistry, Concepts and Perspectives – Jean – Marie Lehn.
9. Practical guide to supramolecular chemistry – Peter Cragg.

Co Number	Co Statement	Knowledge Level
CO1	To Recollect different types of notations in Chemoinformatics.	K1
CO2	To Understand computer packages modeling, molecular structure database.	K2
CO3	To Apply chemoinformatics in drug design.	K3
CO4	To Explain Chemical structure search.	K4
CO5	To Interpret Computer assisted structure elucidations and computer assisted synthesis design.	K3

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Medium	Strong	High
CO2	Strong	Strong	Strong	Strong	Strong
CO3	High	Strong	High	Strong	Strong
CO4	Strong	High	High	Strong	Strong
CO5	Strong	Strong	Strong	High	High

SEMESTER - IV

SEMESTER – IV

Chemistry of Natural Products and Bioinorganic Chemistry

Sub Code: **Hours: 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To learn about the structure and properties of aminoacids proteins.
2. To know about Terperoids and alkaloids.
3. To get knowledge about the role of metal ions – biological systems.

Unit I:

Proteins, peptides, Nucleic acid, Fats and Lipids

Structure and properties of amino acids and proteins, Zwitterions and purification of proteins Nucleic acids - nucleotides and nucleosides - structure of purine and pyrimidine bases; Phosphordiester bond, double helical structure of DNA. Structure of RNA (tRNA)

Fatty acids structure and classification, lipids classification and function (Simple, compound and derived lipids)

Unit II:

Terpenoids

Classification of terpenoids with examples - isoprene rules - General methods of structural determination of terpenes - structure and synthesis of alpha-pinene, cadinene, zingeberene and abietic acid

Unit III:

Alkaloids

General methods of structure analysis of alkaloids - Hoffmann, Emde and von Braun degradations Structure and synthesis of quinine, papavarine, atropine, narcotine, reserpine and lysergic acid.

Unit IV:

Steroids

Types of steroids - structure, stereochemistry and synthesis of cholesterol - Structural features of bile acids - Sex harmones - androsterone, testerosterone, estrone, estriol, estradiol, progesterone - Structure of ergosterol.

Circular birefringence, optical rotary dispersion, circular dichroism - Cotton effect curves - octant rule axial haloketone rule - Applications of chiroptical properties in configurational assignments.

Unit V:

Bioinorganic Chemistry

Metal ions in biological systems: heme proteins, hemoglobin, myoglobin, hemerythrin, hemocyanin, ferritin, transferrin, cytochromes and vitamin B12; Iron-sulphur proteins: rubredoxin, ferredoxin and model systems. Classification of copper proteins and examples - Electron transfer (Cu, Zn) - Blue copper proteins.

Metalloenzymes: active sites, carboxy peptidase, carbonic anhydrase, superoxide dimutase, xanthine oxidase, peroxidase and catalase; photosynthesis, water oxidation, nitrogen fixation, nitrogenase; ion pump, metallodrugs.

References Books:

1. I.L.Finar, Organic Chemistry, Vol. II, ELBS 1985.
2. S.J.Lippard J.M.Berg, Principles of Bioinorganic Chemistry, Panima publishing company, 1977.
3. Gurdeep R.Chatwal, Organic Chemistry of Natural Products, Volume I.Himalaya Publishing House, 2009.
4. Organic Chemistry – M.K.Jain and S.C.Sharma
5. Principles of Bioinorganic Chemistry – CTI Reviews.
6. Bioinorganic Chemistry – Asim K.Das.
7. Organic Chemistry Natural Products, Vol I – O.P.Agarwal.
8. Organic Chemistry Natural Products, Vol II- O.P.Agarwal.
9. Chemistry of Natural Products – V.K.Ahluwalia.
10. Chemistry of Natural Products – P.S.Kalsi.
11. Natural Products Chemistry Vol - I & II – K.Nakanishi.

Co Number	Co Statement	Knowledge Level
CO1	To Understand and the properties of amino acids, proteins and the structure of DNA.	K2
CO2	To apply isoprene rule in terperoids.	K3
CO3	To remember the general methods of structural analysis of alkaloids.	K1
CO4	To analyse the stereochemistry of cholesterol.	K4
CO5	To Explain the role of metal ions in Biological systems.	K4

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Strong	Strong	High	Strong	Strong
CO4	Strong	High	High	Medium	Strong
CO5	Strong	Strong	Strong	High	High

SEMESTER - IV

NANO CHEMISTRY

Sub Code: **Hours: 5** **Credit: 5** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To study different types of nanomaterials.
2. To understand the preparation of nanomaterials.
3. To know about carbon nanotubes.

UNIT-I: NANOCHEMISTRY - I

Introduction - meaning of 'nano'- history of nano materials - Moore's law - nano science the multidisciplinary science. Nano materials: Top-down-and bottom-up approach-examples of the bottom-up approach-different types of nano materials: one dimensional materials-carbon nano tubes-types of carbon nano tubes SWNT & MWNT-two dimensional nano materials.

Properties of nano materials: Different types of nano materials & their sizes –M.pt-quantum effects-size dependent properties of cdse carbon nano tubes & grapheme.

UNIT-II:

NANO CHEMISTRY - II

Preparations of nano materials: Different methods of preparing nano materials - hydro thermal and salvo thermal methods - salvothermal reaction- inorganic nano tubes - assembling nano materials- preparation of metals nano particles, grapheme, gold nano particles, ZnO nano wires, carbon nano tubes and copper sulphide nano films. Analysis of nano particles: Study of nano materials under TEM, SEM, STM & AFM-working of TEM, STM & AFM.

UNIT-III: NANO CHEMISTRY - III

Definition of nanotechnology - nano biotechnology - definition and explanation Applications: applications of nano technology in nano cosmetics, textile, nano sensors, cancer therapy, silver nano particles and water Purification, nano computers, MRI with magnetic nano particles and nano materials for energy.

UNIT – IV Carbon – based Nanomaterials

Carbon - Bonding in carbon compounds, Discovery of Cubane, Fullerenes: Synthesis, Chemical reactions and properties, Carbon Nanotubes: Structure of Single – Walled Carbon Nanotubes, Physical properties of single – Walled Carbon nanotubes. Synthesis of Carbon nanotubes, growth mechanisms, Chemical modification of Carbon nanotubes – Diamondoidnanomaterials: diamondoids, thin diamond films (and other ultrahard substances) – Chemical modification of CVD Diamond.

UNIT – V: Growth techniques and Charatertization tools of nanomaterials

Introduction – top – down vs bottom – up technique – Lithographic process and its limitations – Nonlithographic techniques : Sputtering, Chemical Vapour Deposition, Pulsed Laser Deposition, SOL – Gel technique – nucleation and growth processes, electrodeposition , Scanning Probe Microscopy – General Concept and defining Characteristics of AFM – Electron Microscopy – Transmission Electron Microscopy.

References Books:

1. Essentials of Nano Chemistry – Pradeep.
2. Nano World – "An Introduction to nano science & Technology" – CNR RAO.
3. B.S.Murthy, P.Shankar, B.Raj, B.B.Rath, and J.Murday – Text Book of Nano Science and Nanotechnology.
4. Nanotechnology – Mark Ratner, Daniel Ratner.
5. Nanotechnology – S.Shanmugam.
6. Nanomaterials – B.Viswanathan.

Co Number	Co Statement	Knowledge Level
CO1	To Understand the different types of nanomaterials.	K2
CO2	To recollect the different methods of preparing nanomaterials.	K1
CO3	To apply nanotechnology in various fields.	K3
CO4	To interpret carbon nanotubes.	K3
CO5	To Illustrate lithographic and non lithographic techniques.	K4

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Medium	High	Strong
CO2	High	Strong	Strong	Medium	Strong
CO3	Medium	Strong	High	Strong	Strong
CO4	Strong	High	High	Strong	Medium
CO5	Strong	Medium	Strong	High	Strong

SEMESTER – IV

Major Elective – IV

Option - 1

Industrial Chemistry

Sub Code: **Hours : 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To study about manufacture of glass and refractories.
2. To learn about paints and varnishes.
3. To gain knowledge about soaps and detergents.

Unit – I : Glass and Ceramics : Glass – General properties of glass – types of glasses – manufacture of glass – Ceramics – classification – clay products – white wares – chemical store wares - plasticity of clay – manufacture of white pottery, glazing, Earthen wares.

Refractories: Definition –classification, properties of refractories – manufacture of refractories, fire clay bricks manufacture, uses of fire clay refractories - High alumina refractories – uses – silicon carbide refractories - properties and use.

Unit – II: Paints and varnishes: Paint – definition – classification of paints based on their applications – constituents – Requisites of a good paint – emulsion paints Varnishes – Definition – constituents of varnish – characteristics of a good varnish – uses – japans varnish. Enamel - definition – Types, Ingredients and uses.

Pigments: Definition – composition, characteristics and uses of white lead, zinc oxide, Lithopone and TiO_2

Unit – III: Soap and Detergents: Soap – Definition – General consideration in soap making – manufacture of soap – Hot and Cold process – transparent soaps - properties. Detergents – Definition – classification of face active agents cleaning action of soap deference between soap & detergents. Silicones: Preparation & uses.

Unit – IV: Portland Cement: Introduction – types of cements composition manufacture & Setting of cement.

Corrosion: Dry and Wet corrosion – Electrochemical theory of Corrosion- Mechanism – Galvanic corrosion, Concentration cell corrosion Waterline Attack – Pitting – passivity- stress corrosion – Corrosion control methods.

Unit – V: Fundamentals of Batteries – Classification of Batteries – types of Batteries - Primary Batteries Le' clanche Dry Cell – Magnesium Dry Cell - Secondary Batteries – Lead Acid Battery – Alkaline Storage -Batteries. Fuel cells (hydrogen- oxygen).

TEXT BOOK:

1. Applied Chemistry and chemical engineering, by A.K.Haghi, Devrim Balkose, Omari V. Mukbaniani, Apple Academic Press, published on 20.03.2018.

REFERENCE BOOKS:

1. P.C.Jain & Monika Jain Engineering Chemistry.
2. P.C.Jain & Manika Jain – "Engineering Chemistry" 15th Ed., (2005), Dhanpath Raj publishing company, New Delhi.
3. B.K.Sharma - "Industrial Chemistry", 1st Ed., (1984), Goel Publishing House – Meerut.
4. Applied Chemistry by Krishnamoorthy, P.Vallinayagan K. Jeyasuremanian, Asimk Das Environmental Chemistry with green Chemistry.
5. B.K.Sharma Environmental Chemistry.
6. J.Ghosh, Fundamental concepts of Applied Chemistry.

Co Number	Co Statement	Knowledge Level
CO1	To Explain the manufacture of glass and refractories.	K4
CO2	To apply paints and varnishes.	K3
CO3	To Interpret the cleaning action of soap.	K4
CO4	To recollect the manufacture and setting of cement.	K1
CO5	To Understand the types of batteries.	K2

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Strong	High	High
CO2	High	Medium	Strong	Medium	Strong
CO3	Strong	Strong	Medium	Strong	Strong
CO4	Strong	High	High	High	Medium
CO5	High	Strong	Strong	Medium	High

SEMESTER – IV

Major Elective – IV

Option – II

Dairy and Leather Chemistry

Sub Code: **Hours : 5** **Credit: 4** **Max Marks: 75 (Ext); 25 (Int)**

Objectives:

1. To Describe composition of milk, milk processing and milk products.
2. To Learn about leather processing and tanning process.
3. To Understand ceramic Industries.

Unit I: **Milk**

General composition of milk - factors affecting the gross composition of milk , physico – chemical change taking place in milk due to processing parameters - boiling pasteurization – sterlilzation and homogenization .

Unit II **Milk lipids** – terminology and definitions .

Milk proteins : Physical properties of milk proteins with formaldehyde and ninhydrin .

Milk carbohydrate – Lactose . Estimation of lactose in milk .

Milk vitamins – water soluble vitamins .

Butter : Definition - % composition – manufacture . Estimation of fat acidity , salt and moisture content Desi butter .

Unit III **a. Creams:** Definition – composition – chemistry of creaming process .

b. Ice Cream: Definition percentage composition – types – ingredients needed manufacture of ice – cream stabilizers – emulsifiers and their role .

c. Milk Powder : Definition need for making power – drying process spraying , drum drying , jet drying and foam drying – principle involed in each.

UNIT IV History of tanning industry in India - Conventional tanning process animal skin.

Manufacture of leather , preparation of hides for tanning, use of various inorganic and organic chemicals for tanning process

Various processes of tanning - soaking liming , deliming , deharing and bating

Unit V Vegetables tanning , type of tanning for soles ,belting and heavy leather.

Vegetable tanning – synthetic tanning , chrome tanning , finishing of leather.

Environmental Pollution

Pollution problems caused by tanneries and its control treatment of tannery effluents by primary secondary and tertiary processes , Uses of reverse Osmosis system for the treatment of polluted water .

References Books:

1. Outlines of Dairy Technology Sukumar De.
2. Principles of Dairy Chemistry – Rober Jenness & S.Patorn.
3. Indian Dairy Products K.S.Rangappa and K.T.Achaya.
4. Industrial Chemistry including chemical engineering – B.K.Sharma – Goel Publishing House 13th Revised and Enlarged Edition.
5. Leather Technician's Hand Book – J.H.Sharphous leather producers association North ampton- 1971.

Co Number	Co Statement	Knowledge Level
CO1	To Illustrate composition and Physical properties of milk.	K4
CO2	To Understand structure of hides and leather processing.	K2
CO3	To remember ceramic wares.	K1
CO4	To Describe classifications, Properties and functions of lubricants.	K4
CO5	To Illustrate Explosives and rocket Propellants.	K3

Mapping with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	Strong	Strong	Medium	High	Strong
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CO3	Medium	Strong	High	Strong	Strong
CO4	Strong	High	High	Strong	Medium
CO5	Strong	Medium	Strong	High	Strong

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN, PALANI

PG DEPARTMENT OF CHEMISTRY

OUTCOME BASED EDUCATION

ACADEMIC STRUCTURE IN AUTONOMY

CHOICE BASED CREDIT SYSTEM (CBCS)

Effect from the Academic year 2022-23 onwards

INTERNAL QUESTION PATTERN

Section	Pattern	Marks	Total
A	1& 2 Either or Pattern	2X5	10
B	3& 4 Either or Pattern	2X10	20
		Total	30

COMPONENTS OF INTERNAL ASSESSMENT

Components	Calculation		Marks
Test I	30/2	(15+15)/2	15
Test II	30/2		
Assignment			5
Seminar			5
TOTAL INTERNAL MARKS			**25**

External Question Pattern

Section	Pattern	Marks	Total
A	1- 5 Either or Pattern	5X5	25
B	6 - 10 Either or Pattern	5X10	50
		Total	75

EQUAL WEIGHTAGE TO BE GIVEN TO ALL THE FIVE UNITS