Semester	Subject Title	Subject Code	Category	Total hrs	Credits
I	**Inorganic Chemistry-I**		**Core I**	**90**	**5**

Units	Learning Objectives
I	To acquire the knowledge of HSAB, non-aqueous solvents, isopolyanions and phosphazenes.
II	To understand the importance of radius-ratio rule and crystal defects.
III	To study about theory, measurement and applications of radioactivity.
IV	To acquire the details of symmetry elements and measurement of diffraction angle by various methods and its applications.
V	To study about metallurgy, metal clusters and toxic metals.

Unit I :(18 Hrs)	
1.1	Hard and Soft acids and bases – classification – HSAB principle – Applications - theoretical basis of hardness and softness - electronegativity and hardness and softness – relative strength of acids and bases.
1.2	Non-aqueous solvents-liquid ammonia, acetic acid, bromine trifluoride, dinitrogen tetroxide and liquid hydrogen fluoride.
1.3	Isopolyanions - basic building units of vanadate, molybdate and tungstate ions - apex sharing (structure only) – heteropoly anions (structure only).
1.4	Phosphazenes –structure –Craig and Paddock model –Dewar model.
Unit II : Ionic Bond and Crystal Structure :(18 Hrs)	
2.1	Radius-Ratio rule - calculation of some limiting radius ratio values for C.N.3 (planar triangle), C.N.4 (tetrahedral) and C.N.6 (octahedral).
2.2	Classification of Ionic structures – AX_1, AX_2, AX_3 types, AX type (ZnS, NaCl, $CaCl_2$) structures only - AX_2 type – fluorite, rutile , bêta - cristobalite (structures only) - layer structure - CdI_2, Nickel arsenide structure – Lattice energy - Derivation of Born-Lande equation – Factors affecting the magnitude of lattice energy – stoichiometric and non-stoichiometric defects - semiconductors and transistors –rectifiers - photovoltaic cell.
Unit III: Nuclear Chemistry : (18 Hrs)	
3.1	Radioactive decay-theories of decay processes –laws of radioactivity-detection and measurements of radiations – nuclear structure – composition of nuclei –properties of nuclei-nuclear radii-nuclear forces –its characteristics – meson field theory –nuclear stability –nuclear models –liquid drop, shell and collective models.
3.2	Artificial radioactivity – nuclear reactions – transmutation, stripping and pick up, fission, fusion, spallation and fragmentation reactions – scattering reactions – nuclear cross section.
3.3	Nuclear reactors – charged particle accelerators, neutron, sources –gamma ray and X-ray sources - applications of nuclear science in agriculture and biology - neutron activation and isotopic dilution analysis.
Unit IV : Solid State : (18 Hrs)	
4.1.	Difference between point group and space group – screw axis - glide planes. Crystal symmetry elements –crystal classes - crystal systems - unit cell - Bravais lattices - asymmetric unit space group – equivalent positions, relationship between molecular symmetry and crystallographic symmetry - reciprocal lattice and its applications.
4.2.	X-ray diffraction by single crystal – structure factor - systematic absence - determination of space group-heavy atom method.
4.3.	Neutron diffraction – elementary treatment – comparison with X-ray diffraction –electron diffraction – basic principles.

Unit V: Extraction and Uses of Metals : (18 Hrs)	
5.1	Metallurgy of Zr, Ge, Be and Th - preparation and uses of their important compounds - metal clusters - dinuclear clusters – structure of $Re_2Cl_8^{2-}$ -- qualitative M.O diagrams for dinuclear rhenium and molybdenum complexes to explain the strength of quadrupole bond.
5.2	Bioinorganic chemistry of toxic metals - lead, cadmium, mercury, aluminium, chromium, iron, copper and plutonium - detoxification by metal chelation.

References

1. James E.Huheey, Ellen A Keiter and Richard L Keiter, Inorganic chemistry, Principles of structure and reactivity, 4th Ed., Addition-Wesley, New York (Unit 1 & V).
2. J.D.Lee, A New concise Inorganic Chemistry, 4th Edition, ELBS (1995). (Unit-II).
3. G.Friedlander,J.W.Kennedy and J.M.Miller, Nuclear and Radiochemistry (Unit-III).
4. Keith F.Purchell and John C.Kotz, Inorganic chemistry Saunders Golden Sunburst Series, W.B Saunders Company, Philadelphia (unit-IV).
5. Cotton and Wilkinson, Advanced Inorganic chemistry, 5th Ed, John Wiley & Sons, New York (Unit-V).
6. Satyaprakash, Advanced Inorganic Chemistry.
7. W.U.Malik, G.D. Tuli and R.D, Madan, Selected topics in Inorganic Chemistry, 2nd edition, S. Chand & Co., New Delhi (1979).

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
I	**Organic Chemistry-I**		**Core II**	**90**	**5**

Units	Learning Objectives
I	To understand the naming of aliphatic, aromatic, heteroaromatic and alicyclic systems. To know the generation, stability, structure and reactivity of free radicals, carbenes, nitrenes, carbanions, carbocations and arynes.
II	To describe the methods of determining reaction mechanism. To understand correlation analysis.
III	To know concepts of chirality and Configurational nomenclature. To understand and define the important terms in stereochemistry.
IV	To describe the nomenclature and configuration of geometrical isomers. To analyse the dynamic stereochemistry.
V	To know the structure and conformation of carbohydrates, peptides and proteins. To know chemistry of nucleic acid and synthesis and applications of antibiotics.

Unit I Nomenclature and reaction intermediates	
1.1	Naming of linear and branched alkenes, polyenes and alkynes without and with functional groups by IUPAC nomenclature. Aromatic and hetero aromatic systems – nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen and sulphur. Nomenclature of alicyclic, bicyclic and tricyclic compounds.
1.2	Free radicals, carbenes, nitrenes, carbanions, carbocations and arynes – generation, stability, structure and reactivity.
Unit II	
2.1	Methods of determining reaction mechanism-thermodynamic and kinetic aspects of organic reaction- energy profile diagrams – intermediates versus transition states, isotope effects- kinetic and non-kinetic method of determining reaction mechanism, product analysis and its importance – cross over experiments – isotopic labeling studies-stereo chemical studies – substituent effects.
2.2	Correlation analysis – linear free energy relationships- Hammett equation – significance of sigma and Rho applications – Yukawo–Tsuno equation-Taft equation- Grunwald–Winstein equation and their application.
Unit III Stereochemistry-I	
3.1	Optical Isomerism: Concepts of chirality- Newman, Sawhorse and Fisher notations – representations and interconversions of compounds with two asymmetric centres.
3.2	Configurational nomenclature – D and L notations – R-S notations of acyclic and cyclic chiral compounds.
3.3	Asymmetric synthesis – Creation of chiral centre- Cram's rule and Prelog's rule.
3.4	Concepts of prochirality, enantiotopic and diastereotopic groups. Atropisomerism- Stereochemistry of allenes, spiranes and biphenyls. Catropisomerism–Stereochemistry of ansa compounds, cyclophanes and transcycloalkanes.
Unit IV Stereochemistry-II	
4.1.	Geometrical isomerism-E/Z and syn/anti nomenclature for C=C and C=N bonds. Determination of configuration of the geometrical isomers.
4.2	Cis and trans nomenclature and configuration of mono and disubstituted cyclohexanes. Energy comparison of disubsttuted cyclohexane. Geometrical isomerism in decalins.
4.3	Dynamic stereochemistry-qualitative correlation between conformations and reactivity-Winstein-Eliel equation–Curtain-Hammett principle. conformation, reactivity and mechanism of cyclic systems-saponification of ester, esterification of an alcohol and chromic acid oxidation of cyclohexanols. Neighboring group participation–deamination of 2-aminocyclohexanol– stereo specific and stereo selective reactions.
Unit V Biomolecules	
5.1	Carbohydrates – polysaccharides – structure of starch and cellulose-conformation of mono saccharides-photosynthesis.
5.2	Peptides and proteins-synthesis of peptides – primary, secondary, tertiary and quaternary structure of proteins-protection of N – terminal and C – terminal groups of proteins-Biosynthesis of proteins.
5.3	Nucleic acids – chemistry of nucleic acids – structure of DNA – properties, biological implications of DNA-replication of DNA. Structure of RNA – types of RNA and their functions.
5.4	Antibiotics- synthesis and applications of penicillin, streptomycin and cephalosporin.

References	
1.	R. Panico, N.H.Powell – Jea, C.Richer- A Guide of IUPAC Nomenclature of Organic Compounds (1993).
2.	R.S.Cahn and O.C. Dermer – Introduction to Chemical Nomenclature, 5th Edition, Butlarworth (1979).
3.	Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, 4th Edition, John Wiley & Sons (1992).
4.	S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan (1976).
5.	R.K. Bansal – Organic Reaction Mechanism, 3rd Edition, (1998).
6.	I.L.Finar- Organic chemistry, Vol. 1 & 2.
7.	E.L.Eliel, Stereochemistry of Carbon Compounds, Mc Graw Hill (1975).
8.	D.Nasipuri – Stereochemistry of Organic Compounds.
9.	P.S.Kalsi – Stereochemistry –Conformation and Mechanism.
10.	O.P.Agarwal – Chemistry of Organic Natural products, Vol.1 & 2, Goel Publications (1997).
11.	O.P. Agarwal, Reactions and Reagents in Organic Chemistry, Goel Publishing House, Meerut, 5th Edition (2005)
12.	Clayden Greeves Warren, Organic Chemistry, OUP

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
I	**Thermodynamics and Electrochemistry**		**Core III**	**90**	**4**

Units	Learning Objectives
I	To acquire the knowledge of the distribution of molecular states, internal energy, entropy and the canonical partition function.
II	To appreciate the applications of Bose-Einstein and Fermi-Dirac Statistics.
III	To study the need of third law of thermodynamics, non-equilibrium thermodynamics and phase rule.
IV	To learn the details about the transport of ions in solution and power production
V	To learn the dynamic electrochemistry and control of corrosion.

Unit I Statistical Mechanics (18 Hrs)	
1.1	Basic concepts and classical statistics - statistical mechanics – calculation of thermodynamic probability of a system – ensembles – phase space – ergodic hypothesis – definition of micro and macro states – different methods of counting macro states – distinguishable and indistinguishable particles – classical statistics – derivation of Maxwell–Boltzmann distribution law.
1.2	Bose–Einstein and Fermi–Dirac Statistics comparison of them with Boltzmann statistics - application of B.E. - statistics of photon gas and super fluidity of liquid helium - application of F.D. statistics to electron gas and thermionic emission.
Unit II Quantum Statistics (18 Hrs)	
2.1	Translational, rotational, vibrational, electronic partition functions – calculation of enthalpy, internal energy, entropy and other thermodynamic functions in terms of partition functions – to mono atomic gases and diatomic molecules.
2.2	Heat capacity of solids – Einstein and Debye's treatment – concept of negative Kelvin temperature.
Unit III Thermodynamics and Phase Rule (18 Hrs)	
3.1	Third law of thermodynamics - need for the third law – Nernst heat theorem and other forms of stating the third law - thermodynamic quantities at absolute zero – statistical meaning of third law – apparent exception of the third law.
3.2	Non-equilibrium thermodynamics - thermodynamics of irreversible processes - Onsager's reciprocal relations – Steady state conditions.
3.3	Phase rule - three component system – systems of three liquids – solid-liquid systems - two salts and water - construction of phase diagram by wet – residue method.
Unit IV Electrochemistry – transference and Storage System (18 Hrs)	
4.1	Transport of ions in solution – Debye-Huckel-Onsager theory – Debye-Falkenhagen and Wien's effect – extension to Debye-Huckel-Onsager theory.
4.2	Activity of ions in solutions – experimental determination – Debye–Huckel limiting law - activity coefficient at higher concentration – Bjerrum model.
4.3	Electrochemical energy – storage systems – primary and secondary batteries – fuel cells – H_2–O_2 and C_3H_8–O_2 fuel cells.
Unit V Electro kinetic Phenomena (18 Hrs)	
5.1.	Electrical double layer potential – theory of multiple layers at electrode – electrolyte interface – double layer capacity – electro kinetic phenomena – zeta potential – electroosmosis - electrophorosis and sedimentation potential.
5.2	Processes at electrodes – rate of charge transfer – current density – Bulter-Volmer equation – Tafel equation.
5.3	Principles of electrodeposition of metals - electrochemical corrosion of metals – construction and use of Pourbaix and Evans diagrams - prevention of corrosion – electrochemical oxidation and reduction.

References

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3. H.W. Zemansky, Heat on thermodynamics, McGraw Hill, 1975.
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10. Samuel Glasstone, An Introduction to Electrochemistry, Read Books, 2007.

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
I	**Inorganic Chemistry Practical - I**		**Core – P IV**	**90**	**4**

Learning objectives

- To know the principles applied in the qualitative analysis.
- To understand various techniques of mixture analysis.
- To know the principles involved in the colorimetric estimation.
- To know the techniques to carry out some colorimetric estimation.

QUALITATIVE ANALYSIS AND COLORIMETRIC ESTIMATION

1. Semi-micro Qualitative Analysis

   Analysis of two common and two rare earth cations in a given inorganic mixture.

   Common : Pb, Cu, Bi, Cd, Zn, Co, Ni, Ca, Ba, Sr.

   Rare : W, Se, Te, Mo, Ce, Zr, Th, V, Li.

2. Colorimetric Estimation

   Cu, Fe, Mn, Ni, Cr.

References

1. V.V.Ramanujan – Semi micro Qualitative Analysis.
2. A.I.Vogel - A Text Book of Qualitative Analysis including semi-micro methods.
3. Applied Chemistry (Theory & Practice), O.P.Vermani & A.K.Narula, Wiley Eastern, 1989.
4. Vogel's text book of macro and Semimicro Qualitative Inorganic Analysis Ed G.Svehla Orient Longman 1982.

Scheme of Valuation	
Practicals	60 marks
Viva-Voce	10 marks
Record	05 marks
Total	75 marks

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
I	**Organic Chemistry Practical-I**		**Core - P V**	**90**	**4**

Learning objectives

- To know the basic principles of organic preparations.
- To learn the skills of recrystallization, drying, etc.
- To know the basic principles involved to separate different types of mixtures and analyse the components present.
- To learn the skills of preparing some compounds.

ORGANIC MIXTURE ANALYSIS AND SINGLE STAGE PREPARATION

1. Separate the following types of mixture and analyse the components present:
    a. Ether Soluble and insoluble
    b. Acidic and Neutral
    c. Phenolic and Neutral
    d. Basic and Neutral
    e. Phenolic and Basic

2. Single Stage Preparation:
    a. Glucose penta-acetate from Glucose
    b. Resacetophenone from resorcinol
    c. Benzophenone oxime from Benzophenone
    d. p-Benzoquinone from hydroquinone
    e. methyl-m-nitrobenzoate from methyl benzoate
    f. phenyl azo 2-naphthol from aniline

References

1. Elementary Practical Organic chemistry Part II, Qualitative Organic analysis by A.I Vogel 2nd Ed, CBS publications, 1987.
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Scheme of Valuation	
Practicals	60 marks
Viva-Voce	10 marks
Record	05 marks
Total	75 marks

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
II	**Physical Chemistry-I**		**Core VII**	**90**	**5**

Units	Learning Objectives
I	To learn the need of introducing quantum mechanics and the postulates of quantum mechanics.
II	To apply the wave mechanics to particle in a box, rigid rotor, hydrogen atom and many electron atoms.
III	To study the different reaction rate theories.
IV	To know the details of different catalyzed reactions.
V	To acquire the knowledge about photochemical reactions and applications of radiation chemistry.

Unit I Quantum Chemistry-1 (18 Hrs)	
1.1	Classical mechanics – inadequacy of classical mechanics - wave particle dualism –uncertainty principles – postulates of quantum mechanics-operator algebra – operator linear and Hermitian- Eigen functions and Eigen values, angular momentum operator – commutation relations.
1.2	Applications of wave mechanics to simple systems – particle in a box – one and three-dimensional, quantum numbers, zero point energy – orthogonality and normalization.
1.3	Rigid rotator – harmonic oscillator – rotational and vibrational quantum numbers - Bohr's correspondence principle.
Unit II Quantum chemistry-2 (18 Hrs)	
2.1	Application of Schrodinger wave equation to hydrogen and helium atoms - Pauli's principles and Slater determinants - Born-oppenheimer approximation - variation method - application to hydrogen and helium atoms - perturbation method for non degenerate systems - application of perturbation theory to helium atom - Hartee- Fock self-consistent field method – L-S and J-J coupling.
Unit III Chemical Kinetics (18 Hrs)	
3.1	Theories of reaction rates – simple collision theory – absolute reaction rate theory (ARRT) to simple unimolecular and bimolecular processes - potential energy surfaces – kinetic isotopic effect - theory of unimolecular reactions - Lindmann's theory – Hinshelwood theory – treatment of ARRT - Slater's treatment.
3.2	Principles of microscopic reversibility - steady state approximation - chain reaction – thermal and photo chemical reactions between hydrogen and halogens - gas phase auto oxidation, explosions – hydrogen - oxygen reaction.
3.3	Opposing, consecutive and parallel reactions (definitions and examples).
Unit IV Solution Kinetics (18 Hrs)	
4.1.	Factors influencing reaction rates in solution - application of ARRT to solution kinetics – effect of solvents, double sphere and single sphere model and effect of ionic strength – influence of pressure on rates in solution – significance of volume of activation – substituent effect – LFER – Hammett and Taft equations.
4.2	Homogeneous catalysis - Acid – base catalysis – Hammett – Deyrup acidity function – Bronsted relation – enzyme catalysis – mechanism of single substrate reactions – Michaelis–Menten law – influence of pH and temperature.
4.3	Fast reactions - study of kinetics by stopped flow techniques, relaxation methods T and P jump methods flash photolysis.
Unit V Photochemistry and Radiation Chemistry (18 Hrs)	
5.1	Photochemical Laws – Jablonski Diagram - photo physical processes in electronically excited molecules – Stern–Volmer equation and its applications – experimental techniques in photochemistry – Quantum yield - chemical actinometer – lasers and their applications.
5.2	Radiation chemistry - Definition - source of high-energy radiation -interaction of high-energy radiation with matter - radiolysis of water – solvated electron- Differences between radiation chemistry and photochemistry.
5.3	Definitions of G value, Curie, linear energy transfer(LET) and RAD - scavenging techniques - radiation dosimetry - applications of radiation chemistry.

References

1. F.L. Pilar, Elementary Quantum Chemistry, MCGRAW Hill, 1970.
2. A.K. Chandra, Introductory Quantum Chemistry, Third Edition, Tata MCGRAW Hill, 1990.
3. R.K.Prasad, Quantum Chemistry, Third Reprint, New Age International Ltd.,
4. H.Goldstein , Classical Mechanics, Addison- Wesley Publishing Company, 1956.
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12. S.K.Jain, Chemical Kinetics.

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
II	**Inorganic Chemistry-II**		**Core VII**	**90**	**5**

Units	Learning Objectives
I	To acquire more knowledge of bonding and magnetism in coordination chemistry.
II	To study about kinetic and thermodynamic stability and mechanism .
III	To study the types of photochemical reactions, metal carbonyls and nitrosyls.
IV	To acquire knowledge of synthesis, structure, bonding and reactions of alkene, alkyne, allyl complexes and cyclo pentadienyl complexes.
V	To study the importance of chemotherapy with Pt and Li, non heme iron sulphur proteins, and risks and benefits of radio isotopes.

Unit I : Coordination chemistry – I (18 Hrs)	
1.1	Theories - nomenclature of mono and polynuclear complexes - crystal field theory– shapes of d orbitals - splitting of d orbitals in octahedral symmetry - CFSE- strong field and weak field splitting – calculation of CFSE for d^n system- splitting in tetrahedral symmetry – weak field splitting – reasons - tetragonal symmetry - John – teller distortion – splitting pattern in trigonal, square planar, trigonal bipyramidal, square pyramidal - factors affecting the magnitude of crystal field splitting (10Dq) – spectrochemical series - Jorgensen's relation - evidences for CFT.
1.2	Magnetic properties , stability of particular oxidation states , site preferences in spinels.
1.3	M.O. Theory – octahedral, tetrahedral and square planar complexes - evidences for pi bonding – X ray crystallography – IR - photoelectron spectroscopy - nephelauxetic effectl.
Unit II : Coordination chemistry – II (18 Hrs)	
2.1	Stability of coordination compounds - detection of complex formation in solution - stability constants - stepwise and overall formation constants – pH metric polorographic and spectrophotometric methods of determining formation constants - factors affecting stability constants – statistical and chelate effects.
2.2	Kinetics and mechanism of reactions in solutions - labile and inert complexes - ligand displacement reactions - hydrolysis - aquation in octahedral and square planar complexes - trans effect - electron transfer reactions - complementary and non-complementary and racemisation - reactions of coordinated ligands - template effect and synthesis of macro cyclic ligands.
Unit III : Photochemistry of coordination compounds (18 Hrs)	
3.1	Photochemical reactions of coordination compounds and organometallic compounds – photo reduction-photo substitution and photo isomerisation reactions.
3.2	Complexes of pi acceptor ligands - carbonyls – 18 electron rule – application to the structure of carbonyls (Simple and polynuclear) - application of the IR to identify the terminal and bridging carbonyls - preparation and properties of carbonyl complexes - Ni $(CO)_4$, $Fe_2(CO)_9$, $Cr(CO)_6$ and $Re_2(CO)_{10}$, carbonylate anions , carbonyl hydrides, isolobal fragments - nitrosyl complexes - preparation - bridging & terminal nitrosyls and bent & linear nitrosyls - dinitrogen complexes.
Unit IV : Organo Metallics (18 Hrs)	
4.1.	Carbon pi donor complexes - synthesis, structure and bonding in olefins, acetylenes and allyl complexes – metallocenes - molecular orbital of metallocenes - catalysis by organo metallic compounds - hydrogenation and hydroformylation of olefins - oxidation of olefins to aldehydes and ketones
4.2	Polymerization of alkenes - cyclo–oligomerisation of acetylene – Fischer-Tropsch's synthesis.

Unit V : Chemotherapy (18 Hrs)	
5.1	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 in psychopharmacological drugs
5.2	Heme and non-heme proteins - ferredoxins and rubredoxins – model systems, non-heme iron enzymes - biochemical behaviour of inorganic radio nuclides – radiations risks and medical benefits - natural and man-made radio isotopes - bioinorganic chemistry of radio pharmaceuticals - technetium.

References

1. James E Huheey, Ellen A Keiter and Richard L. Keilter, Inorganic Chemistry, 4thEd. Addison – Wesley (unit I, III, IV).
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Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
II	**Physical Methods in Chemistry**		**Core VIII**	**90**	**5**

Units	Learning Objectives
I	To acquire the knowledge of orbital coupling on spectra.
II	To study the significance of Infra red spectroscopy and Raman spectroscopy.
III	To gain the ideas about NMR Spectroscopy and applications to inorganic compounds.
IV	To understand ESR spectroscopy and instrumentation of Mass spectroscopy.
V	To analyse the types of electronic transitions and determining absolute configuration of simple mono cyclic ketones.

Unit I	
1.1	Electronic Spectroscopy- Microstates, terms and energy levels for d1 to d9 ions in cubic fields orbit coupling on spectra – evaluation of 10Dq and b for octahedral complexes of cobalt and nickel – applications to simple co-ordination compounds- charge transfer spectra.
1.2	Mossbauer spectroscopy-Isomer shifts–magnetic interactions –quadru pole effect of magnetic field on the spectra- application to iron and tin compounds.
Unit II	
2.1	Infra red spectroscopy- Types of stretching and bending vibrations. Calculation of moment of inertia and force constant. Characteristics group frequencies– identification of functional groups. Organic structure determination. Vibrational spectra of metal carbonyls with references to the nature of bonding, geometry and number of C-O stretching vibrations. Finger print region. Effect of hydrogen bonding. Effect of isotopic substitution on the vibrational spectra of molecules.
2.2	Raman spectroscopy-Selection rule – vibrations in simple molecules (H_2O, CO_2). Combined uses of IR and Raman spectroscopy in the structural elucidation of N_2O, ClF_3, NO_3^-, ClO_4^-. Uses of group vibrations in the structural elucidation of metal complexes of urea, cyanide, nitrate and sulphate.
Unit III	
3.1	NMR Spectroscopy-chemical shift–factors influencing chemical shift–chemical and magnetic non–equivalence–coupling constant-geminal and vicinal coupling– spin-spin splitting–first order spectra–Karplus equation–dependence of J on dihedral angle–shift reagent– exchangeable protons (OH, SH, COOH, NH)-elementary treatment of NOE –C^{13} NMR spectroscopy – basic theory of FT – NMR, Relaxation – Broadband decoupling –off resonance decoupling – α, β and γ effects.
3.2	Chemical shifts and coupling constants involving different nuclei (H^1, P^{31}, C^{13})- interpretation and applications to inorganic compounds- study of fluxional behaviour of molecules.
Unit IV	
4.1	ESR Spectroscopy-theory of ESR Spectroscopy–applications of ESR to some simple systems –factors affecting the magnitude of g.
4.2	Mass Spectrometry-instrumentation–resolution, EI, CI and FAB methods– Recognition of molecular ion peak, parent peak, base peak, isotopic peak and meta stable peak and their importance. Determination of molecular formula. Mclafferty rearrangement. Fragmentation pattern of alkanes, aromatics, alcohols, carbonyl compounds, amines and nitro compounds.
Unit V	
5.1.	UV- Spectroscopy-types of electronic transitions – solvent effects – Woodward–Fisher and Scott Rules for conjugated dienes, trienes, polyenes, unsaturated carbonyl compounds, conjugated cyclic ketones and acetophenones- stereo chemical factors affecting electronic spectra of biphenyl, trans isomers – angular distortion.
5.2	Optical Rotary Dispersion and Circular Dichroism-ORD & CD–Cotton effect–Octant Rule-α– haloketone rule–applications to determine absolute configuration of simple monocyclic ketones.

References	
1.	C.N. Banwell, Fundamentals of Molecular Spectroscopy, McGraw-Hill, London, 2nd edition, 1972.
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3.	W. Kemp, Organic Spectroscopy, 2nd Ed, Macmillan, 1987.
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5.	E.A.V.Ebsworth, D.W.H.Rankin and S.Cradock, Structural Methods in Inorganic chemistry,2nd Ed.,1991.
6.	Y.R.Sharma, Elementary Organic Spectroscopy, S. Chand Publications, New Delhi.
7.	P.S.Kalsi, Spectroscopy of Organic Compounds , New Age International Publishers.

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
II	**Inorganic Chemistry Practical-II**		**Core - P IX**	**90**	**4**

Learning objectives

- To know the basic principles of gravimetric analysis.
- To know the basic principles of volumetric analysis.
- To learn the skills of doing different gravimetric and volumetric estimations.
- To estimate some elements by Volumetric and Gravimetric methods.
- To learn the skills of preparing inorganic complexes.

VOLUMETRY, GRAVIMETRY AND COMPLEX PREPARATION

1. Estimation of the following elements by volumetric and gravimetric methods.

i) Cu (V) & Ni (G)
ii) Cu (V) & Zn (G)
iii) Cu (V) & Cu (G)
iv) Zn (V) & Cu (G)
v) Fe (V) & Zn (G)

Note : V - Volumetric
G - Gravimetric

2. Preparation :

i) Tetramminecopper (II) sulphate
ii) Potassium trioxalatochromate(III)
iii) Hexathiourealead(II) nitrate
iv) Potassium trioxalatoalulminate(III)
v) Tristhioureacopper(I) chloride
vi) Tristhioureacopper(II) sulphate

References

1. G. H. Jeffrey, J.Bassette, J. Mendham and R.C. Denny, 'Vogel's Text Book of Quantitative Inorganic Analysis' ELBS Publication, London 1997.
2. Experimental Inorganic Chemistry – G. Palmer.
3. Inorganic Synthesis – O. Glemser.
4. Instrumental analysis manual -Modern Experiments for Laboratory – G.G. Guilbault and L.G. Hargis.
5. D.M.Adams and J.B Raynor 'Advanced Practical Inorganic Chemistry' CRC Press, New York.
6. W.L.Jolly, 'Preparative Inorganic Reactions' Interscience Publishers, New York.

Scheme of Valuation	
Practicals	60 marks
Viva-Voce	10 marks
Record	05 marks
Total	75 marks

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
II	**Organic Chemistry Practical-II**		**Core – P X**	**90**	**4**

Learning objectives

- To learn the basic principles involved in the estimation of organic compounds.
- To estimate some organic compounds.
- To learn the skills of preparing organic compounds in multi-stage.
- To prepare some organic compounds in two stages.

ORGANIC ESTIMATION AND TWO-STAGE PREPARATION

1. Estimation

   Phenol, Aniline, Ethyl methyl ketone/Acetone, glucose, Ascorbic acid.

2. Demonstration Experiment

   Iodine value of an oil and Saponification value of an oil.

3. Two -Stage Preparation
   - i. Acetyl salicylic acid from methyl salicylate
   - ii. 1,3,5- Tribromobenzene from aniline
   - iii. p-Nitro aniline from acetanilide
   - iv. p-Bromoaniline from acetanilide
   - v. Benzilic acid from benzoin
   - vi. P-bromoacetanilide from aniline
   - vii. Benzanilide from benzophenone

References

1. A I Vogel- "A Text Book of Practical Organic chemistry" – Longman.
2. "Elementary Practical Organic Chemistry, Part 3 Quantitative Organic Analysis"- Longman.
3. F G Mann and B C Saunders- "Practical Organic Chemistry"- Longman.
4. P R Singh, D c guptha and K S Bajpai- " Experimental Organic Chemistry Vol I & II".

Scheme of Valuation	
Practicals	60 marks
Viva-Voce	10 marks
Record	05 marks
Total	75 marks

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
III	**Organic Chemistry-II**		**Core XI**	**90**	**5**

Units	Learning Objectives
I	To know the details about the elements and effects of aromaticity on bond length. To gain the knowledge about elimination reactions with their mechanisms.
II	To gain the knowledge about aliphatic nucleophilic and electrophilic substitution reactions and their mechanisms.
III	To gain the knowledge about aromatic nucleophilic and electrophilic substitution reactions and their mechanisms.
IV	To understand the addition reactions to carbon-carbon multiple bonds and to carbonyl compounds.
V	To understand the structural elucidation, medicinal values and synthesis of alkaloids, terpenes and vitamins with specific examples.

Unit I	
1.1	Aromatic compounds-elements of aromaticity – Huckel's and Craig's rules–effects of aromaticity on bond lengths–ring currents-non-benzenoid aromatic compounds- aromatic character in three, five, seven and eight membered rings – antiaromaticity – systems with 2,4,8 & 10 electron systems, annulenes and sydnones – alternate and non-alternate hydrocarbons.
1.2	Elimination reaction-E_1, E_2, E_1CB and E_i mechanisms – stereochemistry of eliminations –Hoffmann and Saytzeff rules–competition between elimination and substitution reactions-Chugaev reaction-dehydration of alcohols – dehydrohalogenation – Hoffman degradation-Cope elimination – Bredt's rule.
Unit II	
2.1	Aliphatic nucleophilic substitution-SN_1, SN_2 & SN_i mechanism-effects of substrate structure, leaving group attracting nucleophile and solvent–neighbouring group participation by σ and π bonds–substitution at allylic and vinylic carbons and their reactivity. Ambident substrates and nucleophiles.
2.2	Aliphatic electrophilic substitution-SE_1, SE_2 & SE_i mechanisms–effect of substrate structure, leaving group and solvent. Stork–enamine reaction, Haller-Bauer reaction., decarboxylation of aliphatic acids, halogenations of aldehydes and ketones, haloform reaction and N-halogenation of amines.
Unit III	
3.1	Aromatic electrophilic substitution-Arenium mechanism–orientation and reactivity. Nitration, Halogenation, Friedel-Craft's reaction, Gattermann, Kolbe-Schmit, Reimer-Tiemann and Houben– Hoesch reaction.
3.2	Aromatic nucleophilic substitution- SNAr, SN^1 and benzyne mechanism. Effect of substrate structure, leaving group and attaching nucleophiles. Chichibabin reaction, Bucherer reaction and Ullmann ether synthesis.
Unit IV	
4.1	Addition-addition to carbon–carbon multiple bonds–electrophilic addition, nucleophile and free radical additions–orientation–reactivity–Birch reduction-hydroxylation-hydroboration, hydrocarboxylation, hydroformylation, epoxidation-Diel's-Alder reaction-Michael addition – ozonolysis- 1, 3 – dipolar addition.
4.2	Addition to carbonyl group-Mannich-Crossed Cannizaro-Stobbes-Benzoin-formation of ketenes-MPV reduction, Grignard reaction, Darzen's glycidic ester condensation and Wittig's reaction.
Unit V	
5.1	Natural products-Terpenes – Structural elucidation –medicinal values and synthesis of pinene, camphor and Zingiberene.
5.2	Alkaloids-Structural elucidation-medicinal values and synthesis of guanine, reserpine, morphine, cinchonine and papaverine.
5.3	Vitamins-Physiological importance–structural elucidation of vitamins B_6, B_{12}, E and K (synthesis not required).

References	
1.	P.S.Kalsi, Organic reactions and mechanisms, II Edition, New Age International Publishers (2000).
2.	Jerry March, Advanced Organic Chemistry, IV Edition, Wiley-Interscience Publication (1992).
3.	I.L.Finar, Organic Chemistry, Vol. II, V Edition, First Indian reprint, Pearson Education Asia Pvt. Ltd. (2000).
4,	O.P.Agarwal, Chemistry of Natural Products, Vol. I, Green Publishing House (1997).
5.	G.R.Chatwal, The Chemistry of Organic Natural Products, Vol. II, Himalaya Publishing House (1983).
6.	Clayden Greeves Warren, Organic Chemistry, Oxford University Press
7.	S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan (1976).
8.	Gautam Brahmachari, Organic Name Reactions A Unified Approach, Narosa Publications
9.	V.K.Ahluwalia, Organic Reaction Mechanism, Narosa Publications

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credit
III	**Physical Chemistry-II**		**Core XII**	**90**	**5**

Units	Learning Objectives
I	Enable the student to understand the concepts of group theory.
II	To study the application of group theory.
III	To learn the various type of polymerization mechanism and polymerization techniques.
IV	To understand the concept of thermodynamics and apply the same to physical and chemical system.
V	To study the importance of surface chemistry and its application

Unit I Group Theory (18 Hrs)	
1.1	Elements of group theory – properties of a group and sub group – classes – group multiplication tables – isomorphism groups – symmetry operations – generation - point groups of molecules - matrix representation theory - consequences of great orthogonality theorem and construction of character tables for C_2V and C_3V point groups – characters - reducible and irreducible representations – representation of vibrational modes in H_2O and NH_3 molecules.
Unit II Applications of Group Theory (18 Hrs)	
2.1	Application of group theory to IR, Raman and electronic spectra– projection operators – SALC procedure – evaluation of energies and MO's for system like ethylene and trans 1,3 butadiene and planar monocyclic aromatic compounds – hybridization schemes of orbitals – CH_4, $[PtCl_4]^{2-}$and SF_6 molecules.
Unit III Polymer Chemistry (18 Hrs)	
3.1	Introduction – structure – classification and polymerization methods – importance of polymers.
3.2	Polymerization reactions – kinetic aspects of free radicals, chain reaction - stereo regular polymers - isotactic – syndiotactic - atactic - mono and bi metallic mechanism for Ziegler-Natta polymerization mechanism.
3.3	Techniques of polymerization and polymer degradation - bulk, solution, interfacial and emulsion polymerization - thermal degradation and photo degradation.
Unit IV Classical thermodynamics (18 Hrs)	
4.1	Thermodynamics of systems of variable composition – partial molar properties – chemical potential, relationship between partial molar quantities – Gibbs–Duhem equation - calculation of partial molar quantities from experimental data - thermodynamic properties of real gases.
4.2	Fugacity concept – calculation of fugacity of real gases - activity coefficient – definition – standard states and experimental determination of activity and activity coefficient of non-electrolytes.
Unit V Surface Chemistry (18 Hrs)	
5.1	Adsorption and free energy reaction relation at interfaces – physisorption and chemisorption – potential energy diagrams – Lennard-Jones plot – Langmuir and BET isotherm – surface area determination- Absorption from solution - Gibbs adsorption isotherm – solid-liquid interfaces – soluble and insoluble films.
5.2	Surface tension – methods of measuring surface tension – electrical phenomenon at interfaces, including electro kinetic micelles and reverse micelles - CMC - solubilization, micro – emulsion.
5.3	Role of surface in catalysis – semi conductor catalysis - n & p type surface kinetics of surface reactions involving absorbed species - Langmuir-Hinshelwood mechanism – Langmuir – Ridel mechanism and Rideal – Eley mechanism.

References

1. K. V. Raman, Group theory and its application to chemistry, Tata McGraw-Hill Publishing Company Limited, New Delhi (2004).
2. Maron S.H. and Lando J.B., Fundamentals of Physical Chemistry, Macmillan.
3. Puri B.R., Sharma L.R. and Pathania B.K., Principles of Physical Chemistry, Vishal Publishing Company.
4. Atkins P.W.,Physical Chemistry, (5th edition) Oxford University Press.(1994).
5. Castellan G.V.,Physical Chemistry, New Delhi, Orient Longmans.
6. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.
7. Sharma, B.K., Polymer Chemistry, Goel Publishing House, Meerut, 1989.
8. Arora M.G., Singh M. and Yadav M.S., Polymer Chemistry, 2nd Revised edition, Anmol Publications Private Ltd., New Delhi, 1989.
9. Billmeyer F.W., Text book of polymer science, Jr.John Wiley and Sons, 1984.

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credit
III	**Physical Chemistry Practical-I**		**Core – P XIII**	**90**	**5**

Learning objectives

- To know the basic principles of various physical chemistry experiments.
- To learn the skills of drawing graph, handling of some precision instruments.
- To learn to do some experiments in different cycles.

NON-ELECTRICAL METHODS

1. Effect of NaCl or succinic acid on CST of phenol – water system and determination of the strength of NaCl or succinic acid.
2. Rast method - Determination of K_f and M.Wt.
3. Comparison of acid strength by kinetics
4. Heat of solution.
5. Adsorption of oxalic acid on charcoal

CONDUCTOMETRY

1. Mixture of acids
2. Solubility of sparingly soluble salt
3. Verification of Ostwald's dilution law.

POTENTIOMETRY

1. Mixture of acids (HCl, acetic acid Vs NaOH)
2. Solubility of sparingly soluble salt
3. Determination of pKa of weak acid (acetic acid)

References

1. Ahluwalia, V. K., Dingra, S. and Gulati, A. College Practical Chemistry, Orient Longman Pvt. Ltd., Hyderabad (2005).
2. Sharma, K. K. and Sharma, D. S. Introduction to Practical Chemistry, Vikas Publishing House, New Delhi (2005).
3. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997).
4. Findlay, A., Practical Physical Chemistry, 7th edition, London, Longman (1959).

Scheme of Valuation	
Practicals	60 marks
Viva-Voce	10 marks
Record	05 marks
Total	75 marks

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
III	**Analytical and Instrumental Techniques in Chemistry**		**CBE I**	**90**	**4**

Units	Learning Objectives
I	To study the classification and minimization of errors and to express the result of a measurement reliably to correct significant figures.
II	To learn the principles, experimental set up and applications of different electro analytical methods.
III	To learn the principle, instrumentation and applications of TGA, DTA and DSC.
IV	To understand the instrumental techniques and applications of various optical methods.
V	To acquire the significance of separation and purification techniques.

Unit I Data Analysis (18 Hrs)	
1.1	Errors – classification and minimization - Methods of expression of data – accuracy and precision - statistical treatment of experimental data – mean and standard deviation - significant figures and computation - method of least squares - reliability of results - rejection of results – The Q – test, Student's t- test, chi-square test, F-test.
Unit II Electro Analytical Methods (18 Hrs)	
2.1	Polarography – principle, experimental technique – dropping mercury electrode - residual, migration and diffusion currents - half wave potential – Ilkovic equation - analytical applications of polarography.
2.2	Cyclic voltammetry – principle, experimental set up - cyclic voltammogram of Fe^{2+} in H_2SO_4.
2.3	Amperometric titration- principle and types - titration between Pb^{2+} and $K_2Cr_2O_7$.
2.4	Electrogravimetry-theory of electro analysis-experimental set-up - application of controlled potential method.
Unit III Thermal Methods of Analysis (18 Hrs)	
3.1	Thermo gravimetric analysis - principle, instrumentation - TG curve – factors affecting TG curve- applications of TGA.
3.2	Differential thermal analysis – principle, instrumentation - factors affecting DTA - applications of DTA.
3.3	Differential scanning colorimetry – principle, instrumentation and applications.
3.4	Atomic absorption and emission spectroscopic techniques - principle, effect of temperature – instrumentations and applications.
3.5	Flame photometry – principle - types of burners - instrumentation and applications.
Unit IV Optical Methods (18 Hrs)	
4.1.	Colorimetry - laws of colorimetry - photoelectric colorimetry – monochromators – detectors - instrumentation and analytical applications.
4.2	Turbidimetry and Nephelometry - principles and choice between two technique - instrumentation and applications.
4.3	Fluorimetry and Phosphometry – principles, instrumentation and applications.
4.4	Polarimetry - principle, instrumentation and applications.
Unit V Separation and Purification Techniques (18 Hrs)	
5.1	Chromatography - theory – adsorption and partition - column, thin layer, paper chromatography - techniques and applications - ion exchange, Solvent extraction, GC, HPLC- techniques and applications.
5.2	Distillation – fractional, azeotropic, vacuum - principles, techniques and applications.
5.3	Crystallization - types, principles and techniques.
5.4	Sublimation - types, principles and techniques.
5.5	Drying of samples – desiccants - types, choice and regeneration - techniques of drying of solids.

REFERENCES

1. R.Gopalan, P.S. Subramaniam and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand and Sons.
2. H. Kaur. Instrumental Methods of chemical analysis, Pragati Prakashan, Meerut.
3. B.K.Sharma, Instrumental Methods of Chemical Analysis, Goel Publishing House, Meerut.
4. A.I. Vogel, Inorganic Quantitative Analysis.

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
III	**Selected Topics in Chemistry**		**CBE II**	**90**	**4**

Units	Learning Objectives
I	To learn the concepts in Drug Design.
II	To know the importance of Retrosynthetic analysis in the synthesis of organic compounds.
III	To acquire knowledge about the modern techniques in nanotechnology and nanomaterials.
IV	To acquire knowledge about principles of dyeing, synthesis of dyes and fastness properties. Students should be able to dye different fibres and test various fastness properties.
V	To understand the chemistry of pesticides, fungicides and herbicides.

Unit I Drug Design	
1.1	Historical Development-Procedures followed in drug design (search for lead compounds, accidental discovery, examination of metabolites, testing of intermediates in drug synthesis) -Prodrugs and Softdrugs (definition only)-Molecular modification of Lead compounds-Biological properties of simple functional groups (Alkyl groups, Alkylene groups, Quaternary ammonium compounds, Carboxylic acid groups and derivatives).
Unit II Retrosynthetic Analysis	
2.1	Introduction- Target molecule, Disconnection, Functional Group Interconversion, Retrosynthetic Analysis (Definitions only) - Synthons and Synthetic equivalents- Guidelines for choosing disconnections –Importance of the order of events in organic synthesis (Guidelines)-Guidelines for solving the problem of Chemoselectivity-Reversal of Polarity.
Unit III Nanotechnology	
3.1	History of Nanotechnology – Fundamental concepts- nanomaterials- fullerenes- nanoparticles –gold nanoparticles - molecular self-assembly – nanomedicines - nanofibers- nanolithography – nanowires – nanoswitches- nanoelectrodes -Carbon nanotubes.
Unit IV Dyes	
4.1	Colour and chemical constitution - Chromophore and auxochromes - natural and synthetic dyes - dyes - classification, synthesis of dyes- congored, bismark brown and crystal violet, theories of dyeing - effect of temperature and salt on dyeing - dyeing of wool, silk and poly-esters - dyeing of cotton with reactive dyes - fastness properties - washing, light, rubbing and perspiration.
Unit V Pesticides, Fungicides and Herbicides	
5.1	Pesticides: Definition – Classification – organic and inorganic pesticides – mode of action – Characteristics – Safe handling of pesticides – impact of pesticides on soil, plants and environment.
5.2	Fungicides: Definition – classification – mode of action – sulfur, copper, mercury compounds, dithanes, dithiocarbamates.
5.3	Herbicides: Definition – Classification – mechanism of action – Arsenic and boron compounds – nitro compounds, chloro compounds, Triazines, propionic acid derivatives, urea compounds.

References

1. S.N.Pandeya and J.R.Dimmock, An Introduction to Drug Design, New Age International (P) Limited, New Delhi (1997).
2. A. Burger, A Guide to the Chemical Basics of Drug Design, Wiley-Interscience, New York (1983).
3. Silverman, R.B., The Organic Chemistry of Drug Design and Drug Action, Academic Press Inc., San Diego (1992).
4. Stuart Warren and Paul Wyatt, Organic Synthesis-The Disconnection Approach, Wiley, 2nd Edition (2008).
5. E. J. Corey and X-M. Cheng ,The Logic of Chemical Synthesis. New York: Wiley (1995).
6. C.N.R. Rao, A. Muller, A.K. Cheetam (Eds), The Chemistry of Nanomaterials, Vol.1, 2, Wiley – VCH, Weinheim, 2004.
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8. Kenneth J. Klabunde, Nanoscale materials in chemistry, A. John Wiley and Sons Inc. Publication.
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10. V.A. Shenai, Chemistry of dyes and Principles of dyeing Vol.II, Mahajan Publishers, Ahmedabad.
11. U.S.Sree Ramula, Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi (1979).
12. K.H.Buchel, Chemistry of Pesticides, John Wiley & Sons, New York (1983).
13. R.M.Christie, Colour Chemistry, Royal Society of Chemistry, Cambridge (2001).
14. R.L.M.Allen, Colour Chemistry, Nelson, Great Britain (1971).

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
IV	**Organic Chemistry-III**		**Core XIV**	**90**	**5**

Units	Learning Objectives
I	To understand the chemical and photochemical organic reactions.
II	To know the nature of addition in pericyclic reactions.
III	To know the details about some oxidation and reduction reactions.
IV	To understand the mechanisms for some molecular rearrangements
V	To understand and appreciate the chemistry of steroids and its importance in the living systems. To enable the students to understand and appreciate the importance of heterocyclic compounds.

Unit I Organic Photochemistry	
1.1	Fundamental concepts – Jablonski diagram – energy transfer characteristics of photoreduction and photooxidation – photoreactions of ketones and enones – Norrish type I & II reactions- photochemistry of alkenes, dienes and aromatic compounds. Photosensitization. Photo additions. Barton reaction, Paterno – Buchi reaction and photo Fries rearrangement.
Unit II Pericyclic reactions	
2.1	Concerted reactions- stereochemistry- orbital symmetry and correlation diagram- Frontier molecular orbital approach – Woodward Hoffman rules – electrocyclic reactions- cyclo additions – selection rules- Sigmatropic rearrangements – selection rules with simple examples (1,3), (3,3) and (1,5) hydrogen shifts. Cope and Claisen rearrangements.
Unit III Oxidation and Reduction reactions	
3.1	Oxidation- Oxidation with chromyl chloride, periodic acid, selenium dioxide, lead tetraacetate, osmium tetraoxide, H_2O_2, O_3 and Oppenauer oxidation.
3.2	Reduction- Catalytic hydrogenation and dehydrogenation- selection in reduction – Clemmensen reduction–Wolf–Kishner reduction and Rosenmund reduction. Reduction with $LiAlH_4$, $NaBH_4$, t-butoxyaluminium hydride, sodium cyanoborohydride, trilalkyltinhydride and hydrazines.
Unit IV Rearrangements	
4.1	Mechanisms and applications of the following rearrangements: Wagner-Meerwein, Dienone–Phenol, Favorski, Neber, Stevens, von Ritchter, Baeyer-Villiger, Sommelet- Hauser, Bamberger, Pummerer, Di-π-methane, Hoffmann-Loffler, Chapman and Wallach rearrangements. Arndt-Eistert synthesis, Demyanov ring contraction and expansion and metathesis of olefins.
Unit V Steroids and Heterocycles	
5.1	Steroids-classification–structural elucidation of cholesterol (synthesis not required)- structural elucidation and synthesis of vitamin D–oestrone–progesterone –ergosterol– stigma sterol – equilenin- androsterone and cortisone.
5.2	Heterocycles-synthesis and reactions of azoles, pyrazole, imidazole, oxazole and thiazole.

References	
1.	P.S.Kalsi, Organic reactins and mechanisms, II Edition, New Age International Publishers 2000).
2.	Jerry March, Advanced Organic Chemistry, IV Edition, Wiley-Interscience Publication (1992).
3.	I.L.Finar, Organic Chemistry, Vol. II, V Edition, First Indian reprint, Pearson Education Asia Pvt. Ltd. 2000).
4.	O.P.Agarwal, Chemistry of Natural Products, Vol. I, Green Publishing House (1997).
5.	G.R.Chatwal, The Chemistry of Organic Natural Products, Vol. II, Himalaya Publishing House (1983).
6.	Jagdamba Singh, Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers
7.	Gautam Brahmachari, Organic Name Reactions A Unified Approach, Narosa Publications
8.	V.K.Ahluwalia, Organic Reaction Mechanism, Narosa Publications
9.	S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan (1976).
10.	Clayden Greeves Warren, Organic Chemistry, Oxford University Pres

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
IV	**Physical Chemistry Practical-II**		**Core - P XV**	**90**	**5**

Learning objectives

- To know the basic principles of various physical chemistry experiments.
- To learn the skills of drawing graph, handling of some precision instruments.
- To learn to do some experiments in different cycles.

NON-ELECTRICAL METHODS

1. Calculation of activation energy
2. Transition Temperature – Determination of K_{tr} and M.Wt.
3. Adsorption of oxalic acid on charcoal
4. Partition Coefficient and K_{eqm}
5. Rate constant of persulphate oxidation by titrimetry and influence of ionic strength
6. Phase diagram three component system or phase diagram two component system with compound formation.

CONDUCTOMETRY

1. Mixture of bases
2. Mixture of halides
3. Estimation of K_2SO_4
4. Verification of Debye- Huckel -Onsager Equation

POTENTIOMETRY

1. Estimation of KI ($K_2Cr_2O_7$ Vs KI) or Estimation of KI ($AgNO_3$ Vs KI)
2. Mixture of halides (KCl & KI)
3. pH and pKa of buffer solution
4. Determination of standard electrode potential of Cu/Cu^{2+} system.
5. Estimation of $FeSO_4$.

References

1. Ahluwalia, V. K., Dingra, S. and Gulati, A. College Practical Chemistry, Orient Longman Pvt. Ltd., Hyderabad. (2005).
2. Sharma, K. K. and Sharma, D. S. Introduction to Practical Chemistry, Vikas Publishing House, New Delhi. (2005).
3. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons(1997).
4. Findlay A., Practical Physical Chemistry, 7th edition, London, Longman (1959).

Scheme of Valuation	
Practicals	60 marks
Viva-Voce	10 marks
Record	05 marks
Total	75 marks

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
IV	**Environment Pollution Analysis Techniques**		**CBE III**	**90**	**4**

Units	Learning Objectives
I	To acquire knowledge about sources of various pollutions and toxicity of pollutants and to understand and appreciate various methods of pollution analysis.
II	To study the classification of air pollutants; sampling and analysis of gaseous pollutants; principles and methods of monitoring gaseous pollutants.
III	To learn the physical and chemical characterization of water treatment methods of industrial and domestic effluents.
IV	To gain knowledge about soil pollution, pesticide pollution, noise pollution and toxic trace elements.
V	To get first-hand information about the measurement, prevention and control of pollution in industries through direct visits to factories.

Unit I (18 Hrs)	
1.1	Environmental Pollution - sources of air pollution, water pollution – industrial effluents - waste water pollution due to sewage and sludge.
1.2	Pesticide pollution - solid waste problem - metal pollutants - environmental carcinogens - control of pollution.
1.3	Toxic pollutants - kinds of toxic pollutants, threshold limiting value, toxic metal pollutants, toxic gaseous pollutants and non metals, toxic minerals and dust, toxic organic compounds.
1.4	Environmental Pollution Analysis - need for analysis - methods of analysis - gravimetric, volumetric, atomic absorption spectroscopy, electro analytical techniques - chromatographic techniques - adsorption, partition, ion-exchange and HPLC - solvent extraction separations.
Unit II (18 Hrs)	
2.1	Classification of air pollutants - air pollution and their effects - characteristics and biochemical effects of some air pollutants on man and environment - meteorology and air pollution - wind speed and wind direction - atmospheric stability and temperature inversion.
2.2	Sampling of gaseous pollutants - analysis of aerosols - analysis of gaseous pollutants - SO_2, H_2S, NO-NO_X, CO-CO_2, NH_3, organic gases and Vapour.
2.3	Principles of monitoring methods - monitoring instruments - techniques used in the estimation of atmospheric pollutants - environmental monitoring programme.
2.4	Monitoring of evolution of gases - SO_2, H_2S, NO-NO_X, CO-CO_2, hydrocarbon and ozone, suspended particulate matter - trace metal pollutants - air pollutants from automobiles - air pollution control.
Unit III (18 Hrs)	
3.1	Physical examination of water - chemical characterization - minor components in water-biological characterization.
3.2	Important steps in water treatment - coagulation, sedimentation, filtration, disinfection, fluoridation, chemical analysis of treated water.
3.3	Objective of industrial effluent analysis - kinds of measurement - quality of industrial effluents - sampling and analysis of organic pollutants - metal pollutants.
3.4	Need for domestic effluent treatment - primary treatment-biological secondary treatment - tertiary treatment - domestic effluent analysis.
Unit IV (18 Hrs)	
4.1	Chemistry of soil-soil irrigation by effluents - agricultural pollution - role of micronutrients in soil - analysis of micronutrients in soil - trace elemental analysis.
4.2	Pesticides and pollution - DDT problem - classification of pesticides - degradation of pesticides - pesticide analysis -chromatographic, polarographic and spectroscopic analysis.
4.3	Noise Pollution - sources of noise - noise and health - types of noise - noise measurement - noise mapping – environment and noise measurement.
4.4	Trace elements - Sources , industrial uses and pollutants - measurement and control of trace elements - mercury, cadmium, lead, chromium, zinc, arsenic and beryllium.

Unit V FIELD TRIPS	
5.1	Dalmia Cements (Dalmiapuram) - air pollution measurement and control techniques.
5.2	Trichy Distillery (Tanjore Road) - water pollution.
5.3	Soil Testing Laboratory (Khajamalai) - soil pollution and its measurement.
5.4	Bharathidasan University - atomic absorption spectroscopy, X- ray spectroscopy, NMR and chromatographic techniques.
5.5	Mathur - pesticide Analysis, High energy batteries

References

1. Environmental Pollution Analysis-S.M. Khopkhar, 2nd Edition, New Age International (P) Limited, 1995.
2. A Text Book of Environmental Chemistry and Pollution Control-S.S.Dara, 5th Revised Edition, S.Chand and Company, 2002.

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75

Semester	Subject Title	Subject Code	Category	Total hrs	Credits
IV	**Green Chemistry**		**CBE IV**	**90**	**4**

Units	Learning Objectives
I	To understand the basic concepts of Green chemistry and its uses in day-to-day life.
II	To analyse the various techniques involved in green synthesis
III	To know the details about the conventional and green method for the preparation of some industrially important chemicals and compounds.
IV	To learn about the basic principle and the importance of microwave chemistry in the preparation of some important compounds
V	To learn the details about ultrasound assisted reactions.

Unit I : Introduction (18 Hrs)	
1.1.	Introduction – Definition - Need for Green Chemistry - twelve principles of green chemistry - concept of atom economy with examples (rearrangement, addition, substitution and elimination reactions) - green chemistry in sustainable development - Green Chemistry Awards - importance of green chemistry in day-to-day life.
Unit II : Green Synthesis-I (18Hrs)	
2.1.	Introduction - choice of starting materials - choice of reagents (dimethyl carbonate, diphenyl carbonate, clayan, Wittig reagent) - choice of catalysts (bio catalysts, polymer supported catalysts) - choice of solvents (water, supercritical CO_2, ionic liquids) - phase transfer catalyst.
Unit III : Green Synthesis-II (18 Hrs)	
3.1	Conventional and Green Synthesis - Ibuprofen, paracetamol, 4-aminodiphenylamine, disodium iminodiacetate, acetaldehyde, citral,urethane, benzyl bromide and catechol. Synthesis and applications of ionic liquids - Environmental Protection Laws.
Unit IV: Microwave Chemistry (18 Hrs)	
4.1.	Microwave Chemistry – definition - characteristics of microwave heating - fundamental theory of microwave heating- difference between conventional heating and microwave heating - interaction of microwave radiation with the material - microwave assisted organic reactions in solvents - reactions in water - solid-phase reactions- multi-component reactions - applications of microwave heating.
Unit V: Ultrasound Assisted Reactions (18 Hrs)	
5.1.	Introduction-use of ultra sound in organic synthesis – esterification , saponification, substitutions , oxidations , reductions, Cannizzaroreaction, Strecker's synthesis and coupling reactions - Green Chemistry related websites.

References

1. V.Kumar, An Introduction to Green Chemistry, 1st edition (2007), Vishal Publishing Co., Jalandhar.
2. K.R.Desai, Green Chemistry - Microwave Synthesis, 1st edition (2005), Himalaya Publishing House, Mumbai.
3. Green Chemistry – Environmentally benign reactions – V. K. Ahluwalia, Ane Books India (Publisher). (2006).
4. Green Chemistry–Designing Chemistry for the Environment–edited by Paul T.Anastas &Tracy C.Williamson. 2nd edn (1998).
5. Green Chemistry – Frontiers in benign chemical synthesis and processes- edited by Paul T. Anastas & Tracy C. Williamson. Oxford University Press, (1998).
6. Green Chemistry – Environment friendly alternatives- edited by Rashmi Sanghi & M. M. Srivastava, Narora Publishing House, (2003).
7. Mukesh Doble and Anil Kumar Kruthiventi, Green Chemistry and Processes, Academic Press, UK (2007).
8. P.T.Anastas and J.C.Warner, Green Chemistry: Theory and Practice: Oxford University Press, New York (1998).

Question pattern for Semester Examinations

S.No.	Section	Marks
1.	Section A (10 Questions): Short Answer Questions	10 X 2 =20
2.	Section B (5 Questions): Built-in-Choice (Either /Or)	5 X 5 =25
3.	Section C (3 Questions): Long answer questions/ Open choice (3 out of 5)	3 X10 =30
	Total Marks	75