COMPLEMENTARY ELECTIVE COURSE

Chemistry for Physical & Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1C01CHE/PCH	2	2	2

Contact Hrs –36

Course Outcome

On successful completion of this course, students should be able to

CO1) Understand the atomic structure, basics of quantum chemistry and its applications.

CO2) Explain theories of chemical bonding and molecular structure.

CO3) Classify environmental pollution and recognise the causes of pollution

CO4) Understand the basic concept of Chemical equilibrium and theories of acids and bases

CO 5) Calculate pH values

CO 6) Explain common ion effect and solubility product

UNIT I : Atomic Structure and Periodic Table (10 hrs)

Bohr atom Model (No derivation) – Atomic Spectra of Hydrogen – limitations – wave mechanical concept of atom – Heisenberg's Uncertainty Principle – Dual nature of electrons – De Broglie equation – quantum numbers. Orbit and orbitals – Wave function and significance of $\psi^{2.}$ Schrodinger equation (no derivation). The periodic table – periods and groups-s, p, d and f block elements – modern concept – periodic trends – atomic radii, ionic radii & covalent radii – effective nuclear charge and screening effect – Ionization potential – electro negativity and electron gain enthalpy.

UNIT II : Chemical bonding (10 hrs)

Types of chemical bonds-Ionic, covalent and co-ordinate bonds. Lattice energy of ionic compounds – Born Haber cycle. VSEPR theory and its applications. Shape of molecules CO_2, BeF_2, BF_3, CH_4, NH_3, H_2O, NH_4^+, PCl_5, SF_6, ClF_3. Orbital overlapping – Hybridization sp, sp^2, sp^3, sp^3d, sp^3d^2, d^2sp^3 and dsp^2 hybridization.
V.B Theory. MO theory.Formation of B_2, C_2, N_2 and O_2 molecules. Hydrogen bonding, types of hydrogen bonding – example

UNIT III : Environmental Chemistry (10 hrs.)

Introduction-environment and segments- Pollutants of water – sewage, industrial effluents, soap and detergents, pesticides, fertilizers, heavy metals, Biological magnification and

bioaccumulation, Toxic effect of pollutants, Water quality parameters – DO, BOD and COD, Water purification- sedimentation, coagulation, filtration, disinfection, ion exchange, desalination, Air pollution – major regions of atmosphere, pollution by oxides of N, S, C, hydrocarbons and other organic chemicals, automobile exhausts, their physiological effects on vegetation and living organisms, Ozone layer – importance – depletion of ozone – consequences, Greenhouse effect – global warming – acid rain, Toxicity and environmental hazards of pesticides, Radiation pollution and noise pollution.

UNIT IV :Ionic Equilibrium (6 Hrs)

Concepts of Acids and Bases-Arrhenius, Lowry- Bronsted and Lewis concepts, ionization of weak electrolytes.pHand pOH values.Buffer solutions and calculations of their pH. Henderson equation(numerical problems expected). Solubility product and common Ion effect.Hydrolysis of salt – degree of hydrolysis and hydrolytic constant, derivation of relation between Kw and Kh for salts of strong acid – weak base, weak acid – strong base and weal acid – weak base.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks
I	14
II	14
III	14
IV	10

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Physical & Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2C02CHE/PCH	2	2	3

Contact Hrs – 36

Course Outcome

On successful completion of this course, students should be able to

CO 1) Understand the basic concept of classification, IUPAC nomenclature, bonding and structure of Organic compounds

CO2) Explain the concept of aromaticity and non-benzenoid aromatics

CO3) Understand the basic concepts of chemical equilibrium . Explain colloids, their properties and applications

CO4) Illustrate the laws of photochemistry and Explain the photochemical phenomena such as Photosensitization, quenching, Fluorescence, Phosphorescence, Chemi luminescence and bioluminescence.

CO5) Familiarise different types of analytical methods in chemistry and explain the principle of colorimetry

CO 6) Explain the principles underlying the qualitative and quantitative analysis

UNIT I : : Introduction to organic chemistry (8 Hrs)

Classification of organic compounds – functional groups,Homologous series –Hybridization and shapes of molecules like methane, ethane, ethylene and acetylene – IUPAC nomenclature of hydrocarbons, organic compounds bearing functional groups –Structure of Benzene –

Aromaticity-Huckel's rule. Non Benzenoid Aromatic systems-cyclopropenyl cation, cyclopentadienyl anion, tropelium cation, Pyrrole, Pyridine

Bond fission – homolysis and heterolysis – carbonium ion – carbanion – and free radicals.

. **UNIT II : Chemical equilibrium (6 hours)**

Reversible reactions – Law of mass action – relationship between Kc, Kp and Kx- thermo dynamic
derivation of chemical equilibrium. Liquid systems – Le-Chatlier's Principle – Effects of temperature, pressure and concentrations.

UNIT III : Photochemistry (4 hrs)

Chemical reactions Vs Photochemical Reactions. Laws of photo chemistry – Grotthus – Draper Law and Stark-Einstein law of photo chemistry. Beer Lambert Law- Quantum yield – Photo sensitization and quenching- Fluorescence and Phosphorescence – Chemiluminescence and bioluminescence.

UNIT IV : Colloids (8 hrs)

Classification – preparation – structure and stability – The electrical double layer – zeta potential – Properties of Colloids – Tyndall effect – Brownian movement- Coagulation of colloidal solution – Hardy-Schultz rule – Flocculation value – protective colloids – Gold number – Emulsions – oil in water and water in oil type emulsions – Emulsifying agents – Gels – imbibition – syneresis – applications of colloids in food, medicine and industry.

UNIT V : Analytical Chemistry (10hrs)

Analytical chemistry – Types of analytical methods –Qualitative and Quantitative analysis, Electrochemical methods, Spectroscopic analysis, Thermal methods (introduction only) –

Accuracy and precision. Errors-classification

Inorganic Qualitative analysis - Solubility product – ionic product – common ion effect- principle of separation of cations in various groups.

Concept of molarity, Normality, Molality (numerical problems expected). Principle of volumetric analysis – Acidimetry and alkalimetry, permanganometry, dichrometry, iodometry and iodimetry.

Colorimetry – Beer-Lamberts law-applications.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	12	V	13
II	9		
III	6		
IV	12		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for Physical Science

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3C03CHE/PCH(PS)	3	2	3

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) Understand the basic principle underlying various spectroscopy

CO2) Understand the basic concepts of thermodynamics and laws of thermodynamics

CO3) Explain the formation , nomenclatureand applications of coordination complexes,

Illustrate the valance bond theory of coordination complexes and explain the factors

affecting the stability of complexes

CO4) Understand the basic concepts of chemical kinetics and Calculate the value of Ea from the values of k at two temperatures .Illustrate the types of Catalysis and understand the Characteristics of catalytic reactions

CO 5) Understand the basic concept of nuclear chemistry, and explain the detection of isotopes using Aston's mass spectrograph and separation of isotopes by diffusion methods
CO6) Explain the principle and applications of different types of Chromatography

Module I : Spectroscopy (9 Hrs)
Electromagnetic spectrum- Ranges of different radiation- general features of spectroscopy- Types of spectra – Rotational, vibrational and electronic spectra. Rotational spectra - Moment of inertia-rotational constant and bond length.
Vibrational spectra – stretching and bending modes-Force constant-Zero point energy.
Raman spectra – Stokes and Anti Stokes Lines – NMR spectra-chemical shift and spin-spin splitting.

Module II : Thermodynamics (8Hrs)

Basic Concepts – System – surroundings – open, closed and isolated systems – heat – energy – internal energy – Isothermal –isochoric and isobaric process – Reversible and irreversible processes- work of expansion of an ideal gas in reversible isothermal work –Heat capacity at

constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv – First law– The second law – Enthalpy-Entropy-and Free energy- significance of ΔG, ΔH and available work-Criteria for reversible and irreversible process - Gibbs –Helmholtz equation(no derivation)-criteria of spontaneous and non spontaneous processes.

Module III : Co-ordination compounds (8 Hrs)

Co-ordination compounds and complex ions –co-ordination number-Ligands – Types - unidentate- bidentate -polydentate ligands– Werners theory – Nomenclature of co-ordination compounds – Effective Atomic Number Rule – Factors affecting the stability of complex ions – valence bond theory of complexes –application of complexes.

Module IV : Chemical kinetics and catalysis (11hrs)

Definition – reaction rate – factors affecting the rate of a chemical reaction – units – Zero order reactions – Order versus molecularity. Pseudo order reactions – Integrated rate equation for first order reaction – half life – determination of the order – Half life method and Graphical method – Ester hydrolysis – rate equation. Collision theory (qualitative) Effect of temperature on reaction rate

Calculation of Ea from the values of k at two temperatures.Transition state theory (qualitative). Types of catalysis – homogeneous and heterogeneous.Characteristics of catalytic reactions – promoters and catalytic poisons. Activation energy and catalysts.

Module V : Nuclear Chemistry (10 hrs)

Concept of nuclides – representation of nuclides – isobars, isotopes and isotones with examples – Detection of isotopes using Aston's mass spectrograph – separation of isotopes by diffusion methods – stability of nucleus – n/p ratio. Liquid drop model, Radioactivity – natural and artificial. Decay constant and half-life period-Radioactive series – Group displacement law – radio isotopes and their applications in structural elucidation, in agriculture and in industry – Radiocarbon dating – Nuclear fission and nuclear fusion. Problems associated in the nuclear waste disposal. Derivation of decay constant – Atom bomb and hydrogen bomb. Mass defect, Nuclear binding energy.

Module VI: Chromatography (8 hrs)

Introduction - Adsorption and partition chromatography - Principle and applications of column, thin layer, paper, Liquid and gas chromatography, HPLC, Ion Exchange chromatography (IEC) - R_f value – Relative merits of different techniques.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	9	V	9
II	9	VI	6
III	9		
IV	10		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistry for physical science

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4C04CHE/PCH(PS)	3	2	3

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) Understand the basic concept in gaseous state Explain the deviation of real gases from ideal behaviorand Maxwell distribution of velocitiesand its use in calculating molecularvelocities. Distinguish average velocity, RMS velocity and most probable velocity

CO 2) Understand the basic concepts of internal structure of Crystals (crystallography) and explain X-ray analysis of crystals

CO3) Understand the basic concepts in liquid state and solutions .Illustrate Henry's law and explain its applications. Identify collegative properties and apply colligative properties to determine molecular mass

CO4) Distinguish Specific conductance – molar conductance and equivalent conductance and explain laws of electrolysis , conductometric titrations and its applications

CO5) Explain electrochemical cell ,electrode potential , types of electrodes ,EMF Nernst equation and potentiometric titration

CO6) Acquaint with various instrumental methods in chemistry and Understand basic concepts of nanochemistry

UNIT I: Gaseous State (9Hrs)

Gaseous State: Introduction - Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities – Average velocity, RMS velocity and most probable velocity (derivations not required) – collision number and collision frequency, mean free path- Boyle's law – Charles's law – Ideal gas equation – Behaviour of real gases – Deviation from ideal behaviour - Van der Waals equation (derivation not required). Joule-Thomson effect and Liquifaction of gases .

UNIT II : Crystalline State (9 Hrs)

Solids – crystalline and amorphous solids – space lattice and unit cell- crystal planes laws of crystallography – Weiss indices and Miller indices - Bravais lattice – Bravais lattices of cubic crystals – characteristic planes in these lattices – interplanar distance ratio – X-ray analysis of crystals – Bragg's equation – problem – crystal structure of NaCl – Liquid crystals – types, properties and applications.

UNIT III: Liquid State and Solutions (10 hrs)

Liquid State: Introduction - Vapour pressure – Raoult's law- surface tension and viscosity – Explanation of these properties on the basis of intermolecular attraction.

Solutions: Kinds of solutions - Solubility of gases in liquids – Henry's law and its applications - Colligative properties - Determination of molecular mass using colligative properties.

Introduction to liquid crystals-classification and properties

Unit IV Electrochemistry(6 hrs)

Specific conductance – molar conductance and equivalent conductance – variation with dilution. Ohm's law - Conductors - metallic and ionic conductors

Electrolysis – laws of electrolysis –. Electrolytic conduction - Migration of ions – relative speed of ions – Transport number. Kohlrausch's law and applications.Conductometric titrations – advantages

UNIT V : Electromotive force (8 Hrs)

Electro chemical cell – Daniel cell – Cell reaction – Single electrode potential – statement – explanation of Nernst equation – Standard hydrogen electrode – Calomel electrode –

measurement of EMF – determination of pH using Hydrogen electrode – Potentiometric titration – concentration cells.

UNIT VI :Instrumental methods of Analysis(6 Hrs)

Principles of TGA, DTA, AAS, Spectrophotometry, Potentiometric Titration and their Applications

UNIT VII ::Chemistry of Nano Materials (6hrs)

Evolution of Nano science – Historical aspects – preparations containing nano gold in traditional medicine, Lycurgus cup – Faraday's divided metal etc.Nanosystems in nature.Preparation of Nano particles – Top – down approach and bottom – up approach, sol – gel synthesis, colloidal

precipitations, Co- precipitation, combustion technique. Properties of nano particles: optical, magnetic and mechanical properties.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	10	V	8
II	7	VI	5
III	9	VII	6
IV	7		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistryfor Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3C03CHE/PCH (BS)	3	2	3

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) i) Understand the basic concept of Coordination Chemistry, nomenclature, Werner's coordination theory and Valance bond theory of coordination complexes
ii) Write the name of Coordination compounds
iii) Explain Werner's coordination theory and Valance bond theory of coordination complexes
iv) Explain the application of coordination complexes

CO2) i) Understand the electron displacement effects in organic molecules
ii) Explain the mechanism of nucleophilic substitutions and eliminations in alkyl halides
iii)Explain the mechanism of aromatic electrophilic substitution reactions

CO3) i) Classify the isomerism in organic molecules
ii) Distinguish the geometrical isomers and explain their stability
iii) Explain the characteristics of chiral compound
iv) Explain the conformational isomers in alkanes and cycloalkanes

CO 4) i) Explain the important types of polymerization, thermoplastics and thermosetting plastics
ii) Understand the characteristics of biodegradable plastics
CO 5) Understand the basic concept of thermodynamics and laws of thermodynamics
CO6) i) Understand the basic concept of chemical kinetics
ii)Calculate Ea from the values of k at two temperatures
iii) Explain homogeneous catalysis, heterogeneous catalysis and Characteristics of catalysis reactions

UNIT I Co-ordination Chemistry(9 hrs)

Co-ordination compounds and complex ions –co-ordination number - Ligands-types - unidentate, bidentate, polydentate ligands – Werners theory – Nomenclature of co-ordination compounds – Effective Atomic Number Rule, significance – Factors affecting the stability of complex ions – valence bond theory of complexes - application of complexes.

UNIT II : Organic reaction mechanisms (10 hrs)

Classifications of organic reactions – Electron displacement effects- Inductive, Electromeric, Resonance, Hyper conjugative,Steriic effects. Mechanisms of SN_1 and SN_2 reaction.Walden inversion.Elimination reactions – E_1 and E_2 reactions. Addition of hydrohalogen acids – Markownikoff's rule – peroxide effect. Aromatic electrophilic substitution reactions - chlorination, nitration, sulphonation and Friedel Crafts reaction

UNIT III : Stereochemistry (9 hrs)

Isomerism – general – stereoisomerism – optical isomerism – chirality – plane polarized light – specific rotation – enentiomerism – recemization – diastereo isomer – optical activity of lactic acid and tartaric acid – meso tartaric acid – resolution – conformational isomerism – ethane, propane and cyclohexane – chair and boat forms- stability – geometrical isomerism – causes – maleic acid and fumaric acid – 1-butene and 2-butene stability.

UNIT IV : Introduction to Polymer Chemistry (8 hrs.)

Types of polymerization: Chain polymerization, step polymerization – homopolymers and copolymers phenol formaldehyde, urea formaldehyde polymers – Natural rubber and synthetic rubbers – Synthetic fibers– Thermoplastics and Thermosetting plastics – pollution due to plastics – Biodegradable plastics.

UNIT V : Thermodynamics (9 Hrs)

Basic concepts**–** System – surroundings – open, closed and isolated systems – Isothermal – isochoric and isobaric process – work – heat – energy – internal energy – Heat capacity at constant volume (Cv) and at constant pressure (Cp) – relation between Cp and Cv – First law– The second law – Enthalpy-Entropy-and Free energy-Criteria for reversible and irreversible process- Gibbs –Helmholtz equation(no derivation) concepts of spontaneous and non spontaneous processes.

UNIT VI : Chemical kinetics and catalysis (9hrs)

Definition – reaction rate – factors affecting the rate of a chemical reaction – units – Zero order reactions – Order versus molecularity. Pseudo order reactions – Integrated rate equation for first order reaction – half life – Ester hydrolysis – equation. Collision theory (qualitative) Effect of temperature on reaction rate – calculation of Ea from the values of k at two temperatures. Transition state theory (qualitative).Types of catalysis – homogeneous and heterogeneous. Characteristics of catalysis reactions – promoters and catalytic poisons. Activation energy and catalysis.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	10	V	9
II	10	VI	9
III	8		
IV	6		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

COMPLEMENTARY ELECTIVE COURSE

Chemistryfor Biological Sciences

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4C04CHE /PCH (BS)	3	2	3

Contact Hrs –54

Course Outcome

On successful completion of this course, students should be able to

CO1) Illustrate the preparatory methods of glucose and fructose and explain their configurations Familiarize the structure and properties of sucrose and poly sachrides

CO2) Know the structure of important five membered and six membered heterocyclic compounds

and explain their reactivity and important reactions .Explain the preparation and properties of Quinoline and iso quinoline

CO 3) Understand the structure and functions of neuclic acids , Classify amino acidsand explain the structure of protein and its importance

CO4) Understand the mechanism of enzyme action , enzyme catalysis

CO5) Know the structure of Vitamin A, B and C. and hormones progesterone, Testosterone, cortisone, adrenaline and Thyroxin

CO6) Understand the importance of metal ions in biological systems and Mechanism of O2 and CO_2 transportation – Nitrogen Fixation Na-K pump

UNIT I : Carbohydrates (9 hrs)

Introduction – Definition and classification. Preparation and properties of Glucose, Fructose and Sucrose – Mutarotation – Epimers and Anomers.D and L configuration. Conversion of glucose into fructose and fructose into glucose. Canesugar – Structure and important properties – Polysaccharides.Starch, Cellulose and Chitin – structure, properties and tests.

UNIT II : Heterocyclic compounds (10 hrs)

Introduction to Heterocyclic systems (5 membered, 6 membered and condensed systems.) Structure of pyrrole, Furan and Thiophene.Electrophilic substitution in pyrrole, Furan and Thiophene. Reactivity and orientation – Saturated 5 numbered heterocyclics – Structure and

properties of pyridine. Electorphilic and nucleophilic substitution reactions in pyridine – Basicity and reduction.Quinoline and isoquinoline – preparation and properties.

UNIT III : Nucleic acids **(7 hrs)**Classification – Purine and pyrimidine bases - structure of DNA and RNA – Functions of Nucleic Acids – DNA replication –Bio synthesis of Proteins – Test for DNA and RNA. Effect of hydrogen bonding in biologicalsystems.

UNIT IV : Amino acids and proteins **(9 hrs)**

Classification of Amino acids – Physical and Chemical Properties – Zwitter ions – Iso Electric point – Sorensons formal titration – chromatographic separation of amino acids – Peptides – Proteins classification, characterization by electrolysis – Primary, Secondary and Tertiary level structures of proteins – Tests for Proteins.

UNIT V : Enzymes, Vitamins and Hormones **(10 hrs)**

Enzymes – General Nature – Mechanism of Enzyme action, Enzyme catalysis, Michaelis – Menten equation (No derivation) – Application of Enzymes, Enzyme deficiency deceases – Vitamins – Classifications structure of Vitamin A, B and C. Hormones – Classification – Structures of progesterone, Testosterone, cortisone, adrenaline and Thyroxine.

UNIT VI : Bio inorganic compounds **(9 hrs)**

Introduction - Metal ions in biological system – Metals in medicine – metal – nucleic acid interaction – biochemistry of iron – haemoglobin and myoglobin – structure and functions – Mechanism of O2 and CO2 transportation – Nitrogen Fixation Na-K pump – Bio chemistry of Zn Co and Ca in biological system.

Distribution of Marks for Complementary Elective Course

Marks including choice:

Unit	Marks	Unit	Marks
I	10	V	10
II	8	VI	8
III	6		
IV	10		

Type of Questions & Marks for External Examination- Complementary Elective Course

	Total Questions	No. Of Questions to be answered	Mark for each Question	Total Marks
Very short answer	5	5	1	5
Short answer	6	4	2	8
Short essay/Problems	5	3	3	9
Essay	4	2	5	10
	20	14		32

References:

1. Inorganic chemistry : Puri and Sharma
2. Inorganic chemistry : P.L.Soni
3. Concise inorganic chemistry : J.D.Lee
4. Basic inorganic chemistry : Cotton and Wilkinson
5. Physical Chemistry : Puri and Sharma
6. Physical Chemistry P.L.Soni and Dharmarah
7. Elements of Physical Chemistry Glasstone and Lewis
8. University Chemistry Bruce M Mahan and Rollie J Myers
9. Basic Physical Chemistry Moore W.J
10. Essentials of Physical Chemistry Bahl,Tuli and Arun
11. Advanced organic Chemistry : Jerry March
12. Organic Chemistry Morrison and Boyd
13. Environmental Chemistry A.K.De
14. Organic Chemistry Vol. 1 and II I.L.Finar
15. Polymer Chemistry Gawarikar and Vishvanadhan
16. Organic reaction mechanism : Peter Sykes
17. Organic reaction mechanism : Mukherjee and Singh
18. Organic photochemistry: Depuy and Chapman
19. Organic Spctroscopy William Kemp
20. Pragathi's Instrumental Methods of Analysis : H.Kaur