# UNIVERSITY DEPARTMENTS
# ANNA UNIVERSITY:: CHENNAI 600 025
# REGULATIONS - 2013
# CURRICULUM I TO IV SEMESTERS (FULL TIME)
# M.Sc. APPLIED CHEMISTRY

## SEMESTER I

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OBJECTIVES
- To make the students conversant with wet chemical analysis, electro analytical and spectral methods of quantitative estimations.
- To impart thorough understanding of theory, instrumentation and applications of thermal methods and chromatographic techniques that are widely used in industries for testing quality of raw materials, intermediates and finished products.

OUTCOME
- Can identify the method of analysis for any given compound in the industrial context.
- Can identify and estimate compounds using spectral methods.
- Will be familiar with the analytical techniques available.

UNIT I  WET CHEMICAL METHODS OF ANALYSIS  9
Volumetric analysis – neutralization, precipitation, complexometric and redox titrations - theoretical titrations curves - theory of indicators; Gravimetric analysis - volatilization and precipitation methods - homogeneous precipitation.

UNIT II  SPECTRAL METHODS  9
Molecular and atomic spectroscopy - interaction of electromagnetic radiation with matter – Beer-Lambert law - UV / Visible absorption spectroscopy- photometric titrations, IR absorption spectroscopy; Fluorescence and phosphorescence methods; Atomic spectroscopy – atomic absorption spectrometry; Emission spectroscopy - flame photometry and ICP-AES; Principles, instrumentation and analytical applications of spectral methods.

UNIT III  ELECTROANALYTICAL TECHNIQUES  9
Conductometry, Potentiometry, pH-metry, Ion selective electrodes; Electrogravimetry and coulometry; Voltammetry – polarography, amperometric titrations principles, practice and applications.

UNIT IV  SEPARATION TECHNIQUES  9
Solvent extraction and ion exchange techniques – principles and applications; Chromatographic techniques – adsorption chromatography, thin layer chromatography, gas chromatography, high performance liquid chromatography and size exclusion chromatography; Supercritical fluid chromatography.

UNIT V  Thermal methods of analysis, and evaluation of analytical data  9
Thermal analytical techniques – TGA, DTA and DSC – principles, instrumentation and applications; Types of errors - evaluation of analytical data - statistical methods.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVES
- To provide exposure to the students to understand concepts of chemical thermodynamics and partial molar quantities.
- To familiarize the students with phase equilibria.
- To develop an understanding of electro chemistry principles upon which various applications such as batteries, fuel cells and electro metallurgy are built.

OUTCOME
- Will be in a position to identify spontaneous reaction along with its thermodynamic principles
- Will be able to understand influence of chemical potential
- Can solve Phase equilibria problems and recognize changes at the phase
- Can apply electrochemical principles to the benefit of mankind

UNIT I CONCEPTS OF CHEMICAL THERMODYNAMICS
9
First law of thermodynamics – Joule Thomson effect – Second law of thermodynamics - Free energy and work function - physical significance of free energy and work function - variation of free energy - pressure and temperature - Variation of work function - temperature and volume – Maxwell’s relations – third law of thermodynamics - entropies of chemical reactions.

UNIT II PARTIAL MOLAR QUANTITIES
9
Partial molar properties – chemical potential – Van’t Hoff’s equation - Gibbs- Duhem equation - Variation of chemical potential with temperature and pressure - applications of chemical potential.

UNIT III PHASE EQUILIBRIA
9
Gibb’s Phase rule-two component systems – classification – liquid-liquid and liquid vapourequilibria ( fractional distillation ) solid – gas (dehydration and rehydration of CuSO₄. 5H₂O), solid-liquid systems (Bi-Cd, Al-Mg and – benzene – picric acid systems)– three component systems involving liquid–liquid equilibria.

UNIT IV ELECTROCHEMISTRY
9

UNIT V APPLIED ELECTROCHEMISTRY
9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVES
- To make the students conversant with the atomic structure and non-valence forces.
- To familiarize the students with the structures of crystals and theories on covalent bonding.
- To teach the significance of acid – base concepts, aqueous and non-aqueous chemistry.

OUTCOME
- Will be aware of atoms and their periodicity and the forces acting in the molecule
- Will be competent in predicting crystal structure of molecules and understand the theories behind covalent bond formation.
- Will appreciate the use of relevant solvents in synthesis

UNIT I ATOMIC STRUCTURE
Wave equation – hydrogen atom and polyelectron atoms; electronic configuration and term symbols, periodic properties of elements – atomic size, ionization energy, electron affinity, electronegativity, covalent and ionic radii, magnetic properties.

UNIT II NON-VALENCE FORCES

UNIT III CRYSTAL STRUCTURE
Radius ratio, structures of AX, AX₂, A₂X₃, ABX₃ and A₂BX₄ type solids – layer structure – cadmium iodide; covalent solids – diamond, graphite.

UNIT IV COVALENT BOND
Valence bond theory – hybridization and resonance – diatomic and polyatomic systems; VSEPR theory; molecular orbital theory – LCAO approximation for diatomic and polyatomic systems

UNIT V AQUEOUS AND NON-AQUEOUS CHEMISTRY
Acid-base concepts, HSAB theory, non-aqueous solvents – reactions in liquid ammonia, sulphuric acid, aprotic solvents; molten salts; electrode potentials and applications in inorganic systems.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

OBJECTIVES
- To acquaint the students with the types and mechanisms of organic reactions.
- To make the students knowledgeable in addition, substitution and elimination reactions.
- To provide comprehensive knowledge on name reactions and rearrangements.
OUTCOME: the student

- Gains the skill to identify reaction intermediates in order to understand any given reaction.
- Can discriminate a substitution reaction from an elimination reaction.
- Has a wide-ranging idea about the accepted name reactions.
- Will be able to identify the rearrangement occurring in a given reaction.

UNIT I ADDITION REACTIONS

- Reactive intermediates - formation and stability of carbonium ions, carbanions, carbenes and carbonoids, nitrenes, radicals and arynes - addition to carbon-carbon and carbon-hetero multiple bonds - electrophilic, nucleophilic and free radical additions - stereochemistry of addition to carbon-carbon multiple bonds - orientation and reactivity - addition to conjugated systems and orientation - addition to \( \alpha,\beta \)-unsaturated carbonyl compounds.

UNIT II SUBSTITUTION REACTIONS

- Aliphatic nucleophilic substitutions - \( S_N1 \), \( S_N2 \) and \( S_Ni \) mechanisms - effects of substrate, attacking nucleophile, leaving group and solvent - stereochemistry of nucleophilic substitution reactions - mechanism of ester hydrolysis (\( B_{AC}^2 \), \( A_{AC}^2 \) and \( A_{AL}^1 \)) - alkylation of active methylene compounds - substitutions at carbonyl, bridgehead, vinylic and allylic carbons - neighbouring group participation - labelling and kinetic isotope effects - norbornylation and other non-classical carbocations, ambident nucleophiles - O versus C alkylation - aromatic nucleophilic substitution - mechanisms - effects of substrate, structure, leaving group and attacking nucleophile - various methods of benzyne generation and reactions of benzyne, reactions of aryl diazonium salts - vicarious nucleophilic substitution (VNS) - aromatic electrophilic substitution reactions and mechanisms.

UNIT III ELIMINATION REACTIONS

- E1, E2 and ElcB mechanisms - stereochemistry of E2 elimination - Hofmann and Saytzeff rule - competition between elimination and substitution reactions - orientation effects in elimination reactions - effects of substrate structures, attacking base, leaving group and medium on E1 and E2 reactions - pyrolytic eliminations - Bredt's rule.

UNIT IV NAME REACTIONS


UNIT V REARRANGEMENTS


TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8111 INORGANIC CHEMISTRY LABORATORY L T P C
0 0 12 6

OBJECTIVES
- To impart the knowledge on quantitative inorganic analysis of ores, alloys and industrial chemical products.
- To teach the importance of water analysis so as to enable complete quality assessment of water for domestic and industrial use.
- To train the students “hands-on” in qualitative inorganic semi-micro analysis and preparation of complexes

OUTCOME
- Will be capable of analyzing ore, alloy, metal samples
- Will be competent in solving analytical issues in industry
- Can analyze any industrial waste water.
- Can detect ions given in micro quantities and prepare industrially useful complexes.

UNIT I QUANTITATIVE INORGANIC ANALYSIS 36
(i) Ores: oxides and carbonate ores
(ii) Alloys: ferrous and nonferrous alloys-brass and solder
(iii) Spectrophotometry- estimation of copper, nickel, iron and manganese

UNIT II ESTIMATION OF INDUSTRIAL PRODUCTS 36
(i) Active CaO in lime
(ii) Chlorine in bleaching powder
(iii) Analysis of cement -silica, mixed oxide – Fe₂O₃, Al₂O₃ &CaO/MgO
(iv) Lead content in red lead

UNIT III WATER ANALYSIS 36
(i) Total dissolved solids
(ii) Carbonate and non-carbonate hardness by EDTA
(iii) Dissolved oxygen, BOD, COD
(iv) Alkalinity
(v) F, Cl, SO₄²-, Fe³⁺
(vi) Turbidity

UNIT IV PREPARATION OF TYPICAL INORGANIC COMPLEXES 36

UNIT V QUALITATIVE INORGANIC SEMI-MICRO ANALYSIS 36
Detection of atleast four cations (2 common and 2 uncommon) in a mixture of salts.

TOTAL: 180 PERIODS
TEXT BOOKS

REFERENCES

AC8201 CO-ORDINATION CHEMISTRY L T P C
3 0 0 3

OBJECTIVES
- To provide basic understanding of the geometry, isomerism and stability of coordination compounds.
- To make the students conversant with theories of metal-ligand bonds and the magnetic and spectral properties of complexes.
- To facilitate the understanding of reactions of coordination compounds of d and f block metals.

OUTCOME
- Can name and identify the geometry and isomerism in coordination compounds.
- Will be familiar with the theories behind the bond formation and predict their spectral properties.
- Will have a general understanding of the rare earth metals and their applications.

UNIT I COORDINATION COMPOUNDS

UNIT II THEORIES OF METAL LIGAND BOND
Valence bond theory – hybridization; crystal field theory – crystal field splitting, crystal field stabilization energy – thermodynamic, structural, spectral and magnetic characteristics, John-Teller effect, ligand field theory; molecular orbital theory – pi bonding.

UNIT III SPECTRA OF COORDINATION COMPOUNDS
Spectral characteristics - Free ion terms, transformations in crystal field, energy diagrams in weak and strong field cases – Tanabe-Sugano diagrams, selection rules; magnetic properties – Van Vleck equation, magnetic susceptibility – Guoy and Faraday methods; ESR spectra of transition metal ions.

UNIT IV REACTIONS OF COORDINATION COMPOUNDS
Inert and labile complexes; substitution reactions in square-planar and octahedral complexes – factors affecting reactivities; electron transfer reactions- outer sphere and inner sphere mechanisms; photochemical reactions of coordination compounds – substitution, red-ox and rearrangement reactions.
UNIT V COMPARATIVE CHEMISTRY OF OXIDATION STATES OF D AND F BLOCK METALS

Lanthanides – occurrence, isolation, lanthanide contraction, oxidation states, spectral and magnetic properties, coordination complexes; actinides- configuration, properties; nuclear reactions of uranium, thorium and plutonium- power generation by nuclear reactors, breeder reactor, fusion reaction, radioisotopes and their applications.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8202 INTRODUCTORY PRINCIPLES OF CHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES
- To teach chemical engineering concepts and heat transfer.
- To make student appreciate the purpose of mass transfer operations and also mechanical operations.
- To make the student acquire knowledge on unit processes.

OUTCOME
- Will have a basic understanding of the engineering concepts involved in the chemical industry.
- Knows the importance of heat and mass transfer in the industrial operations.
- Can associate the reactions that he has already learnt with the actual process in the industry.

UNIT I CHEMICAL ENGINEERING CONCEPTS

UNIT II HEAT TRANSFER

UNIT III MASS TRANSFER OPERATIONS
UNIT IV  MECHANICAL OPERATIONS
Laws of crushing – Closed and Open circuit grinding – Various types of Crushers and Grinders – Settling, Floatation and Filtration concepts.

UNIT V  UNIT PROCESSES
Nitration, Sulphonation, Halogenation, Esterification, Amination, Saponification and Hydrogenation – Role of the above unit processes in such industries as petroleum, drugs, pharmaceuticals and organic synthesis.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8203  STEREOCHEMISTRY AND ORGANIC SYNTHESIS  L T P C
3 0 0 3

OBJECTIVES
- To impart knowledge on stereo chemistry
- To provide understanding of reagents and synthetic methods in organic synthesis.
- To teach basics of photochemistry applied to organic compounds and pericyclic reactions for organic synthesis.

OUTCOME
- Will be able to clearly understand the stereochemistry of organic reactions
- Will be conversant in applying available reagents in organic synthesis
- Will be capable of planning an organic synthesis
- Has a general understanding of photochemical processes and pericyclic reactions.

UNIT I  STEREOCHEMISTRY
Optical activity and chirality - classification of chiral molecules as asymmetric and dissymmetric - Newman, Sawhorse Wedge and Fischer projection formulae and interconversion - R,S-nomenclature - diastereoisomerism in acyclic and cyclic systems - enantiotopic, homotopic and diastereotopichydrogens and prochiral carbons - optical activity of biphenyls, allenes and spirans - stereospecific and stereoselective syntheses- asymmetric synthesis - Cram’s rule - Prelog’s rule - conformational analysis of cyclic and acyclic compounds - conformation and reactivity - conformation and stereochemistry of cis and trans decalin and 9-methyl decalin - E,Z-nomenclature - E,Z-isomerism of olefins containing one double bond and more than one double bond - determination of configuration of geometrical isomers using physical and chemical methods.
UNIT II  REAGENTS IN ORGANIC SYNTHESIS
Diborane  -  lithium aluminium hydride - sodium borohydride - selenium-di-oxide - osmium tetroxide - phenyl isothiocyanate - N-bromosuccinimide (NBS) - lead tetraacetate - dicyclohexylcarbodiimide (DCC) - pyridiniumchlorochromate (PCC) - Swern oxidation - p-toluenesulphonyl chloride - trifluoroacetic acid - lithium disopropylamide (LDA) - 1,3-dithiane (reactive umpolung) - crown ethers - trimethylsilyl iodide - Gilman reagent - dichlorodicyanobenzoquinone (DDQ) - lithium dimethylcuprate - tri-n-butylin hydride - di-tert-butoxydicarbonate - dihydropyran - phase transfer catalysts - Wilkinson’s catalysts - Peterson synthesis - and diethylaluminium cyanide - IBX and Swern oxidations.

UNIT III  MULTISTEP SYNTHESIS

UNIT IV  PHOTOCHEMISTRY AND AROMATICITY

UNIT V  PERICYCLIC REACTIONS

TEXT BOOKS

REFERENCES
OBJECTIVES
- To impart knowledge on basics of quantum chemistry and group theory.
- To make the student conversant with the statistical thermodynamics and separation of partition functions and quantum statistics.
- To facilitate the understanding of non-equilibrium thermodynamics.

OUTCOME
- Will know the basics of quantum chemistry.
- Can apply symmetry operations to a given molecule
- With the help of quantum mechanical principles can have a general perception of statistical and non equilibrium thermodynamics

UNIT I QUANTUM CHEMISTRY

UNIT II MOLECULAR SYMMETRY AND GROUP THEORY

UNIT III STATISTICAL THERMODYNAMICS

UNIT IV SEPARATION OF PARTITION FUNCTIONS AND QUANTUM STATISTICS

UNIT V NON-EQUILIBRIUM THERMODYNAMICS

TEXT BOOKS

REFERENCES
3. L.K. Nash and Addison, Elements of Statistical Thermodynamics, Wiley Pub Co. 1971
OBJECTIVES

- To make the student conversant with the quantitative organic analysis and also qualitative analysis of two-component mixtures.
- To acquaint the student with purification of solvents and reagents and also organic preparations.
- To teach the students, the identification of organic compounds by instrumental methods.

OUTCOME

- Will be able to analyze and quantify any given organic compound.
- Will be competent in separation and purification technique.
- Will be capable of utilizing instrumental methods to identify compounds

UNIT I QUANTITATIVE ORGANIC ANALYSIS

30

Percentage purity of aniline, phenol, acetone, glucose and glycerol. Determination of acid value, saponification value and iodine value of oils. Determination of fatty acid content, total alkali content and moisture content of soap

UNIT II QUALITATIVE ANALYSIS OF TWO-COMPONENT MIXTURES

30

Separation of two component mixture, analysis for hetero atoms, functional group analysis, derivative preparation and confirmatory tests

UNIT III PURIFICATION OF SOLVENTS AND REAGENTS

45

Purification of liquids by distillation. Purification of solids by recrystallization. Determination of melting point. Determination of boiling point by capillary method. Analysis with thin layer and column chromatographic techniques

UNIT IV ORGANIC PREPARATIONS

45

Preparation of dimethylaminopropiophenone hydrochloride by Mannich reaction. Two-stage preparation of a few organic compounds. Phase transfer catalysis. Synthesis of azo dyes

UNIT V IDENTIFICATION of organic compounds by instrumental methods

30

UV, IR, NMR, Mass spectroscopy and TGA

TOTAL: 180 PERIODS

TEXT BOOKS


REFERENCES

OBJECTIVES
- To make the student conversant with kinetics and mechanism of gas phase reactions.
- To provide exposure to the students to understand surface phenomena and heterogeneous catalysis.

OUTCOME
- Will be competent in analyzing the rates of chemical reactions.
- Will be familiar with the significant mechanisms and its theories.
- Understands the concepts of surface chemistry and the methods of analysis

UNIT I KINETICS

UNIT II MECHANISM OF GAS PHASE REACTIONS

UNIT III HOMOGENEOUS CATALYSIS

UNIT IV SURFACE PHENOMENA AND HETEROGENEOUS CATALYSIS

UNIT V SURFACE ANALYTICAL TECHNIQUES
Principles and Applications- Thermal methods, Electron spectroscopy- XPS and AES. Electron microscopy-SEM and TEM – XRD.

TOTAL: 45 PERIODS

TEXT BOOKS
2. B.Vishwanathan, S.Sivasankar and A.V.Ramasamy, Catalysis: Principles and applications, Narosa, 2002

REFERENCES
OBJECTIVES
• To teach the students about the basic principles of spectroscopy.
• To facilitate the understanding of the molecular structures through spectroscopic analyses.
• To enable the interpretation of spectra of unknown compounds.

OUTCOME
• Will be able to analyze and quantify any given organic compound using spectroscopic methods.
  Will be competent in analyzing and interpreting spectral data of any unknown compound.

UNIT I  ELECTROMAGNETIC RADIATION AND ROTATIONAL SPECTROSCOPY  9

UNIT II  ABSORPTION SPECTROSCOPY  12

UNIT III  SPIN RESONANCE SPECTROSCOPY  12

UNIT IV  MASS SPECTROMETRY  7

UNIT V  MOSSBAUER SPECTROSCOPY  5

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVES

- To provide comprehensive information about the synthesis of heterocyclics, alkaloids, proteins and nucleic acids.
- To impart thorough knowledge on the synthesis and structural elucidation of terpenoids, steroids and vitamins.

OUTCOME

- Will be familiar with synthesis of heterocyclics, alkaloids, proteins and nucleic acids.
- Will appreciate the structure of terpenoids, steroids and vitamins.
- Will be able to understand the value of biochemistry in the human body.

UNIT I  HETEROCYCLIC AND ALKALOIDS  10

Synthesis and reactivity of furan, thiophene, pyrrole, thiazole, pyridine, indole and their derivatives, quinoline, isoquinoline, pyrimidine, purine and flavone - Skraup synthesis - Fischer indole synthesis and Pachmannoumarin synthesis - alkaloids - sources and classification - structural elucidation by chemical degradation - total synthesis of quinine, morphine, reserpine, papaverine and nicotine.

UNIT II  PROTEINS AND NUCLEIC ACIDS  8

Classification - structure and synthesis of amino acids – peptides – Merrifield solid phase peptide synthesis - structure determination - peptide sequence and synthesis of - primary, secondary, tertiary and quaternary structures- Merrifield solid phase peptide synthesis - nucleic acids - structure and synthesis of DNA - structure and synthesis of RNA-WC Model

UNIT III  TERPENOIDS  9


UNIT IV  STEROIDS  9

Structural elucidation and stereochemistry of cholesterol, ergosterol, estrone, testosterone, progesterone, cortisone and bile acids.

UNIT V  VITAMINS  9

Structure and synthesis of vitamins A, B₁, B₂, B₆, C, D, E and K.

TOTAL: 45 PERIODS

TEXT BOOKS


REFERENCES

OBJECTIVES
- To teach the preparation, properties and applications of some important organometallic compounds and solid state materials.
- To facilitate the understanding of structure and bonding in inorganic compounds.
- To acquaint the student with the principles and concepts of photochemistry.

OUTCOME
- Gets a general understanding of the essential organometallic compounds and their applications
- Understands the structure of solids and methods to characterize them.
- Is conversant with basics of photochemistry.

UNIT I BASIC ORGANOMETALLIC CHEMISTRY
18 electron rule, ligands, bonding, and electron count; structure, bonding and stereo-chemical non-rigidity in metal carbonyls, metal nitrosyls, metal alkyl and aryl and aryl complexes; basic organometallic mechanisms: ligand exchange, oxidative addition, reductive elimination. Synthesis and reactivity of metal carbonyls; vibrational spectra of metal carbonyls.

UNIT II APPLICATIONS OF ORGANOMETALLIC COMPOUNDS
Catalysis by organometallic compounds - hydrogenation, hydroformylation, Olefin polymerization and co-polymerization, Wacker and Monsanto processes.

UNIT III FOUNDATIONS IN SOLID STATE
Crystalline and amorphous solids; crystal systems; types of close packing - hcp and ccp, packing efficiency, radius ratios; Crystal structure types -CsCl,NaCl, ZnS, CaF₂; Na₂O, rutile (TiO₂), perovskite (CaTiO₃), spinel (MgAl₂O₄); Polyhedral description of solids; defects and non-stoichiometry.

UNIT IV PREPARATION, CHARACTERIZATION AND PROPERTIES OF SOLIDS
Preparation Methods: Solid state reaction, chemical precursor method, co-precipitation, sol-gel, intercalation reactions; template, hydrothermal and high pressure synthesis; Characterization by powder X-ray diffraction; Properties: band theory of solids; electrical, magnetic, optical and dielectric properties.

UNIT V PRINCIPLES AND CONCEPTS IN PHOTOCHEMISTRY
Beer-Lambert law, electronic energy levels, selection rules for electronic transition, Jablonski diagram and photophysical processes, Franck-Condon principle, spontaneous and stimulated emission of radiation, chemical actinometry, solar energy conversion and applications.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVES

- To impart hands-on training on electrochemical analysis techniques.
- To make the students conversant with the experimental methods for kinetics, phase equilibria and spectroscopic analyses.
- To enable the application of the theoretical principles to adsorption, optical property, thermal methods and molecular weight determinations.

OUTCOME

- Will attain excellent experimental skills.
- Will be able to apply the theoretical concepts in the lab.
- Will appreciate the importance of instrumental methods available for analysis.

UNIT I  CONDUCTOMETRY  20

UNIT II  POTENTIOMETRY AND PH-METRY  20
EMF measurement - Potentiometric titrations – red-ox and precipitation titrations; pH measurement, pH-metric titrations – acid-base reactions

UNIT III  KINETICS  20
Determination of order - acetone-iodine reaction; Study of primary salt effect on the kinetics of ionic reaction

UNIT IV  HETEROGENEOUS EQUILIBRIA  20
Determination of CST in phenol-water system; Phase diagram of a ternary system-nitrobenzene–acid–water or water–acetic. Two component solid solutions – eutectic formation, Transition Temperature determination.

UNIT V  THERMODYNAMICS  20
Activity coefficients of weak or strong electrolyte by solubility method. Determination of activity coefficients of an electrolyte at different molalities.

UNIT VI  SPECTROPHOTOMETRIC AND FLAME PHOTOMETRIC METHODS  10
Determination of molar absorptivity – verification of Beer-Lambert equation – Simultaneous estimation of Mn and Cr in solutions containing KMnO₄ and K₂Cr₂O₇. Photometric titration of Fe(III) by EDTA; Estimation of Na/K by flame photometer.

UNIT VII  ELECTRO CHEMICAL METHODS  20
Cyclic voltammetric (CV) studies of redox systems, Corrosion rate determination of materials using Tafel extrapolation method.

UNIT VIII  OPTICAL METHODS  20
Polarimetry - Determination of sucrose content in cane sugar / cane juice Kinetics of hydrolysis of sucrose - effect of acid strength. Abbe’s refractometer- Percentage composition of binary mixtures

UNIT IX  ADSORPTION STUDIES  10
Verification of Freundich isotherm – adsorption of acetic acid, oxalic acid on carbon – determination of surface area of a solid by BET method.
UNIT X  MISCELLANEOUS
Molecular weight of a polymer by viscometry, Demonstration experiments-TGA and DTA, Atomic absorption spectrometry, G.C, HPLC, TOC analyser, FT-IR spectrophotometer, X-Ray Diffraction and GPC

TOTAL : 180 PERIODS

TEXT BOOKS

REFERENCES

AC8001  BIO-ORGANIC CHEMISTRY  L T P C
3 0 0 3

OBJECTIVES
• To make the students conversant with biomolecular cell structures and functions.
• To impart knowledge about structure and functions of proteins, nucleosides, nucleic acids, enzymes, lipids and membranes and facilitate correlation between the properties of biomolecules and bioenergetics.

OUTCOME
• Will be familiar with biomolecular cell structures and functions.
• Will recognize the structure and properties of proteins.
• Will gain the knowledge of enzymes, their kinetics and action in general.
• Will understand the metabolism and energetics in animal tissues.

UNIT I  CELL STRUCTURE AND FUNCTION
Cell structure and function: Molecular logic of living matter, Origin of biomolecules, cell structure – structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells.

UNIT II  INTRODUCTION TO BIOMOLECULES
Introduction to biomolecules: Examples of biomolecules, Building blocks of biomacromolecules, Nature of biomolecular interactions. Types of reactions occurring in cells.

UNIT III  PROTEINS, NUCLEOSIDES AND NUCLEIC ACIDS
Proteins, Nucleosides and nucleic acids: Primary structure of proteins, End group determination, Secondary structure of proteins tertiary structure, oligomeric proteins, ribonucleotides and deoxyribonucleotides, RNA and DNA, Base pairing, double helical structure of DNA and genetic code, transcription, Ribosomes.

UNIT IV  ENZYMES LIPIDS AND MEMBRANES
Enzymes Lipids and membranes: Enzymes categorization catalysis, kinetics –single substrate enzyme catalysed reactions, Inhibition, common class of lipids, self association of lipids, Formation of micelles, membranes, bilayer and hexagonal phases. Membrane bound proteins structure, properties and transport phenomena.
UNIT V  BIOENERGETICS
Bioenergetics: Basic principles, glycolytic pathways, kreb’s cycle, oxidative phosphorylation, hydrolysis of esters and amids, c=c and c=c bond formation, oxidation, reduction, Decarboxylation, Biomimetic reactions, Drug design.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8002  BIO-PROCESS TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES
• To facilitate the understanding of bioprocess principles and enzyme technology.
• To make the student conversant with the microbial processes, product recovery and purification operations in industries

OUTCOME
• Will be familiar with concepts of bioprocess principles and enzyme technology.
• Will gain the knowledge of microbial processes, their kinetics and action in general.
• Will understand product recovery and purification operations in industries.

UNIT I  BIOPROCESS PRINCIPLES
Bioprocess principles – components and objectives; microorganisms – bacteria, yeasts and molds, animal and plant cells – cell structure, biomolecules, cellular organisation, metabolic processes, stoichiometry and energetics elementary aspects of molecular genetics.

UNIT II  ENZYME TECHNOLOGY
Enzyme technology – classification of enzymes, enzyme activity; kinetics of enzyme catalysis; modulation and regulation; immobilization of enzymes; applied enzyme catalysis.

UNIT III  MICROBIAL PROCESSES

UNIT IV  PRODUCT RECOVERY AND PURIFICATION OPERATIONS
Product recovery and purification operations–principles of filtration, centrifugation, cell disruption, extraction, adsorption, precipitation, membrane separation, chromatographic and affinity technique.
UNIT V  BIOPROCESSES AND ENZYME TECHNOLOGY IN INDUSTRIES

Bioprocesses and enzyme technology in industries – fuel generation ethanol and methane production; industrial enzymes; food production and processing – SCP, fermented foods, beverages, dairy products, vegetable and fruit products - pharmaceuticals – antibiotics and monoclonal antibodies.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

AC8003  CHEMICAL PROCESS EQUIPMENT AND INSTRUMENTATION  L  T  P  C 3 0 0 3

OBJECTIVES
- To provide basic understanding of chemical reactors and process equipments.
- To expose the students to measuring devices and computer instrumentation.

OUTCOME
- Will have a basic understanding of the engineering concepts involved in the chemical industry.
- Knows the importance of heat and mass transfer in the industrial operations.
- Can associate the reactions that one has already learnt with the actual process in the industry

UNIT I  CHEMICAL REACTOR

UNIT II  PROCESS EQUIPMENT

UNIT III  MEASURING DEVICES

UNIT IV  PHYSICAL PROPERTIES

UNIT V  Computer instrumentation

TOTAL:45 PERIODS
TEXT BOOKS

REFERENCES

OBJECTIVES
• To impart knowledge to the students on nanotechnology and types of synthesis.
• To make the student conversant with the nano tube, nano wires and nano composites.
• To familiarize the student with applications of nano materials.

OUTCOME
• Will be aware of the synthetic methods of nanomaterials.
• Will have clear understanding of nano tube, nano wires and nano composites.
• Will have an idea of the various fields where nanotechnology can be applied.

UNIT I  NANOTECHNOLOGY  9
Nanotechnology – scope and emerging trends - bottom-up and top-down approaches; chemistry of solid surfaces – surface energy – chemical potential of curved surfaces; stabilization of colloidal dispersions by electrostatic and steric interactions; different types of nano materials.

UNIT II  TYPES OF SYNTHESIS  8
General methods of synthesis of zero-dimensional nano particles – homogeneous nucleation and heterogeneous nucleation, growth of nuclei and factors of importance; synthesis of metallic, semiconductor and metal oxide nano particles.

UNIT III  NANO TUBES AND OTHER MATERIALS  10
Nanotubes - carbon nanotubes – synthetic methods( CVD and MOCVD) for single walled and multi walled nanotubes; Chemical properties hybridization, solubility, stability and functionalization; physical properties- optical, mechanical, magnetic and electrical properties, quantum size effects, Inorganic nanotubes – synthesis and properties. Nanoporous Materials – Silicon - Zeolites, mesoporous materials – nanosponges and its Applications

UNIT IV  NANO WIRES AND NANO COMPOSITES  9
One-dimensional Nanowires and nanorods, two-dimensional thin films, nano composites and nano-structured polymers, nano catalysts, nano clusters – preparation and properties

UNIT V  APPLICATIONS OF NANO MATERIALS  9
Physical techniques for fabrication of nanostructures – photolithography, electron beam lithography and related techniques– nanolithography by scanning tunneling microscopy and atomic force microscopy; assembly of nano particles and nanowires. Applications of nano materials in electronic,solar, and optoelectronic devices

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

AC8005 COMPUTATIONAL METHODS IN CHEMISTRY L T P C
3 0 0 3

OBJECTIVES
- To make the student conversant with the fundamentals of numerical methods and programming.
- To explain the applications of computational methods and programming to basic chemistry problems and chemical analysis.

OUTCOME
- Will be able to appreciate incorporation of computers in chemistry.
- Will be able to use computers as a tool in solving chemistry related problems.
- Will be able to create programs for direct use in problem solving.

UNIT I INTRODUCTION TO COMPUTERS 7

UNIT II NUMERICAL METHODS 7

UNIT III BASIC PROGRAMMING 11
Introduction – I/P & Read statements, Library functions, Statements – if-then, if-then-else, go-to, for-to-next, for-to-next-step, for-to-next-loops, One dimensional and two dimensional arrays – writing simple programs for applications in chemistry.

UNIT IV C PROGRAMMING 11

UNIT V APPLICATIONS OF C PROGRAMMING 9

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

AC8006 CORROSION AND CORROSION CONTROL

OBJECTIVES
• To make the student conversant with the types and mechanism of corrosion.
• To familiarize the student with corrosion testing and corrosion control methods.

OUTCOME
• Will understand the types and mechanism of corrosion.
• Will be able to develop methods for corrosion testing and control.
• Will develop concern for protection of metals.

UNIT I CORROSION 9

UNIT II FORMS OF CORROSION 9

UNIT III CORROSION TESTING 9

UNIT IV FACTORS INFLUENCING CORROSION 9

UNIT V CORROSION CONTROL 9

TOTAL: 45 PERIODS
OBJECTIVES

- To impart knowledge on chemistry and toxic effects of environmental pollutants.
- To provide knowledge about biodegradation and separation processes for pollution abatement.
- To introduce the concept and principles of green chemistry for environmental management.

OUTCOME

- Will have a clear understanding of the hazards of environmental pollution.
- Will be able to discuss pollution abatement methods.
- Will be capable of developing skills and technology towards green chemistry.

UNIT I CHEMISTRY AND THE ENVIRONMENT


UNIT II TOXIC EFFECTS OF POLLUTANTS

Toxic effects of pollutants - toxicity - carcinogenicity - mutagenecity- teratogenicity - Classification of metals (Speciation) - biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur dioxide, ozone and pan, cyanide, pesticides, asbestos.

UNIT III BIODEGRADATION AND SEPARATION PROCESSES


UNIT IV POLLUTION ANALYSIS

Water pollution - water quality parameters—Significance and determination - turbidity, colour, pH, acidity, alkalinity, solids, hardness, chlorides, residual chlorine, sulphates, fluorides, phosphates, iron and manganese, DO, BOD, COD, nitrogen, grease, volatile acids- Soil pollution –heavy metals by x-ray fluorescence- Analysis of Gaseous and particulate air pollutants- Noise pollution.

REFERENCES


TEXT BOOKS

UNIT V  ENVIRONMENTAL GREEN CHEMISTRY


TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8008  FUNDAMENTALS OF POLYMER CHEMISTRY

OBJECTIVES
- To provide basic understanding of the fundamental concepts of polymers and their characteristics.
- To make the students conversant with the types and mechanisms of polymerization.

OUTCOME
- Will be aware of preparation and properties of polymers at length.
- Will be able to methodically discuss moulding techniques.
- Will develop capacity to characterize polymers and draw a parallel to their properties.

UNIT I  BASIC CONCEPTS OF POLYMERS


UNIT II  CHAIN POLYMERIZATION


UNIT III  STEP GROWTH POLYMERIZATION


UNIT IV  POLYMERIZATION TECHNIQUES

Polymerization techniques– homogeneous and heterogeneous polymerisation – bulk (liquid, gas and solid monomers), solution, suspension and emulsion polymerisation –merits and demerits – interfacial, and melt polycondensation
UNIT V  MOLECULAR WEIGHT AND ITS DISTRIBUTION
Number, weight and viscosity average molecular weights of polymers– determination of constants in Mark Houwink’s equation. Poly dispersity index and molecular weight distribution – Molecular weight determination by GPC and viscometry; Polymer dissolution, thermodynamics of polymer dissolution – solubility parameter – Fractionation of polymers-fractional precipitation and fractional dissolution methods.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8009  INDUSTRIAL CATALYSIS  L  T  P  C
3  0  0  3

OBJECTIVES
• To provide basics of catalyst preparation and characterization techniques.
• To explain the principles and operations of catalytic reactors.
• To impart thorough knowledge on the environmental and industrial applications of catalytic processes.

OUTCOME
• Will have in depth knowledge about the catalyst available and their application.
• Will know the characterization techniques.
• Will be able to define conditions of catalytic activity in the industrial environment.

UNIT I  INTRODUCTION TO CATALYSIS AND CATALYSTS PREPARATION
Catalyst definitions, Homogeneous and Heterogeneous catalysts: Definition of catalytic activity, Conversion, selectivity, contact time, time on stream, Kinetics of heterogeneous catalysis, adsorption, phase transfer catalysis, Inter and intramolecular catalysis, enzyme catalysis, photocatalysis and Promoters, stabilizers, Activation energies, Catalysts Preparation: Microporous materials (Zeolites, AlPO-5, 11, Carbon) Mesoporous materials (MCM-41, SBA-15, Alumina and Carbon), Super acids and Hydrotalcites.

UNIT II  CATALYST CHARACTERIZATION TECHNIQUES
Surface area measurements, Chemisorption techniques, Static and dynamic methods, XRD, ESCA (XPS,UPS and AES), ESR, NMR, MASS, Raman, IR spectroscopy and UV-vis, Surface acidity (spectral and thermal methods), Thermal methods; TG-DTA, TPD, TPR, Electron microscopy (SEM, TEM and AFM) and probe molecule characterizations (pyridine, ammonia, NO and CO adsorption).
UNIT III OPERATING CATALYTIC PROCESS AND CATALYST DEACTIVATION 8
Mechanism of performing mass transfer effect in chemical reactions, metal-support interaction, reactors – batch reactor, flow reactor, trickle bed and fluidized bed reactor - Poisons, sintering of catalysts, Pore mouth plugging and uniform poisoning models, Kinetics of deactivation, Catalyst regeneration.

UNIT IV ENVIRONMENTAL CATALYSIS 9

UNIT V INDUSTRIAL CATALYTIC PROCESSES 9
Cracking, reforming, alkylation, isomerization, hydrogenation/dehydrogenation, dehydrocyclisation, dehydrogenation, hydrcracking, oxidation, metathesis, carbonylation, polymerization, synthetic fuels, hydrogen generation. Industrial processes - synthesis of ammonia, synthesis of methanol, vegetable oils conversion, functional group hydrogenations for fine chemicals, Selective oxidation reactions, Ziegler-Natta polymerization, Monsanto process and Hydroformylation.

TEXT BOOKS

REFERENCES
UNIT II  ELECTROMETALLURGY  8
Metal extraction and refining – electro winning – aluminum extraction – manufacture of sodium, lithium and magnesium – hydrometallurgical processes – electro refining – aqueous and molten salt electro refining.

UNIT III  METAL Finishing  12

UNIT IV  ELECTRO SYNTHESIS  9

UNIT V  INDUSTRIAL ELECTROCHEMICAL PROCESSES  8

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS

AC8011  INORGANIC CHEMICAL TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES
- To impart knowledge on the synthesis and properties of important industrial inorganic chemicals such as, fuels, industrial gases, fertilizers and silicates.
- To acquaint the student with the principles and practice of metallurgical processes.

OUTCOME
- Will be appreciative of the utility of various fuel and industrial gases.
- Will be aware of a variety of chemicals used in the industry.
- Will be in a position to maneuver methods in ore extraction.

UNIT I  FUEL AND INDUSTRIAL GASES  9

UNIT II  HEAVY CHEMICALS  9
Chloralkali industry – soda ash, caustic soda, chlorine: Chemicals from sea- sodium chloride, magnesium chloride, bromine.
UNIT III  ACIDS AND FERTILIZERS  9

UNIT IV  SILICATE INDUSTRIES  9
Silicate industries – refractories – abrasives – ceramics – glass – cement, lime, gypsum

UNIT V  PRINCIPLES OF METALLURGICAL PROCESSES  9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8012 ORGANIC CHEMICAL TECHNOLOGY  L  T  P  C
3  0  0  3

OBJECTIVES
- To make the student conversant with the basic principles of chemical technology and industrial organic synthesis.
- To provide knowledge base on the synthesis of industrially important organic fine chemicals, pharmaceuticals, dyes and pesticides.

OUTCOME
- Will have better understanding of synthetic organic chemicals.
- Will obtain awareness about pharmaceutical chemistry.
- Will appreciate apt usage of pesticides and dyes.

UNIT I  BASIC PRINCIPLES OF CHEMICAL TECHNOLOGY  9
Classification of chemical technological processes – chemical equilibrium in technological processes - rates of technological processes – designing and modeling chemical technological processes and reactors.

UNIT II  INDUSTRIAL ORGANIC SYNTHESIS  9
Raw materials – manufacture of methyl alcohol, ethyl alcohol, ethylene, 1,3-butadiene, acetylene – ethyl benzene, cumene, linear alkyl benzenes alkyl phenols.

UNIT III  SYNTHETIC ORGANIC CHEMICALS  9

UNIT IV  PHARMACEUTICALS AND PESTICIDES  9

Attended

S diploma

Centre For Academic Courses
Anna University, Chennai-600 025
UNIT V  

DYES  


TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8013  

PHARMACEUTICAL CHEMISTRY  
L  T  P  C  3 0 0 3

OBJECTIVES
- To impart knowledge on the principles of drug design.
- To provide basic knowledge on the preparation and pharmaceutical properties of classes of drugs such as, antibiotics, antibacterial, antihypertensive, antitubercular and antidiarrheal agents.

OUTCOME
- Will be familiar with principles of drug design.
- Will gain the knowledge of preparation and pharmaceutical properties of various drugs.

UNIT I  

DRUG DESIGN  9


UNIT II  

ANTIHISTAMINES AND ANTIMALARIALS  9


UNIT III  

ANTIBIOTICS AND ANTIBACTERIALS  9

UNIT IV  ANTIHYPERTENSIVE AND ANTITUBERCULAR DRUGS
Antihypertensive drugs— synthesis and mode of action of methyldopa, pargyline, bertyline, hydralazine, propranolol- Antitubercular drugs – synthesis of PAS, ethambutol – pyrazinamide, isoniazid

UNIT V  ANTIDIARRHEAL AGENTS
Antitussives and antineoplastic drugs, antidiarrheal agents – cimetidine, domperidone, loperamide; Expectorants – antitussives – guaiphenesin, ambroxal, bromhexine, dextromethorphan, Antineoplastic drugs - alkylating agents –nitrogen mustards – sulphonic acid esters -

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES

AC8014 POLYMER TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES
• To provide comprehensive knowledge on the preparation and properties of various classes of polymers.
• To impart thorough understanding of the principle and practice of polymer moulding techniques.
• To facilitate understanding of the characterization of polymeric materials and correlation to the properties.

OUTCOME
• Will be aware of preparation and properties of polymers at length.
• Will be able to methodically discuss moulding techniques.
• Will develop capacity to characterize polymers and draw a parallel to their properties.

UNIT I  POLYMERIC MATERIALS

UNIT II  ELASTOMERS
UNIT III Moulding Techniques

UNIT IV Characterization and Testing

UNIT V Polymer Properties
Effect of structure on mechanical, chemical, thermal, electrical and optical properties.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVES
- To impart knowledge on generation of solid waste, solid waste collection and disposal.
- To provide exposure to the students to understand the energy recovery.
- To teach the students about air pollution analysis and control devices.

OUTCOME
- Will have a general idea about solid waste and disposal.
- Will have a general idea about air pollution and control.
- Will be introduced to energy recovery.

UNIT I SOLID WASTE

UNIT II SOLID WASTE COLLECTION AND DISPOSAL
Solid waste generation - on-site handling, storage and processing - collection of solid waste - transfer and transport - ultimate disposal - Screening, Planning and developing a site for solid waste management. Separation of wastes – benefits, reuses and recycles material recovery. Reclamation of polluted and degraded soil by Bioremediation- Phyto-remediation

UNIT III ENERGY RECOVERY
Energy recovery - processing techniques - materials recovery systems – recovery of biological conversion products and thermal conversion products - materials and energy recovery system - Principles, Aerobic & anaerobic composting and energy recovery.

UNIT IV AIR POLLUTION

UNIT V ANALYSIS AND CONTROL DEVICES
Sampling and analysis - particulates and gaseous pollutants - methods for monitoring air pollutants - air quality control devices for particulate and gaseous contaminants - major polluting industries - measures to check industrial pollution. Air Quality Standards

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
OBJECTIVES
- To make the students conversant with the properties of textile fibres and their processing
- To explain the significance and practice of dyeing, printing and finishing operations.

OUTCOME
- Will be aware of the preparation and properties of fibers.
- Will have clear understanding of the concept of dyeing.
- Will be familiar with the stages involved in textile processing.

UNIT I PROPERTIES OF TEXTILE MATERIALS 10
Classification of textile fibres – chemical structure, physical and chemical properties of textile fibers – cotton, wool, silk, viscose, rayon, synthetic fibres.

UNIT II PREPARATORY PROCESSES 10
Brief outline on desizing, singeing and mercerization, scouring – bleaching with hypochlorite’s and peroxides.

UNIT III DYEING 15

UNIT IV PRINTING 5
Stages involved in printing – printing paste ingredients, styles and methods of printing. Outline on printing of cotton fabrics with reactive dyes, polyester fabrics with disperse dyes.

UNIT V FINISHING 5
Classification – calendaring, crease proofing and shrink proofing.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
UNIT I  PREPARATORY PROCESSES  7
Preparation to coloration and finishing of natural, manmade fibers and their blends – desizing, singeing, scouring, mercerizing and bleaching.

UNIT II  DYEING  11
Theory of dyeing fundamentals involved in the theory of dyeing. Dyeing of various textile fibres and their blends – dyeing of cotton, wool, silk and manmade fibres with direct, acid, basic, reactive, sulphur, vat, aryo, disperse dyes and other special dyes.

UNIT III  MACHINERY FOR PREPARATION AND DYEING  10
Machines used for preparation and dyeing processes - singeing, mercerizing, scouring machines - bleaching ranges dyeing machines – jigger, winch padding ranges, HTHP machines, jet dyeing machines and overflow dyeing machines.

UNIT IV  PRINTING & MACHINERIES  10

UNIT V  FINISHING  7
Finishing of textile materials – scotching, calendaring, starching, creeping, anti-shrinking, crease-proofing, wool-finishing and other finishes.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

AC8018  WATER AND WASTEWATER TREATMENT  L T P C
3 0 0 3

OBJECTIVES
• To provide basic understanding about the requirements of water, its preliminary treatment.
• To make the student conversant with the water treatment methods including adsorption and oxidation process.

OUTCOME
• Will appreciate the necessity of water and acquire knowledge of preliminary treatment.
• Will gain idea about various methods available for water treatment.
• Will have knowledge about adsorption and oxidation process.

UNIT I  REQUIREMENTS OF WATER AND PRELIMINARY TREATMENT  9
UNIT II  INDUSTRIAL WATER TREATMENT  9
Filteration – size and shape characteristics of filtering media – sand filters hydraulics of
filtration – design considerations – radial, upflow, highrateand multimedia filters, pressure filter.
Water softening – lime soda, zeolite and demineralization processes – industrial water
treatment for boilers.

UNIT III  TREATMENT METHODS  9
Taste and odour control – adsorption – activated carbon treatment – removal of color – iron and
manganese removal – aeration, oxidation, ion exchange and other methods – effects of
fluorides – fluoridation and defluoridation –desalination - corrosion prevention and control –
factors influencing corrosion – Langelier index – corrosion control measures.

UNIT IV  WASTEWATER TREATMENT  9
Wastewater treatment – pre and primary treatment – equalization neutralization – screening
and grid removal – sedimentation – oil separation gas stripping of volatile organics – biological
oxidation – lagoons and stabilization basins – aerated lagoons – activated sludge process –
trickling filtration – anaerobic decomposition.

UNIT V  ADSORPTION AND OXIDATION PROCESSES  9
chemical process – adsorption – theory of adsorption – ion exchange process – chemical
oxidation – advanced oxidation process – sludge handling and disposal – miscellaneous
treatment processes.

TOTAL: 45 PERIODS

TEXT BOOKS
   (1989).

REFERENCES
   Company Ltd. (1994).
3. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous – Environmental