UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY:: CHENNAI 600 025

REGULATIONS - 2013

CURRICULUM I TO IV SEMESTERS (FULL TIME)

M.Sc. APPLIED CHEMISTRY

SEMESTER I

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AC8101	Analytical Chemistry	3	0	0	3
AC8102	Chemical Thermodynamics and Electrochemistry	3	0	0	3
AC8103	Concepts in Inorganic Chemistry	3	0	0	3
AC8104	Organic Reactions and Mechanisms	3	0	0	3
	Elective I	3	0	0	3
PRACTICAL					
AC8111	Inorganic Chemistry Laboratory	0	0	12	6
	TOTAL	**15**	**0**	**12**	**21**

SEMESTER II

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AC8201	Co-ordination Chemistry	3	0	0	3
AC8202	Introductory Principles of Chemical Engineering	3	0	0	3
AC8203	Stereochemistry and Organic synthesis	3	0	0	3
AC8204	Theoretical Chemistry	3	0	0	3
	Elective II	3	0	0	3
PRACTICAL					
AC8211	Organic Chemistry Laboratory	0	0	12	6
AC8212	Seminar	0	0	2	1
	TOTAL	**15**	**0**	**14**	**22**

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AC8301	Kinetics and Catalysis	3	0	0	3
AC8302	Molecular Spectroscopy	3	0	0	3
AC8303	Natural products	3	0	0	3
AC8304	Organometallic, solid state and photochemistry	3	0	0	3
	Elective III	3	0	0	3
PRACTICAL					
AC8311	Physical Chemistry Laboratory	0	0	12	6
	TOTAL	**15**	**0**	**12**	**21**

SEMESTER IV

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COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
	Elective IV	3	0	0	3
	Elective V	3	0	0	3
PRACTICAL					
AC8411	Project work	0	0	20	10
	TOTAL	**6**	**0**	**20**	**16**

TOTAL CREDITS: 80

ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AC8001	Bio-organic Chemistry	3	0	0	3
AC8002	Bio-Process Technology	3	0	0	3
AC8003	Chemical Process Equipment and Instrumentation	3	0	0	3
AC8004	Chemistry of Nanomaterials	3	0	0	3
AC8005	Computational Methods in Chemistry	3	0	0	3
AC8006	Corrosion and Corrosion Control	3	0	0	3
AC8007	Environmental and Green Chemistry	3	0	0	3
AC8008	Fundamentals of Polymer Chemistry	3	0	0	3
AC8009	Industrial Catalysis	3	0	0	3
AC8010	Industrial Electrochemistry	3	0	0	3
AC8011	Inorganic Chemical Technology	3	0	0	3
AC8012	Organic Chemical Technology	3	0	0	3
AC8013	Pharmaceutical Chemistry	3	0	0	3
AC8014	Polymer Technology	3	0	0	3
AC8015	Solid Waste Management and Air Pollution	3	0	0	3
AC8016	Textile Chemistry	3	0	0	3
AC8017	Textile Processing	3	0	0	3
AC8018	Water and Wastewater Treatment	3	0	0	3

AC8101	ANALYTICAL CHEMISTRY	L	T	P	C
		3	0	0	3

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 evaluationof 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

1. D.A.Skoog, D.M.West, F.J. Holler and S.R.Crouch, " Fundamentals of Analytical Chemistry", 8th Edn., - Thomson Brooks/Cole Pub. (2005).
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press (2012).

REFERENCES

1. Robert D. Braun, "Introduction to Instrumental analysis", Pharma Book Syndicate, Indian reprint (2006).
2. J.Mendham, R.C.Denney, J.D. Barnes, .J.K.Thomas, and B.Sivasankar" Vogel's Text book of quantitative chemical analysis", 6th Edn., Pearson Education (2009).
3. F.W. Fifield and D.Kealey, "Principles and Practice of Analytical Chemistry, 1st Indian Reprint, Blackwell Pub. (2004).
4. H.H Willard, L.L Merritt, J.A Dean, and F.A Settle, "Instrumental Methods of Analysis", 7th Edn., -CBS Pub (2004).

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AC8102 CHEMICAL THERMODYNAMICS AND ELECTROCHEMISTRY

L	T	P	C
3	0	0	3

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

- Willbe in a position to identify spontaneous reaction along with its thermodynamic principles
- Will be able to understand influence of chemical potential
- Can solve Phase equillibria 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 $CuSO_4$. $5H_2O$), solid-liquid systems (Bi-Cd, Al-Mg and – benzene – picric acid systems)– three component systems involving liquid–liquid equilibria.

UNIT IV ELECTROCHEMISTRY 9

Electrochemical cells - electrical double layer – various models – electro capillary phenomena – –electro-osmosis - electrophoresis –kinetics of electrode processes – Butler–Volmer equation – Tafel equation.

UNIT V APPLIED ELECTROCHEMISTRY 9

Electrochemical energy conversion - Batteries- - dry cells - lead accumulators - Ni-Cd - lithium ion-fuel cells (Hydrogen – Oxygen). Corrosion - theories of corrosion – types of corrosion-galvanic – pitting – waterline – corrosion control – cathodic protection - sacrificial anodic protection – impressed current cathodic protection - electroplating – electroforming and electrochemical machining.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P. W. Atkins, and J.D. Paula, Physical Chemistry, 7th Edn. Oxford University Press, London (2012).
2. P.A. Alberty and R.U. Silbey, Physical Chemistry 1st Edn. John Wiley and Sons Inc. (2000).

REFERENCES

1. E.V.Anslyn and D.A.Dougherty, "Modern Physical Chemistry", University Science Books, Sausalito, USA (2006).
2. J.C. Kuriacose and J.Rajaram, Thermodynamics for students of Chemistry, 4rd Edn. S.Chand& Co., New Delhi (2002).
3. C.M.Starks, Phase transfer catalysis – Principles and Techniques Academic Press, New York (1978).
4. Philip H.Reiger, Electrochemistry, 2nd Prentice Hall Inc., New Delhi (1994).

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AC8103 CONCEPTS IN INORGANIC CHEMISTRY L T P C
3 0 0 3

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

- Willbe 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 9

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 9

Van der Waals'forces, hydrogen bond –clathrates, metallic bond – free electron theory of metals, ionic solids – lattice energy – Born-Haber cycle.

UNIT III CRYSTAL STRUCTURE 9

Radius ratio, structures of AX, AX_2, A_2X_3, ABX_3 and A_2BX_4 type solids – layer structure – cadmium iodide; covalent solids – diamond, graphite.

UNIT IV COVALENT BOND 9

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 9

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

1. F.A. Cotton, G. Wilkinson and P. L. Gaus, "Basic Inorganic Chemistry", 3rd Edn. John Wiley and Sons, 2004.
2. D.F. Shriver and P. W. Atkins, "Inorganic Chemistry", 5th Edn. Oxford University Press (2011).

REFERENCES

1. J. D. Lee, Concise Inorganic Chemistry, 5th Edn. Wiley-India Edition (2009).
2. J.E. Huheey, E.A. Keiter and R.L. Keiter, "Inorganic Chemistry: Principles of structure and reactivity", 4th Edn. Pearson Education (2009).
3. A.G. Sharpe, "Inorganic Chemistry", 3rd Edn., 2nd Impression, Pearson Education (2009).
4. W. L. Jolly, "Modern Inorganic Chemistry", 2nd Edn. Tata McGraw –Hill Pub.Co. (2007)

AC8104 ORGANIC REACTIONS AND MECHANISMS L T P C
3 0 0 3

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.

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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 8

Reactive intermediates - formation and stability of carbonium ions, carbanions, carbenes and carbenoids, 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 α,β-unsaturated carbonyl compounds.

UNIT II SUBSTITUTION REACTIONS 10

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 - norbornylcation 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 7

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 10

Birch, Clemmensen, Wolff-Kishner and Meerwein-Ponndorf-Verley reductions - Oppenauer oxidation - Claisen, Dieckmann, Benzoin, Darzens and Stobbe condensations - Chugaev and Cope eliminations - Michael addition - Mannich reaction - Wittig reaction - Chichibabin reaction - Hunsdiecker reaction - Robinson annulation - Hell-Volhard-Zelinsky reaction - Japp-Klingemann reaction - Stork enamine alkylation - Ziegler alkylation - Vilsmeier-Haack reaction - Heck reaction - Shapiro reaction - Polonovski reaction - Sharpless asymmetric epoxidation - Hofmann-Loffler-Freytag reaction - Reformatsky reaction - Simmons-Smith reaction - Gattermann-Koch reaction - Schiemann reaction - von Braun reaction - Ullmann reaction - Thorpe reaction.

UNIT V REARRANGEMENTS 10

General mechanistic considerations - nature of migration - migratory aptitude - nucleophilic, electrophilic and free radical rearrangements - Wagner-Meerwein, McLafferty, Demyanov, Benzil-benzilic acid, Favorskii, Fritsch-Buttenberg-Wiechell, Neber, Hofmann, Curtius, Beckmann, Schmidt, Lossen, Wolff, Baeyer-Villiger, Dienone-phenol, Pinacol, Stevens, Wittig, Chapman, Wallach, Orton, Bamberger, Pummerer and von Richter rearrangements.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jerry March, Advanced Organic Chemistry, - Reactions, Mechanisms and Structure - 4th edition, John Wiley & Sons , New York, 2006.
2. R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th edition, Prentice-Hall of India Private Ltd., New Delhi 2006.

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REFERENCES

1. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part A & B, 5th Edition, Springer, New York, 2007.
2. T.W. Graham Solomons, Organic Chemistry, 10th edition, John Wiley & Sons, New York 2009.
3. Michael B Smith and Jerry March, "MARCH's Advanced Organic Chemistry Reactions, mechanisms and structures ", 6thEdn.,John Wiley & Sons (2007).
4. R.K. Mackie and D.M. Smith, Guide book to Organic Synthesis, 2nd edition, ELBS Publications, London (1998).

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 – Fe_2O_3, Al_2O_3 &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, SO_4^{2-}, Fe^{3+}
(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

1. J.Mendham, R.C.Denney, J D Barnes, M. Thomas and B. Sivasankar, Vogel's text book of quantitative chemical analysis, Pearson Educaion Ltd., Indian subcontinent edition, 2009.
2. V.V. Ramanujam, "Inorganic Semi Micro Qualitative Analysis", 3rd Edn. The National Publishing Company (1994 reprint 2004)

REFERENCES

1. Svehla and B.Sivasankar, " Vogel's Qualitative Analysis", 7thEdn. Pearson Publishers(2012)
2. H.H Willard, L.L Merritt, J.A Dean, and F.A Settle, "Instrumental Methods of Analysis", 7thEdn., -CBS Pub (2004).
3. B. Sivasankar, "Instrumental Methods of Analysis", 1stEdn. Oxford University press (2012)

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 9

Nomenclature; coordination geometry and isomerism – structural and stereoisomerisms; absolute configuration – ORD and CD spectra; stability of complexes – successive and overall formation constants - experimental methods – polarography and potentiometry- thermodynamic aspects.

UNIT II THEORIES OF METAL LIGAND BOND 9

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 9

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 9

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.

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UNIT V COMPARATIVE CHEMISTRY OF OXIDATION STATES OF D AND F BLOCK METALS **9**

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

1. D.F.Shriver and P.W. Atkins, "Inorganic Chemistry 5rdEdn. Oxford University Press (2011).
2. J.D.Lee, Concise Inorganic Chemistry, 5thEdn. Blackwell Science (2006).

REFERENCES

1. J.E. Huheey, E.A. Keiter, R.L. Keiter and O.K. Medhi, "Inorganic Chemistry", 4thEdn. Pearson Education (2009).
2. F.A.Cotton, G.Wikinson, C.A.Murillo and M.Bochmann, "Advanced Inorganic Chemistry", 6thEdn. John Wiley and Sons (2003).
3. A.G. Sharpe, "Inorganic Chemistry", 3rdEdn. Pearson Education (2004).
4. B.Douglas, D. McDaniel and J. Alexander, "Concepts and Models of Inorganic Chemistry", 3rdEdn. Wiley India (2006).

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 **10**

Stoichiometric principles – Material and Energy balances, Problems – Fluid Mechanics – Bernoullis Theorem – Fluid Flow Measurement – Orifice and Venturi Meter, Pitot tubes, Rotameter, Weirs – Valves – Pumps.

UNIT II HEAT TRANSFER **10**

Fouriers law – Heat transfer through Plane Wall, series of resistances, hollow cylinder and spherical wall – Simple numerical problems on conduction – natural and forced convection – (1,1) and (1,2) Heat Exchangers – Heat transfer from condensing vapours and boiling liquids – Drying – Different types of dryers – Distillation – vapour liquid equilibria – distillation methods – continuous rectification of binary systems – design method for theoretical plates – HETP concepts.

UNIT III MASS TRANSFER OPERATIONS **10**

Absorption principles – Equipment for absorption – Packed towers – Kremser Brown Souders Equation – Liquid Extraction – ternary diagram – selection of solvent – Calculation for multistage co-current and counter-current extraction – Crystallization – Vacuum and Draft tube baffle Crystallizer.

UNIT IV MECHANICAL OPERATIONS 6

Laws of crushing – Closed and Open circuit grinding – Various types of Crushers and Grinders – Settling, Floatation and Filtration concepts.

UNIT V UNIT PROCESSES 9

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

1. W.I.Badger and I.T.Banchero Introduction to Chemical Engineering, McGraw Hill Book co., Inc., Kogakusha, 2009.
2. W.L.McCabe, J.C.Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill Book Co.2005.

REFERENCES

1. P.H.Groggins, Unit Processes in Organic Synthesis, McGraw Hill Book Co., 5th Edition, 2004.
2. O.Levienspiel, Chemical Reaction Engineering, 3rd Edition, John Wiley and Sons, 1999.
3. J.M.Coulson, J.F.Richardson, D.G.Peacock,Chemical & Biochemical Reactors & Process Control, 3rd Edition, 2007
4. Don W.Green, Robert H.Perry, Perry's Chemical Engineers Handbook, 8th Edition, McGraw Hill Book Co.2008.

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 10

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 acylic 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 10

Diborane - lithium aluminium hydride - sodium borohydride - selenium-di-oxide - osmium tetroxide - phenyl isothiocyanate - N-bromosuccinamide (NBS) - lead tetraacetate - dicyclohexylcarbodiimide (DCC) - pyridiniumcholorochromate (PCC) - Swern oxidation - p-toluenesulphonyl chloride - trifluoroacetic acid - lithium diisopropylamide (LDA) - 1,3-dithiane (reactive umpolung) - crown ethers - trimethylsilyl iodide - Gilman reagent - dichlorodicyanobenzoquinone (DDQ) - lithium dimethylcuprate - tri-n-butyltin hydride - di-tert-butoxydicarbonate - dihydropyran - phase transfer catalysts - Wilkinson's catalysts - Peterson synthesis - and diethylaluminium cyanide- IBX and Swern oxidations.

UNIT III MULTISTEP SYNTHESIS 7

Concepts in multistep synthesis - strategies for retrosynthetic analysis, synthon and planning - functional group introduction - removal and interconversion - protective groups - hydroxyl, amino, carbonyl and carboxylic acid groups - retrosynthetic analysis - disconnections - synthons - synthetic equivalents - a,dsynthons - C-C, C=C bond forming reactions - control of stereochemistry**.**

UNIT IV PHOTOCHEMISTRY AND AROMATICITY 9

Photochemistry –Jablonski diagram – photochemistry of olefins and carbonyl compounds - photo oxidation and reduction, cis – trans isomerism, Paterno – Buchi , Barton, Norrish type I and II reactions, di-pi- methane rearrangement. Aromaticity- concept – Huckel and Craig rules – NMR and X – ray diffraction as a tool – diatropy and paratropy. Aromatic and anti-aromatic compounds. Benzenoid, non-benzenoid and homo aromatic compounds. Alternant and nonalternant hydrocarbons. Annulenes - Aromaticity in ferrocenes, fullerenes, heterocyclic rings and charged ring systems.

UNIT V PERICYCLIC REACTIONS 9

Definition-electrocyclic, cycloaddition, sigmatropicandene reactions. Woodward – Hoffmann rules – Frontier orbital, Mobius- Huckel and orbital symmetry correlation approaches. Stereospecificity and regiospecificity of pericyclic reactions - pericyclic reactions in organic synthesis. Diels –Alder reaction, 1,3 dipolar cycloaddition, Claisen, Cope, chelotropic reactions. Fluxional molecules.

TOTAL: 45 PERIODS

TEXT BOOKS

1. F.A.Carey and R.J. Sundberg, Advanced Organic Chemistry, Part A and Part B, 5th edition, Springer, New York (2007).
2. R.K. Mackie and D.M. Smith, Guide book to Organic Synthesis, 2nd edition, ELBS Publications, London (1998).

REFERENCES

1. E.L. Eliel, S.H. Wilen and L.N. Mander, Stereochemistry of Carbon Compounds, John Wiley and Sons, New York (2005).
2. P. S. Kalsi Stereochemistry And Mechanism (Through Solved Problems), New Age International, New Delhi,2007.
3. S. Sankararaman, Pericyclic Reactions - A Textbook**:** Reactions, Applications and Theory, 1st Edition, John Wiley & Sons, Ltd, New York, 2005.
4. Photochemistry of Organic Compounds: From Concepts to Practice, PetrKlán, JakobWirz, John Wiley & Sons, Ltd, West Sussex, United Kingdom,2009.

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AC8204 **THEORETICAL CHEMISTRY** **L T P C**
3 0 0 3

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 9

Inadequacy of classical mechanics- black body radiation, photo electric effect, heat capacity of solids- Planck's quantum theory - quantum mechanical operators- Hamiltonian operators, momentum operators, permutation operators – matrix representations –eigen value – eigen function equations. Schrodinger wave equation and its solution to a particle in a box, rigid rotor, harmonic oscillators.

UNIT II MOLECULAR SYMMETRY AND GROUP THEORY 9

Symmetry elements and symmetry operations – group postulates – types of groups –point groups – representation of molecular point groups – great orthogonality theorem – character tables– reduction of reducible representations –construction of character tables - applications of group theory.

UNIT III STATISTICAL THERMODYNAMICS 9

Objectives of statistical thermodynamics – probability – microstates and macrostates for distinguishable and indistinguishable particles – permutation and combinations – Maxwell – Boltzmann statistics - use of partition function for obtaining thermodynamic functions and entropy.

UNIT IV SEPARATION OF PARTITION FUNCTIONS AND QUANTUM STATISTICS 9

Molar partition functions – evaluation of translational, rotational, vibrational and electronic partition functions – rotational heat capacity for the hydrogen molecule. Quantum statistics – Fermi - Dirac and Bose – Einstein statistics.

UNIT V NON-EQUILIBRIUM THERMODYNAMICS 9

Steady state – conservation of energy and mass-entropy production and entropy flow in open system – fluxes and forces – transformation of properties of rates and affinity – microscopic reversibility and Onsager reciprocal relation, thermo kinetic effect.

TOTAL: 45 PERIODS

TEXT BOOKS

1. D.A.McQuarrie, Quantum Chemistry, 1st Edn. University Science Books, Mill Valley, California (2003) .
2. I.N. Levine, Quantum Chemistry, 5th Edn. Pearson Education (2000).

REFERENCES

1. Cotton F.A. Chemical Application of group theory, 3rd Edn. Wiley, New York (2003)
2. J.C. Kuriacose and J.Rajaram, Thermodynamics for students of Chemistry 3rd Edn. ShobanLalNagin Chand and Co. 1999.
3. L.K. Nash and Addison, Elements of Statistical Thermodynamics, Wiley Pub Co. 1971
4. F.W. Sears and G.L. Salinger, Thermodynamics, Kinetic theory and Statistical Thermodynamics 3rd Edn. Narosa Publishing House, New Delhi 1998

AC8211 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 12 6

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 Monnicerreaction.Two-stage preparation of a few organic compounds. Phase transfer catalysis. Synthesis of azo dyes

UNIT V IDENTIFICATION of organic compounds by instrumentalmethods 30

UV, IR, NMR, Mass spectroscopy and TGA

TOTAL: 180 PERIODS

TEXT BOOKS

1. B. Sivasankar, “Instrumental Methods of Analysis”, 1st Edn. Oxford University press (2012)
2. L. M. Harwood, C J. Moody, J M. Percy‘Techniques and Experiments for Organic Chemistry’ 2nd Edition, Blackwell Publishing (1999)

REFERENCES

1. Daniel R.Palleros, “Experimental Organic Chemistry” John Wiley & Sons, Inc., New York (2001).
2. Furniss B.S, Hannaford A.J, Smith P.W.G and .Tatchel A.R., Vogel’s Textbook of Practical Organic Chemistry, LBS, Singapore (1994).
3. William Horwit, “Official methods of Analysis of the Association of official Analytical Chemists”, 13th edition, Washington, D.C. (2004).

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AC8301 KINETICS AND CATALYSIS

L	T	P	C
3	0	0	3

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 **9**

Methods of determining rate laws – reversible, consecutive and competing reactions – theory of absolute reaction rates – transmission coefficient – quantum mechanical tunneling – thermodynamic formulation of reaction rates – kinetics – classical treatment – stochastic methods, principle of microscopic reversibility.

UNIT II MECHANISM OF GAS PHASE REACTIONS **9**

Lindeman's theory - Hinshelwood, Kassel, Slater, Marcus's extension of RRK treatments - Reaction rates in solution – effect of dielectric constant and ionic strength – Substituent and correlation effects- Hammett equation – Taft equation –Techniques for fast reactions. Gas phase combustion- H_2-O_2 reaction and Hydrocarbon Combustion - explosion limits.

UNIT III HOMOGENEOUS CATALYSIS **9**

Acid – Base catalysis – general catalytic mechanisms – Arrhenius complex – Van't Hoff's complex –Activation Energies for catalysed reactions - specific and general catalysis – Investigation of acid-base catalysis – catalytic activity and Acid-Base strength – Hammett acidity functions –- Salt effects in Acid-Base catalysis. Catalysis by transition metal ions and their complexes, supported transition metal complexes as catalysts – enzyme catalysis – Fenton's reagent– theory and applications

UNIT IV SURFACE PHENOMENA AND HETEROGENEOUS CATALYSIS **9**

Adsorption, Adsorption Isotherms- Simple Langmuir Isotherm, Adsorption with Dissociation, Competitive Adsorption, Non ideal adsorption (Multilayer), Thermodynamics and statistical Mechanics of adsorption. Structures of solid surfaces and adsorbed layers. Mechanism of surface reactions. Uni molecular and Bimolecular surface reactions. Determination of Surface area, pore volume and pore size. Solid catalysts – metal - metal oxides, zeolites – geometric factor – electronic factor.

UNIT V SURFACE ANALYTICAL TECHNIQUES **9**

Principles and Applications- Thermal methods, Electron spectroscopy- XPS and AES. Electron microscopy-SEM and TEM – XRD.

TOTAL: 45 PERIODS

TEXT BOOKS

1. K.J.Laidler, Chemical Kinetics, Pearson , 5th edition, New Delhi 2011.
2. B.Vishwanathan, S.Sivasankar and A.V.Ramasamy, Catalysis: Principles and applications, Narosa, 2002

REFERENCES

1. D.K. Chakrabarty and B. Viswanathan, Heterogeneous Catalysis, New Age, 2008.
2. A.W. Adamson, A.P. Gast, Physical Chemistry of Surfaces, Wiley, 1997
3. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanism of Chemical Transformation, Macmillan India Ltd., 1993.
4. B.Viswanathan, S.Kannan and R.C. Deka, Catalysts and Surfaces, Characterization Techniques, Narosa, 2010

AC8302 MOLECULAR SPECTROSCOPY

L	T	P	C
3	0	0	3

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

Characterization of electromagnetic radiation – regions of the spectrum - basic elements of practical spectroscopy–enhancement of spectra – Microwave spectroscopy – rotational spectra of molecules – applications.

UNIT II ABSORPTION SPECTROSCOPY 12

Applications of group theory- Infra-red spectroscopy - harmonic and anharmonic vibrations – dissociation energy of diatoms – vibrating rotator - PQR branches in IR spectra - Fermi resonance – Raman spectroscopy – mutual exclusion principle – UV–vis spectroscopy – electronic transitions – solvent effects – Woodward's rule.

UNIT III SPIN RESONANCE SPECTROSCOPY 12

Proton magnetic resonance spectroscopy – relaxation processes – chemical shift – coupling – simplification of complex NMR spectra – ^{13}C NMR spectra - Electron spin resonance spectroscopy – hyperfine interactions.

UNIT IV MASS SPECTROMETRY 7

Reactions of ions in gas phase – effect of isotopes – nitrogen rule - determination of molecular formula - fragmentations and rearrangements - metastable ions – fragmentation oforganic compounds.

UNIT V MOSSBAUER SPECTROSCOPY 5

Mossbauer nuclei – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine interactions.

TOTAL: 45 PERIODS

TEXT BOOKS

1. C.N.Banwell and E.M.McCash, "Fundamentals of molecular spectroscopy", 5th Edn., Tata McGraw Hill, New Delhi, 2006.
2. W.Kemp, "Organic Spectroscopy", 3rd Edn, ELBS, McMillan, London, 2004.

REFERENCES

1. R.Drago, "Physical methods for chemists", Saunders, Philadelphia, 2008.
2. D.H.Williams and I.Fleming, "Spectroscopic methods in organic chemistry", 6th Edn, McGraw Hill, New York, 2007.
3. D.Pasto, C.Johnson and M.Miller, "Experiments and techniques in organic chemistry" Prentice- Hall Inc., New Jersey, 1992.
4. G.Aruldhas, "Molecular structure and spectroscopy", 2nd Edn.,Prentice – Hall of India, 2007.

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AC8303 **NATURAL PRODUCTS** **L T P C**
3 0 0 3

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 terpeniods, 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 Pachmanncoumarin 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

Classification – isolation of terpenes – isoprene rule, methods of structural elucidation. Synthesis and structure of α -Terpeniol, Camphor, car – 3 – ene, ,zingiberene, santonin, abietic acid and β - caryophyllene.

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, B_1, B_2, B_6, C, D, E and K.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R.H. Thomson, The Chemistry of Natural Products,(1993).
2. I.L. Finar, Organic Chemistry:Stereochemistry and the Chemistry of Natural Products (Volume - 2) 5th Edition, 9th Indian reprint, ELBS Longman Group Ltd., London, (2009).

REFERENCES

1. R.M. Achesen, Chemistry of Heterocyclic Compounds, Wiley Eastern (1973).
2. R.Ikan, Selected topics in the chemistry of natural products,World Scientific Publishing Co. Pvt Ltd,(2008)
3. V.K.Ahluwalia, L.S. Kumar Chemistry Of Natural Products, Anne book Pvt ltd (2009)

AC8304 ORGANOMETALLIC, SOLID STATE AND PHOTOCHEMISTRY

L	T	P	C
3	0	0	3

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 9

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 9

Catalysis by organometallic compounds - hydrogenation, hydroformylation, Olefin polymerization and co-polymerization, Wacker and Monsanto processes.

UNIT III FOUNDATIONS IN SOLID STATE 9

Crystalline and amorphous solids; crystal systems; types of close packing - hcp and ccp, packing efficiency, radius ratios; Crystal structure types -CsCl,NaCl, ZnS, CaF_2; Na_2O, rutile (TiO_2), perovskite ($CaTiO_3$), spinel ($MgAl_2O_4$); Polyhedral description of solids; defects and non–stoichiometry.

UNIT IV PREPARATION, CHARACTERIZATION AND PROPERTIES OF SOLIDS 9

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 9

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

1. F.A. Cotton, G.Wilkinson and P.L.Gaus, “Basic Inorganic Chemistry”, 3rdEdn. John Wiley and Sons (2003)
2. D.F. Shriver and P.W.Atkins, “Inorganic Chemistry”, 5rdEdn. Oxford University Press (2011).

REFERENCES

1. J.D.Lee, Concise Inorganic Chemistry, 5thEdn. Blackwell Science (2006).
2. B.Douglas, D. McDaniel and J. Alexander, “Concepts and Models of Inorganic Chemistry”, 3rdEdn. Wiley India (2006).
3. J.E. Huheey, E.A. Keiter, R.L. Keiter and O.K. Medhi, “Inorganic Chemistry”, 4thEdn. Pearson Education (2009).
4. William L.Jolly, “Modern Inorganic Chemistry”, 2ndEdn. Tata McGraw –Hill Pub.Co. (2007)

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AC8311 PHYSICAL CHEMISTRY LABORATORY L T P C
0 0 12 6

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

Equivalent conductance of strong electrolytes and verification of Debye-Huckel-Onsager equation. Basicity of an acid. Verification of Ostwald dilution law using weak acid and determination of its dissociation constant. Conductometric titrations – acid- base, mixed acid-base, precipitation titrations. Determination of critical micelle concentration

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–acetic 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 $KMnO_4$ and $K_2Cr_2O_7$. 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.

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UNIT X MISCELLANEOUS 20

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

1. B. Viswanathan and P.S. Ragavan, Practical Physical Chemistry, 1st Edn. Viva Books (P) Ltd., Chennai 2005
2. Khosla, A.Gulnti and V.C. Garg, Senior Practical Physical Chemistry, 7th Edn. S.Chand& Co., New Delhi 1994.

REFERENCES

1. D.R.Satiya, Practical Chemistry, 2nd Edn. Allied Publishers, Madras 1991
2. F.W. Fifield and D.Kealey, "Principles and Practice of Analytical Chemistry, 1st Indian Reprint, Blackwell Pub. (2004).
3. V.D. Athawale and P. Mathur, Experimental Physical Chemistry, New Age International Publishers 2001.

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 9

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 9

Introduction to biomolecules: Examples of biomolecules, Building blocks of biomacromolecules, Nature of biomoleculear interactions. Types of reactions occurring in cells.

UNIT III PROTEINS, NUCLEOSIDES AND NUCLEIC ACIDS 9

Proteins, Nucleosides and nucleic acids: Primary structure of proteins, End group determination, Secondary structure of proteins tertiary structure, oligomeric proteins, ribonuleotides and deoxyribonucleotides, RNA and DNA, Base pairing, double helical structure of DNA and genetic code, transcription, Ribosomes.

UNIT IV ENZYMES LIPIDS AND MEMBRANES 9

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.

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UNIT V BIOENERGETICS 9

Bioenergetics: Basic principles, glycolytic pathways, kreb's cycle, oxidative phosphoylation, hydrolysis of esters and amids, c–c and c=c bond formation, oxidation, reduction, Decarboxylation, Biomimetic reactions, Drug design.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R.J. Simond, Chemistry of Biomolecules, Royal Society of Chemistry, U.K. London (1992).
2. A.L. Lehninger, Biochemistry: The molecular Basis of cell structure and function, Worth Publishers (1982).

REFERENCES

1. D.E. Metzier, Biochemistry – The chemical reactions of a living cell, Volume 2, 2nd Edn, Academic Press (2003).
2. H. Dugas, Bio organic Chemistry, A.Chemical approach to enzyme action, 2nd Edn. Springer – Verlay (1989).
3. Lehninger, Nelson, and Cox, Principles of Bio chemistry, 2nd Edn. CBS Publishers, (1993).

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 10

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 8

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

UNIT III MICROBIAL PROCESSES 8

Microbial processes – bacterial and yeast strains for industrial processes; fermentation – aerobic and anaerobic fermentation; fundamentals of bioreactors– types – batch, fed-batch and CSTR; substrate utilization, product formation and bio-oil production.

UNIT IV PRODUCT RECOVERY AND PURIFICATION OPERATIONS 9

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 10

Bioprocesses and enzyme tec hnology 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

1. J.E.Bailey and D.F.Ollis, "Biochemical Engineering Fundamentals", McGraw Hill Book Co., (1986).
2. B. Sivasankar, "Bioseparations – Principles and Techniques", 5thEdn., PHI Learning Private Limited, (2009).

REFERENCES

1. B. Sivasankar, "Food Processing and Preservation", 7thEdn. PHI Learning Private Limited, (2010).
2. Michael L. Shuler and FikretKargi, "Bioprocess Engineering Basic Concepts", PHI, 2nd Ed., (2005).
3. B. Sivasankar, "Instrumental Methods of Analysis", 1stEdn., Oxford University press, (2012).

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 9

Chemical reactors – Batch reactor – Flow reactor – Fixed bed, Fluidized bed and slurry reactor – fluid moving machinery – pumps – blowers – compressors.

UNIT II PROCESS EQUIPMENT 9

Storage vessels – humidification – cooling towers. Agitation – Mixing – Industrial driers, crystallisers, absorbers. Extractors – Absorbers – Distillation – Extractive distillation, H.T.equipment, furnaces, heaters.

UNIT III MEASURING DEVICES 9

Industrial measurement of temperature – pressure – level – flow – humidity – density – pH – characteristics of measuring devices – concepts of automatic control recorders.

UNIT IV PHYSICAL PROPERTIES 9

Measurement of physical parameters like surface tension –viscosity – melting point – Boiling point – optical rotation – Refractive Index – Thermal properties – molecular wt determination.

UNIT V Computer instrumentation 9

Elements of analogue and digital computers – computer instrumentation interfacing – microprocessor – controlled instruments – outlines of on-line and automatic analyzers.

TOTAL:45 PERIODS

TEXT BOOKS

1. Feeder and R.W.Roussean, "Elementary Principles of Chemical Processes", 3rd Edition. John Wiley and Sons,(2008).
2. E.BruceNauman, Chemical Reactor Design, Optimization and Scale up, 2nd Edition, John Wiley & Sons, New York, (2008).

REFERENCES

1. O.Levenspiel, Chemical Reaction Engineering Kinetics, John-Wiley, 3rd Edition, London, (1999).
2. H. Scott Fogler**, "**Elements of Chemical Reaction Engineering", 4th Edition, Prentice Hall, (2006).
3. W.L.McCabe, J.C.Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill Book Co.(2005).

AC8004 CHEMISTRY OF NANOMATERIALS

L	T	P	C
3	0	0	3

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

1. G. Cao, "Nanostructures and nanomaterials - Synthesis, properties and applications" Imperial College Press, (2004).
2. P. Yang (ed.) "The chemistry of nanostructured materials", World Scientific, (2005).

REFERENCES

1. G.A. Ozin and A.C. Arsenault, "Nanochemistry:A chemical approach to nanomaterials", Royal Society of Chemistry, (2005).
2. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, (2002).
3. Thomas Varghese and K.M. Balakrishnan, 'Nanotechnology' , Atlantic publishers,(2012)

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**

Binary System - Processor – Storage devices – I/O devices – Introduction to operation systems – DOS, WINDOWS and Unix – Algorithms – Flow charts - Introduction to e mail and internet – world wide web.

UNIT II NUMERICAL METHODS **7**

Roots of equations – Bisection method – Newton-Raphson method- Curve fitting – Principle of Least squares – Correlation and Regression Analysis – Sample distributions, Students' t distribution.

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**

Fundamentals and input/output statements: Constants – Variables- Data types-Operators – standard input output functions. Control structures: The decision control structure-The loop control structure- The case control structure. Functions: assessing a function - multidimensional arrays – pointer declarations – passing pointers to a function – operations on pointers.

UNIT V APPLICATIONS OF C PROGRAMMING **9**

Applications of C Programming to Simple Chemistry problems. Determination of rate constants of I^{st}, 2^{nd} and 3^{rd} order reactions- consecutive, parallel and equilibrium reactions - enzyme catalyzed reactions- Reactivity ratios in copolymerization- determination of spectroscopic data and error analysis - simple quantum chemical calculation for simple molecules.

TOTAL: 45 PERIODS

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TEXT BOOKS

1. K.V.Raman, Computers in Chemistry, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, (2008).
2. K.Arora, "Computer applications in chemistry", Anmol Pub. New Delhi, (2004).

REFERENCES

1. E. Balagurusamy, E. "Programming in ANSI C", 3rdEdn.,Mc-Graw Hill Pub. Co., New Delhi, (2004).
2. R Kumari, Computers And Their Applications to Chemistry**,** Alpha Science International, (2005)
3. R. S Rao, G. N Rao,Computer Applications in Chemistry, Himalaya Publishing House, (20 (2005)

AC8006 CORROSION AND CORROSION CONTROL

L	T	P	C
3	0	0	3

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 forcorrosion testing and control.
- Will develop concern for protection of metals.

UNIT I CORROSION **9**

Causes and effects of corrosion - theories of corrosion - oxidation - direct atmospheric effect - electrochemical corrosion - hydrogen evolution - presence and absence of oxygen - corrosion by gaseous reduction.

UNIT II FORMS OF CORROSION **9**

Galvanic bimetal corrosion - differential aeration corrosion - concentration cell corrosion - erosion corrosion - pitting corrosion - underground soil corrosion - intergranular corrosion - stress corrosion - seasonal cracking of alloys - caustic embrittlement - corrosion fatigue - bio fouling - microbiologically influenced corrosion (MIC).

UNIT III CORROSION TESTING **9**

Rate of corrosion - calculation of ΔG and other related thermodynamic parameters - potential measurement - electrochemical series - redox reactions - Pourbaix and Evans diagrams - potentiodynamic polarization methods - Tafel extrapolation - anodic polarization - cyclic polarization - polarization resistance - characterization of different forms of corrosion - pitting - crevice - stress corrosion cracking - electrochemical impedance spectroscopic technique for corrosion evaluation.

UNIT IV FACTORS INFLUENCING CORROSION **9**

Nature of metal - overvoltage - areas of anodic / cathodic - purity of metal - physical state of metals - passive nature of metal - solubility - volatility of corrosion products - corroding environment - influence of pH - ions - formations of cells - polarization of electrodes.

UNIT V CORROSION CONTROL **9**

Design - selection of materials - pure metals and alloys - annealing - elimination of galvanic action - modification of environment - inhibitors - preparation of materials for coating - metallic and non-metallic - protective coatings - physical vapor deposition - chemical vapor deposition- anodic oxidation - plasma nitriding - plasma spray coating - thermal spray coating - organic coatings - paints**.**

TOTAL: 45 PERIODS

TEXT BOOKS

1. M. G. Fontana, Corrosion Engineering, Third Edition, Tata McGraw Hill Edition, New York (2005).
2. E. McCafferty, Introduction to Corrosion Science, Springer, New York (2010).

REFERENCES

1. Nestor Perez, Electrochemistry and Corrosion Science, Kluwer Academic Publishers (2004).
2. R. Winston Revie, UHLIG's Corrosion Handbook, 3rd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey (2011).
3. Robert G. Kelly, John. R. Scully, David W. Shoesmith, Rudolph G. Buchheit, Electrochemical Techniques in Corrosion Science and Engineering, CRC Press, Taylor & Francis Groups, Brocken Sound parkway NW, Suite (2003).
4. D. Satas, Arthur. A. Tracton, Coatings Technology Handbook, Second Edition, CRC press, Marcel Dekker inc., US (2001).

AC8007 ENVIRONMENTAL AND GREEN CHEMISTRY L T P C
3 0 0 3

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 ofthe 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 8

Chemistry and the environment - environmental pollution - causes of pollution - Environmental fate of pollutants - transformation process - bio concentration - fate of air, water and soil pollutants. Environmental chemistry of Colloids and Surfaces —Electrical double Layer theory- Electrostatic precipitation – Specific adsorption – Redox process- pH – pE –Diagrams.

UNIT II TOXIC EFFECTS OF POLLUTANTS 9

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 8

Biological activity - biodegradation of carbohydrates, proteins, fats and oil, detergents, pesticides; Metabolic fate of pollutants - adsorption – distribution - metabolism - excretion. Biodegradation of PCAH-QSAR-Membrane separation processes – capillary flow model – solution diffusion mode-retention coefficient – Factors affecting membrane processes – Pervaporation – Electron affinity chromatography –– Solid phase extraction and solid phase micro extraction, applications.

UNIT IV POLLUTION ANALYSIS 9

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.

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UNIT V ENVIRONMENTAL GREEN CHEMISTRY 11

Principles of green chemistry —Clean synthesis - choice of reagents and catalysis, Organic synthesis in aqueous media, Solvent Free Organic Synthesis and microwave assisted – Atom economy as a measure of efficiency in organic synthesis , – Environmental factor 'E' and Quotient'Q', Mass Index, Green Analytical chemistry- Green separation methods-RTIL, Aqueous Biphasic Systems and super critical fluid extraction-CO_2, Green chemistry in day to day life and industrial applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1. V. K. Ahluwalia., M. Kidwai, New Trends in Green Chemistry, Anamaya Publishers, 2nd Ed. (2007).
2. B. Sivasankar Bioseparations –Principles and Techniques, Prentice Hall India, (2006).

REFERENCES

1. A.K. De, Environmental Chemistry, New age International, 7th Ed, 2010.
2. http://www.design-joomla.eu/Sawyer and McCarty, Chemistry for Environmental Engineering and Science, 5th Ed, Tata McGraw-Hill, 2005.
3. James E. Girard, Principles of Environmental Chemistry, Jones and Bartlett Publishers, 2nd Ed., 2005.
4. Stanley E. Manahan, Environmental Chemistry, Ninth Edition, CRC Press (2009)

AC8008 FUNDAMENTALS OF POLYMER CHEMISTRY

L	T	P	C
3	0	0	3

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 11

Basic concepts of polymers – classification of polymers – organic and inorganic polymers.- classification based on occurrence, end use, thermal properties and structure. Tacticity and its determination using ^{1}H NMR. Crystalline and amorphous polymers – Factors affecting crystallinity and crystallisability. Effect of crystallinity on properties- Glass transition temperature and its determination.- thermal transitions- dialatometer-variation of specific volume of polymers with temperature- Factors affecting glass transition temperature.

UNIT II CHAIN POLYMERIZATION 9

Kinetics and mechanism of free radical, cationic and anionic polymerization Trommsdorff's effect – chain transfer reactions and constants – living polymers – alfin catalysts –– coordination polymerisation -Ziegler-Natta catalysts-iniferters -Atom transfer radical polymerization.

UNIT III STEP GROWTH POLYMERIZATION 9

Kinetics of polycondensation reactions – copolymerization – co-polymer equation – copolymer compositions from ^{1}H-NMR, FT-IR, UV spectra and chemical methods –Monomer reactivity ratios- Mayo-Lewis and Fineman-Ross methods- significance of reactivity ratios-Sequence length–Metathetical, Group transfer, Electrochemical and Ring-opening polymerization

UNIT IV POLYMERIZATION TECHNIQUES 6

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 10

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

1. V.R.Gowarikar, N.V.Viswanathan and JayadevSreedhar, Polymer Science, Wiley Eastern Limited, Madras (2006).
2. F.W. Billmayer, Text Book of polymer Science, 3rd Edn. John Wiley & Sons, New York 2002).

REFERENCES

1. George Odian, Principles of Polymerization, 3rd Edn, McGraw Hill Book Company, New York (2003).
2. M.S.Bhatnagar, " A Text Book of Polymers (Chemistry and Technology of polymers), Vol I, II & III, 1st Edn., S.Chand and Company, New Delhi (2007).
3. R.S. Young, Introduction to Polymers, Chapman and Hall Ltd., London (1999).
4. R. B. Seymour and C. E. Carraher, Jr "Polymer Chemistry – An Introduction "Marcel Dekker, Inc. New York(2006)

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 9

Catalyst definitions, Homogeneous and Heterogeneous catalysts: Definition of catalytic activity, Conversion, selectivity, contact time, time on stream, Kinetics of heterogeneous catalysis, adsoprtion, 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 andHydrotalcites.

UNIT II CATALYST CHARACTERIZATION TECHNIQUES 10

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).

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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

Oxidation catalysts for control of CO and HC emissions, Three way catalysts, Homogeneous polymerization catalysts, Crude oil distillation/separation, Catalysts and process for high quality fuels: Hydrotreating, hydrodesulphurization, Hydrodenitrogenation - Hydrodeoxygenation and hydrodematellation, Utilization of Carbon dioxide, Solar cells.

UNIT V INDUSTRIAL CATALYTIC PROCESSES 9

Cracking, reforming, alkylation, isomerization, hydrogenation/dehydrogenation, dehydrocyclisation, dehydrosulphurization, hydrocracking, 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.

TOTAL : 45 PERIODS

TEXT BOOKS

1. B.Viswanathan, “Catalysis for selected application”, Narosa, 2009.
2. Viswanathan, S.Kannan and R.C. Deka, “Catalysts and surfaces: Characterization techniques”, Alpha science international Ltd., UK., 2006.

REFERENCES

1. Jens Hagen, “Industrial catalysis”, 2nd Edition, Wiley-VCH VerlayGambh& Co, 2006.
2. Herman Pines, “The chemistry of catalytic hydrocarbon conversions”, Academic Press, New York, 1981.
3. R. Pearce and W.R.Patterson, “Catalysis and chemical processes”, Leonard Hill, London, 1981.
4. Charles, N. Satterfield, “Heterogeneous catalysis in industrial practice”, 2nd Edn. Mc.Graw Hill, International Edition, Singapore, 1993.
5. Ian M. Campbell. “Catalysisat Surface”, The UniversityPress,Cambridge, 1988.

AC8010 INDUSTRIAL ELECTROCHEMISTRY

L	T	P	C
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OBJECTIVES

- To impart knowledge about the general principle and processes in chloralkali industry.
- To provide overall information on the processes, practices and significance of electrochemical operations in industries.

OUTCOME

- Will know about the general principle and processes in chloralkali industry.
- Will have basic information on the processes, practices and significance of electrochemical operations in industries.

UNIT I CHLORALKALI INDUSTRY 8

General concepts of brine electrolysis – modern cell technologies – diaphragm cell process – Nelson cell – Hooker’s cell. Mercury cell process – Castner and Kellner cells – Kellner Solvay cell - De Nora cell – membrane cell process. Processing - Chlorine and hydrogen.

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**

Pretreatment – conversion coatings – phosphating – types –methods – properties and influencing factors – evaluation and testing – applications – anodizing – principle – applications. Electroplating – objectives – theory – method – electroplating of nickel (only) – electroless plating – galvanizing – tinning.

UNIT IV ELECTRO SYNTHESIS **9**

Electrolytic preparation of inorganic compounds – fluorine – per acids and their salts – $KMnO_4$ -- $K_2Cr_2O_7$ – CuO – MgO - sodium hypochlorite. Organic electrosynthesis – hydromerisation of acrylonitrile – Monsanto process – Manufacture of ethylene glycol.

UNIT V INDUSTRIAL ELECTROCHEMICAL PROCESSES **8**

Water treatment and environmental protection – metal ion removal and metal recovery – electro-filtration of particulates from gases – electro dialysis – desalination – electro flotation – electrokinetic remediation of soil.

TOTAL: 45 PERIODS

TEXT BOOKS

1. B. K. Sharma, Industrial Chemistry, Goel Publishing House, New Delhi (2011).
2. C.Rajagopal and K. Vasu, Conversion Coatings, 1st Edn. Tata McGraw Hill, New Delhi (2000).

REFERENCE BOOKS

1. D Pletcher,F.C.Walsh Industrial electrochemistry, Chapman and Hall, London (1990).
2. I. Konstantin, Popov, S. Stojan, Djokic and B. N. Grgur, Aspects of Electrometallurgy, Kluwer Academic Publishers, New York (2002).
3. John O'M. Bockris, Comprehensive Treatise of Electrochemistry Vol 2Electrochemical processing,Plenum Press, (1981)

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**

Fuel and industrial gases – production and uses of producer gas, water gas, coke oven gas, acetylene, natural gas, LPG: Liquefaction of gases– noble gases, carbon dioxide, hydrogen, oxygen, nitrogen.

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

Sulphur and sulphuric acid – nitric acid – ammonia –nitrogenous fertilizers – phosphorus – phosphoric acid – phosphatic fertilizers – potassic fertilizers.

UNIT IV SILICATE INDUSTRIES 9

Silicate industries – refractories – abrasives – ceramics – glass – cement, lime, gypsum

UNIT V PRINCIPLES OF METALLURGICAL PROCESSES 9

Principles of metallurgical processes – ore beneficiation pyrometallurgy, hydrometallurgy powder metallurgy, electrometallurgy: Explosives and propellants: Nuclear materials.

TOTAL: 45 PERIODS

TEXT BOOKS

1. B. Norris Shreve and Joseph A.Brink, Chemical Process Industries,. McGraw Hill, Kogakusha Ltd. (1991).
2. Dryden's outlines of Chemical Technology, (Ed) M.GopalaRao and Marshall Sitty – Affliated East West Press Pvt. Ltd. (1992).

REFERENCES

1. B.K. Sharma – Industrial Chemistry, GOEL Publishing House (1991)
2. N.Berkowitz,Fossil Hydrocarbons: Chemistry and Technology**,** Academic Press Inc(1997)
3. Riegel's Industrial Chemistry, edited by James A. Kent, Asia Publishing House (1989).

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

Chemicals derived from ethylene – polyethylene, ethylene oxide, ethylene dichloride chlorinated hydrocarbons – chemicals derived from propylene – isopropyl alcohol, polypropylene, acrylonitrile, propylene oxide – oxidation of butane – esters – maleic anhydride - acetone-ethyl methyl ketone - bisphenol - DDT - aniline.

UNIT IV PHARMACEUTICALS AND PESTICIDES 9

Introduction – manufacture - aspirin, phenobarbital, penicillin – malathion, parathion, naled.

UNIT V DYES **9**

Classification - raw materials – intermediates - manufacture – azodyes – triphenylmethane dyes – xanthene dyes. Indigoid and thioindigoid dyes, sulphur dyes, phthalocyanines – optical brighteners.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P.H. Groggins, Unit Processes in Organic Synthesis, 5th Edn., McGraw Hill Book Co., Kogakusha (1995).
2. Peter Wiseman, An Introduction to Industrial Organic Chemistry, 2nd Edition, Applied science publishers Ltd., London (1979).

REFERENCES

1. J.A. Kent, Riegel's Hand book of Industrial Chemistry, 7thEdn, Van Nostrand Reinhold Co., New York (1974).
2. D.Pasto, C.Johnson and M.Miller, "Experiments and techniques in organic chemistry" Prentice- Hall Inc., New Jersey, 1992.
3. Kirk-Othmer, Encyclopedia of Chemical Technology, 5th edition, John Wiley and Sons,(2007)

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**

Factors governing drug design – Advantages - types of drug-literature survey for preparation of drugs - characterization /structural elucidation of drugs using Spectral methods. Analgesics – Narcotic analgesics –morphine analogues – synthesis of codeine – Synthetic narcotic analgesics – synthesis and use of pethidines, methodones, dexdtropropoxyfene- narcotic antagonists – nalorphine – naloxone – Antipyretic analgeics – salicylic acid analogues – methyl salicylate, phenyl salicylate – paraamino phenol derivatives – structure synthesis and use of paracetamol, phenacetin, aspirin and salol

UNIT II ANTIHISTAMINES AND ANTIMALARIALS **9**

Antihistamines – classification H1 & H2 receptor antagonists – structure, synthesis and their action & use of Diphenhydramine, cyclizinc, chlorpheneraminemaleate, Promethazine, Antimalerials classification – Quinine-4-aminoand 8-amino quinolines – chloroquine phosphate-Pyrimidines –Acidines; Sedatives – Barbiturates – structure, synthesis, action & use of Phenobarbitol-Benzodiazepines – mode of action structure and synthesis of Diazepam, Nitrazepam

UNIT III ANTIBIOTICS AND ANTIBACTERIALS **9**

Antibiotics - penicillin, D-pencillamine, Phenoxy methyl pencillin –chloramphenicol-Antibacterials - norfloxacin, ciprofloxacin, Trimethoprim sulphadrugs – mode of action – preparation of sulphanilamide, sulphadiazine, sulphathiazole, sulphapyridine, sulphadimidine, sulphagauidine, sulphamethoxazole Antifungals – action, use and synthesis of clotrimazole, micronazole, Isoconazole.

UNIT IV ANTIHYPERTENSIVE AND ANTITUBERCULAR DRUGS 9

Anthihypertensive drugs– synthesis and mode of action of methyldopa, pargyline, bertyline, hydralazine, propranolol- Antitubercular drugs – synthesis of PAS, ethambutol – pyrazinamide, isoniazid

UNIT V ANTIDIARRHEAL AGENTS 9

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

TOTAL:45 PERIODS

TEXT BOOKS

1. Berger, A. “Medicinal chemistry”, Vol 1&2, Wiley Interscience, New York, (1990).
2. Asutoshkar, “Medicinal Chemistry”, Wiley Eastern Ltd., Chennai, (1992).

REFERENCES

1. Bentely and Driver’s, “Textbook of Pharmaceutical Chemistry”, Oxford Univ. Press., (1985).
2. H.J Roth, A. Kleemann, “Pharmaceutical chemistry”, vol.1, Drug synthesis, (2001).
3. D.Cairns, Essentials of Pharmaceutical Chemistry, 4th edition,Pharmaceutical press (2012)
4. D. G. Watson, Pharmaceutical Chemistry, Churchill Livingstone Elsevier (2011).

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 POLYMERICMATERIALS 9

Introduction – classification – thermoplastics - cellulose derivatives - LDPE, HDPE, PVC, PMMA, PTFE, PET, Nylons – thermosettingresins – phenolicresins, epoxyresins, silicones, polyurethanes – polymerblends and alloysreinforced plastics

UNIT II ELASTOMERS 9

Natural rubber – processing – vulcanization – synthetic rubber – SBR, neoprene, butyl, thiocol rubber – thermoplastic elastomers – high performance polymers – polyethers – PEEK, polysulphones, polyimides.

UNIT III MOULDING TECHNIQUES 9

Moulding constituents – functions –moulding techniques – compression – injection - extrusion – blow moulding – thermoforming – vacuum forming – pultrusion – casting – calendering – RIM – lamination

UNIT IV CHARACTERIZATION AND TESTING 9

Characterization of polymers by IR and NMR – Thermal properties by TGA and DSC, Testing tensile strength, Izod impact, Compressive strength, Rockwell hardness, Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength – water absorption.

UNIT V POLYMER PROPERTIES 9

Effect of structure on mechanical, chemical, thermal, electrical and optical properties.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Michael L. Berins, Plastics Engineering hand book, 5thEdn. Chapman & Hall, New York (1991).
2. Jacqueline.I. Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley & sons, New York (1998).

REFERENCES

1. R.W.Iyson, Specialty Polymers, Blackie Academic & Professional, London (1992).
2. Mourice Morton, Rubber Technology, Van Nostrand, Reinhold, New York (2010).
3. ManasChanda, Advanced Polymer Chemistry, Marcel Dekker, Inc.New York (2000).
4. J. R. Fried, Polymer Science and Technology, Prentice-Hall of India Pvt. Ltd., New Delhi,(2009).

AC8015 SOLID WASTE MANAGEMENT AND AIR POLLUTION

L	T	P	C
3	0	0	3

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 pollutionand control
- Will be introduced to energy recovery.

UNIT I SOLID WASTE **9**

Solid waste - definition – characteristics – perspectives - types of solid waste -sources - properties of solid waste - physical and chemical composition – changes in composition - solid waste management-materials flow - reduction in raw materials usages and solid waste quantities - reuse of solid waste materials- industrial hazardous waste.

UNIT II SOLID WASTE COLLECTION AND DISPOSAL **9**

Solid waste generation - on-site handling, storage and processing-collection of solid waste-transfer and transport-processing techniques - 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 **9**

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 **9**

Air pollution - global implication of air pollution-units of measurement - sources of pollutants - classification of pollutants. Effects of pollutants on human beings, animals, vegetation, buildings and materials. Atmospheric stability - Effect of Wind – Plume behavior - Dispersion of Air Pollutants - Estimation of plume rise.

UNIT V ANALYSIS AND CONTROL DEVICES **9**

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

1. Solid Waste Management in Developing Countries –Bhide and Sundaresan, Indian National Scientific Documentation Centre. New Delhi (2000).
2. Handbook of Solid Waste Management By Frank Kreith, George Tchobanoglous (2002).

REFERENCES

1. Principles of Sustainable Energy (Mechanical and Aerospace Engineering Series)byFrankKreith, Susan Krumdieck and Jan F. Kreider(2010).
2. S.K.Garg,Sewage Disposal And Air pollution Engineering, Khannapublishers,New. Delhi.(2000).
3. M.N Rao and H.V.N Rao, Air Pollution, Tata McGraw- Hill Publishing Company Limited, New Delhi (2000).
4. Davis Cornvel,Environmental Engineering, McGraw Hill Book Co., New York, (2000).
5. Met Calf &Eddy, Waste Water Engineering, McGraw Hill Book Co., New York,(2006).

Attested

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AC8016 **TEXTILE CHEMISTRY** **L T P C**
3 0 0 3

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

Theory of colours – dye chemistry - preparation of simple dyes and intermediates. Introduction to theory of dyeing. Application of direct, vat , azoic, reactive, sulphur, disperse and acid dyes and mineral colours.

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

1. R.Trotman, Dyeing and Chemical Technology of Textile Fibres, Charles Griffin and Co., Ltd., London (1985).
2. V.A. Shenai, Technology of Textile Processing, Vol II, IV and V, Sevak Publications, Bombay (1976).

REFERENCES

1. F. Sadov, M.Korchagin and A.Matetsky, Chemical Technology of Fibrous Materials, Mir Publishers, Moscow (1978).
2. J.T. Marsh, Textile Science – An Introductory Manual, B.I. Publications (1979).
3. J.T. Marsh, An Introduction to Textile Finishing, B.I. Publications, New Delhi (1979).

AC8017 **TEXTILE PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES

- To impart knowledge on the preparation of textile materials for processing.
- To expose the students to the machineries and processing techniques used in dyeing, printing and finishing operations.

OUTCOME

- Will be up to date with the preliminary preparation of fibers.
- Will have clear understanding of the concept of dyeing.
- Will be familiar with the machinery and stages involved in textile processing.

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

Printing – methods and styles – direct, discharge and resist styles, block, roller and screen printing –transfer printing. Printing of various classes of dyes and pigments – printing of natural and synthetic materials with direct, reactive, disperse and other dyes – pigment printing. Printing machinery and post printing operations – roller printing machinery, hand, flat and rotatory screen printing machines – transfer printing machine – dryers, steamers, curing chambers and washing ranges.

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

1. R.H. Peters, “Textile Chemistry, Vol II. Impurities in Fibers and Purification of Fibers”, Elsevier Pub. (1975).
2. E.R. Trotman, “Textile Scouring and Bleaching”, Griffins Pub. (1968).

REFERENCES

1. R.R. Chakravarthy and S.S.Trivedi, “Technology of Bleaching and Dyeing of Textile Fibres”, Vol.Imahajan Bros. (1979).
2. J.T. Marsh, “Textile Finishing”, B.I. Publications (1979).
3. V.A. Sheni, “Technology of Textile Processing”, Vol.II, ‘Textile Printing’, Sevak Pub. (1976).

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

Requirements of water – quality standards for drinking water – object of water treatment – conventional treatment – turbidity removal – cause of turbidity – coagulation – common coagulants – theory of coagulation – mixing basins – flocculation – principle and design of flocculators – sedimentation – settling tanks – settling velocity – surface loading rate – efficiency of settling tanks – sludge removal mechanism.

UNIT II INDUSTRIAL WATER TREATMENT 9

Filteration – size and shape characteristics of filtering media – sand filters hydraulics of filteration – 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

1. W. Wesley Eckenfelder, Jr. - Industrial water pollution control, 2nd Edn., McGraw Hill Inc. (1989).
2. Metcalf & Eddy – Wastewater engineering, 3rd ed., McGraw Hill Inc. (1991).

REFERENCES

1. C.S. Rao – Environmental pollution control engineering, Wiley Eastern Ltd. (1994).
2. S.P. Mahajan – Pollution control in process industries, Tata McGraw Hill Publishing Company Ltd. (1994).
3. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous – Environmental Engineering, McGraw-Hill Inc. (1985).
4. M. Lancaster, Green Chemistry: An Introductory Text,RSC publishing, 2nd edition, (2010)