MSc Chemistry

Faculty of Physical Sciences

(Revised with effect from 2022-23 AY onwards)

AMRITA
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M. Sc. Chemistry Curriculum 2022

Course Code	Course Title	L T P	Cr	ES	Course Code	Course Title	L T P	Cr	ES
SEMESTER 1					**SEMESTER 2**				
22CHY501	Quantum Chemistry	3 0 0	3		22CHY511	Chemical Thermodynamics and Equilibrium	3 1 0	4	
22CHY502	Concepts in Inorganic Chemistry	3 0 0	3		22CHY512	Molecular Spectroscopy	3 1 0	4	
22CHY503	Principles in Organic Chemistry	3 1 0	4		22CHY513	Organic Reaction Mechanism	3 1 0	4	
22CHY504	Coordination Chemistry	3 0 0	3		22CHY514	Heterocyclic and Natural Products Chemistry	3 0 0	3	
22CHY505	Group Theory and its Applications	3 0 0	3		22CHY515	Organometallic Chemistry	3 0 0	3	
22CHY581	Inorganic Semi-micro Qualitative Analysis Lab	0 0 5	2		22CHY583	Advanced Physical Chemistry Lab	0 0 5	2	
22CHY582	Organic Quantitative Analysis Lab	0 0 5	2		22CHY584	Inorganic Quantitative Analysis Lab	0 0 5	2	
21CUL501	Cultural Education	2 0 0	P/F		21AVP501	Amrita Values Programme	1 0 0	1	
					22AVP103	Mastery Over Mind	1 0 2	2	
TOTAL			**20**		**TOTAL**			**25**	
SEMESTER 3					**SEMESTER 4**				
22CHY601	Electrochemistry, Kinetics and surface Chemistry	3 1 0	4		22CHY699	Dissertation		14	
22CHY602	Synthetic Strategies and Reagents	3 1 0	4						
22CHY603	Solid State Chemistry and Material Science	3 0 0	3						
22CHY604	Bioinorganic Chemistry	3 0 0	3						
	Core Elective	3 0 0	3						
22CHY681	Organic Qualitative Analysis Lab	0 0 5	2						
22CHY682	Instrumental and Analytical Methods Lab	0 0 5	2						
22CHY690	Live-in-Lab@ / Open Elective*	2 0 0	2						
TOTAL			**23**			**TOTAL**		**14**	
						GRAND TOTAL		**82**	

Core Electives					Open Electives				
22CHY631	Applied Electrochemistry	3 0 0	3	E	21OEL631	Advanced Statistical Analysis for Research	2 0 0	2	D/E
22CHY632	Bioanalytical Chemistry	3 0 0	3	E	21OEL632	Basics of PC Software	2 0 0	2	D/E
22CHY633	Chemistry of Biomolecules	3 0 0	3	E	21OEL633	Computer Hardware and Networking	1 0 1	2	D/E
22CHY634	Industrial Chemistry	3 0 0	3	E	21OEL634	Consumer Protection Act	2 0 0	2	D/E
22CHY635	Industrial Stoichiometry	3 0 0	3	E	21OEL635	Corporate Communication	2 0 0	2	D/E
22CHY636	Material Science and Nanochemistry	3 0 0	3	E	21OEL636	Design Studies	2 0 0	2	D/E
22CHY637	Medicinal Chemistry	3 0 0	3	E	21OEL637	Disaster Management	2 0 0	2	D/E
22CHY638	Supramolecular Chemistry	3 0 0	3	E	21OEL638	Essentials of Cultural Studies	2 0 0	2	D/E
22CHY639	Nanomaterials for Biomedical Applications	3 0 0	3	E	21OEL639	Foundations of Mathematics	2 0 0	2	D/E
22CHY640	Industrial Metal Finishing Processes	3 0 0	3	E	21OEL640	Foundations of Quantum Mechanics	2 0 0	2	D/E
22CHY641	Biosensors: Fundamentals and Application	3 0 0	3	E	21OEL641	Glimpses of Life through Literature	2 0 0	2	D/E
22CHY642	Computational Chemistry	3 0 0	3	E	21OEL642	Information Technology in Banking	2 0 0	2	D/E
22CHY643	Sustainable Chemical Science	3 0 0	3	E	21OEL643	Knowledge Management	2 0 0	2	D/E
22CHY644	Sustainable techniques in Chemical Sciences	3 0 0	3	E	21OEL644	Marketing Research	2 0 0	2	D/E
					21OEL645	Media for Social Change	2 0 0	2	D/E
					21OEL646	Media Management	2 0 0	2	D/E
					21OEL647	Object-Oriented Programming	2 0 0	2	D/E
					21OEL648	Painting and Sculpture	1 0 1	2	D/E
					21OEL649	Personal Finance	2 0 0	2	D/E
					21OEL650	Principles of Advertising	2 0 0	2	D/E
					21OEL651	Principles of Packaging	2 0 0	2	D/E
					21OEL652	Scripting for Rural Broadcasting	1 0 1	2	D/E
					21OEL653	Social Media Website Awareness	1 0 1	2	D/E
					21OEL654	Theatre Studies	1 0 1	2	D/E
					21OEL655	Writing for Technical Purposes	2 0 0	2	D/E
					21OEL656	Yoga and Personal Development	1 0 1	2	D/E
					21OEL657	Fundamentals of Legal Awareness	2 0 0	2	D/E

*__One Open Elective__ course is to be taken by each student, in the third semester, from the list of Open Electives offered by the School.

[@]Students undertaking and registering for a Live-in-Lab project, can be exempted from registering for the Open Elective course in the third semester.

22CHY501 QUANTUM CHEMISTRY 3 0 0 3

Unit I: Quantum Chemistry - Introduction

Origin of quantum mechanics, de Broglie relationship, the uncertainty principle (no derivation); Postulates of quantum mechanics: postulate I – wave functions, postulate II - Operators in quantum mechanics, operator algebra, postulate III – eigen values, eigen value equations, postulate IV – Expectation value, postulate V – time dependent and time independent Schrodinger equation.

Unit II: Applying Schrodinger equation to various general systems

Translational motion of a quantum entity (particle in one-dimensional box and three-dimensional box); vibrational motion (harmonic oscillator); rotational motion (rigid rotator, particle on a ring and particle on a sphere); angular momentum.

Unit III: Atomic structure and chemical bonding

Hydrogen and hydrogen-like atoms; Multi electron systems- variation methods, perturbation methods, application to the ground state of helium atom, SCF method, the exclusion principle

Chemical bonding: hydrogen molecule ion and hydrogen molecule - molecular orbital and valence bond theory, homo- and hetero- nuclear diatomic molecules from VB and MO theory, the concept of directed valences and hybridization; quantum mechanics in band theory of metallic solids

Unit IV: Electronic structure of polyatomic systems: Computational quantum chemistry

Semi empirical and ab-initio methods; QM approximations, Details of HMO and EHMO and its application to chemical bonding in unsaturated molecules (ethylene, 1,3-butadiene etc); Details of SCF procedure, Hartree and Hartree Fock methods (up to ground and excited states of hydrogen molecule); the basis sets, STOs and GTOs, nomenclature of basis sets, basis set errors, introductory ideas on DFT.

Unit V: Molecular properties: Computational quantum chemistry

Calculations of molecular properties like atomic charges, dipole moments, electronic distributions, vibration frequencies, NMR chemical shift etc using Gaussian program, specification of molecular geometry using Cartesian coordinates and internal coordinates, Z-matrix, Z-matrix of some simple molecules, structure of a Gaussian input file

TEXTBOOKS

1. *Ira N. Levin, 'Quantum Chemistry', 6th Edition, Prentice-Hall, 2008*
2. *Peter Atkins, Ronald Friedman, 'Molecular Quantum Mechanics', 4th edition, Oxford university press*
3. *R K Prasad, 'Quantum Chemistry', New Age International (P) LTD publishers*

REFERENCES

1. *Andrew R Leech,' Molecular Modelling – Principles and Applications', 2nd Edition, Pearson Education.*
2. *Donald A. McQuarrie, 'Quantum Chemistry', Viva Books2016.*

22CHY502 Concepts in Inorganic Chemistry 3 0 0 3

Unit 1 Nuclear Chemistry

Nuclear structure, mass and charge, mass defect, binding energy, stability rules, magic numbers, nuclear quantum numbers, nuclear parity and statistics, models of nucleus, shell model, liquid drop model, , semi empirical mass equation, equations of radioactive decay and growth, half-life, average life determination of half-lives, nuclear reactions, energetics of nuclear reactions, types of nuclear reactions, spontaneous and induced fission, neutron capture cross sections- critical size principle and working of nuclear reactor. Numerical problems relevant to each session.

Unit 2 Radiation Chemistry

Radioactive elements, decay kinetics, parent-daughter decay relationships, radioactive equilibrium - transient and secular equilibrium, alpha and beta decay, gamma emission, Radiochemical methods - measurement of radioactivity, measurement of radiations - ionization chamber, proportional counter, the Geiger counter,

scintillation counter, semiconductor detectors. Applications of nuclear and radiation chemistry, isotope dilution analysis - activation analysis, radioactive tracers, radiometric titrations, radiation dosimetry, hydrated electron.

Unit 3 Inorganic materials I

Alkali and alkaline earth metals, their compounds, crown ethers and cryptands as complexing agents for alkali metal ions, Be and Mg compounds, boron cage compounds, boron hydrides, structure and bonding, 3-centre-2-electron bonds, styx numbers, the importance of icosahedral frame work of boron atoms in boron chemistry, closo, nido and arachno structure, carboranes, metallocene carboranes, applications of boron clusters, B-N compounds, interstitial compounds, metal carbides, nitrides and hydrides, fullerenes, functionalized fullerenes, C-nanotubes.

Unit 4 Inorganic materials II

Inorganic chains and polymers, rings, cages, and clusters, sulphur-nitrogen compounds, polymeric sulphur nitride, isopoly anions, heteropoly anions, Keggin and Dawson polyoxometallates, borazines, metal clusters, nature of Si-Si bonds, silicates, silicates with zero-, one-, two- and three-dimensional structures, structure of elemental P, phosphonitrilic compounds, polymers with P-N bonds, interhalogen and pseudo halogens, intercalation chemistry, intercalation in layered materials like graphite, xenon fluorides & other xenon compounds.

Unit 5 Chemistry of f-block elements

The lanthanides and actinides, stable oxidation states, the lanthanide and actinide contractions, the f-orbitals, spectral and magnetic properties - comparison with inner transition and transition metals, separation of lanthanides, use of lanthanide compounds as shift reagents, photo-emission of lanthanide compounds, organometallic compounds of lanthanides and actinides and their structural features, reactions of lanthanide and actinide compounds, mineral sands of south west India - Ilmenite, Monazite, etc.

TEXTBOOKS

1. *H J Arnikar, Essentials of Nuclear Chemistry, 4th revised edition, New Age International (P) Limited publishers, 2015.*
2. *H J Arnikar, Nuclear Chemistry through Problems, New Age International Publishers.*
3. *J. Huheey, Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, 2006.*
4. *F.A. Cotton, Advanced Inorganic Chemistry, Wiley; 6th Edition edition (22 April 1999)*
5. *J.D. Lee Concise Inorganic Chemistry, Oxford University Press, 5th edition, 2008*

REFERENCES

1. *Gregory R. Choppin, Jan-Olov Liljenzin and Jan Rydberg, Radiochemistry and Nuclear Chemistry (Third Edition), Elsevier, 2002*
2. *Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg, Modern nuclear chemistry, A JOHN WILEY & SONS, INC., PUBLICATION, 2017.*
3. *Shriver and Atkins' Inorganic Chemistry, Oxford; 5 edition, 2009.*

22CHY503 Principles in Organic Chemistry 3 1 0 4

Unit 1 Aromaticity: Review of inductive and field effects – Resonance effects. Criteria for aromaticity – structural and electronic. Types – Huckel and Craig's rule, homo (Five, Six, seven and eight, membered rings), hetero (furan, thiophene and pyrrole) and nonbenzenoid aromatic systems. Aromaticity of fused rings, annulenes, catenanes, rotaxanes, mesoionic compounds, metallocenes, cyclic carbocations and carbanions.

Unit 2 Structure activity relationships – Orientation effects of substituent, Quantitative treatment of structure on reactivity - free energy relationships – Hammett equations, Taft equation.
Reactive Intermediates: Generation, structure and reactivity - reactions and rearrangement involving) of carbocations - non-classical carbocations, carbanions, carbon radicals, radical ions, carbenes, nitrenes, isonitrenes, arynes.

Unit 3 Mechanism and methods to determining them: Thermodynamic and kinetic requirement, Baldwin rules for ring closure – Kinetic and thermodynamic control – Hammond postulates, microscopic reversibility, Marcus theory, methods of determining reaction mechanisms - solvents and their effect on course of a reaction. Acids and Bases: Bronsted and Lewis acids - HSAB concept and bases, pH and pK_a, effect of structure on acidity and basicity, effect of medium.

Unit 4 Stereochemistry

Optical and geometrical isomerism, absolute and relative configuration, Cahn-Ingold-Prelog system, prochirality, prochiral centre, atoms, groups and faces, designations. Atropisomerism, optical isomerism in biphenyls, allenes, spirans and "ansa" compounds, compounds containing chiral nitrogen and sulphur atom, geometrical isomerism of cyclic compounds, cumulenes and oximes. Asymmetric synthesis, stereospecific and stereoselective synthesis, regioselective and regiospecific reactions.

Unit 5 Conformational Analysis

Conformational analysis of cyclic and acyclic systems with special emphasis on six membered rings, conformational effects on the reactivity of acyclic and cyclic systems - elimination, substitution and addition, strain, structure and stability of small, medium, and large rings, anomeric effect - cycloalkenes and cycloalkynes - kinetically and thermodynamically favoured products stereochemistry of SN1, SN2, SNi, E1 and E2

Selectivity in organic reactions: Chemoselectivity, regioselectivity, enantio- and stereo-selectivity. Stereo aspects of the addition of X_2, HX, boranes and hydroxylation to C=C systems. *Cis*- and *trans*- hydroxylation of cycloalkenes.

TEXT BOOKS

1. *Michael B Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th edition, Wiley (2015).*
2. *Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part A: Structure and Mechanisms", 5th Edition, Springer, 2008*
3. *P. S. Kalsi, "Stereochemistry, Conformation and Mechanism", New Age Publications, 2008.*

REFERENCES

1. *E. L. Eliel and S. H. Wilen, "Stereochemistry in Organic Compounds", John Wiley, 2008.*
2. *D. Nasipuri, "Stereochemistry of Organic Compounds - Principles and Applications", 4th Revised Edition, New Academic Science, 2012.*
3. *Peter Sykes, "A Guidebook to Mechanism in Organic Chemistry", Pearson Education; 6th edition, 2003.*

22CHY504 Coordination Chemistry 3 0 0 3

Unit 1 Theories and Concepts on *d*-block Coordination Compounds

Introduction - ligands, nomenclature of coordination compounds, coordination compounds of *d*-block ions with coordination numbers of 2, 3, 4, 5, 6, 7 and 8. Werner's coordination theory, Valence bond theory (VBT), Crystal field theory (CFT), CFSE, effects of CFSE on hydration energies and spinel groups (normal and inverse), types of ligands – spectrochemical series, spectral and magnetic properties (spin-only magnetic moments), nephelauxetic effect. Crystal field splitting patterns in complexes having Oh, Td, square planar, square pyramidal and trigonal pyramid geometries, factors affecting the magnitude of CFSE, various types of isomerism in coordination complexes, Jahn-Teller (JT) distortion, manifestation of JT on spectral properties. Molecular orbital theory (MOT), ligand field theory (LFT), molecular orbital energy level diagram for octahedral complexes without pi-bonding, metal-ligand pi-bonding, metal-metal multiple bonds, *d*-orbital based metal-metal σ, π and δ bonds in compounds like $[Re_2Cl_8]^{2-}$, $[Os_2Cl_8]^{2-}$, $Cr_2(CH_3COO)_4$ and R-Cr(I)-Cr(I)-R. Application of group theory to coordination compounds.

Unit 2 Reaction Mechanism

Complex equilibrium - formation constants, chelate and macrocyclic effects, factors affecting stability of complexes, methods of determination of stability constants, stability of complex ions in solutions, inert and labile complexes, mechanisms of ligand displacement and addition reactions in octahedral complexes and square planar complexes of platinum *cis*- and *trans*-effect, substitution reactions, mechanisms of substitution, kinetic consequences of reaction pathways, dissociation, interchange, association, dissociation, linear free energy relationships, conjugate base mechanism, stereochemistry of reactions (substitution in *trans*-complexes and substitution in *cis*-complexes), isomerisation of chelate rings, sigma-bonding and pi-bonding effects, oxidation-reduction reactions, inner and outer sphere electron transfer reactions, conditions for high and low oxidations numbers, reactions of coordinated ligands, hydrolysis of esters, amides and peptides, template reactions, electrophilic substitution, photochemical reactions of coordination compounds. Asymmetric synthesis catalyzed by coordination compounds.

Unit 3 Coordination Chemistry of Inner-transition (*f*-block) Elements

f-block metal ions – oxidation states preferences, ligand preferences, coordination numbers and the geometry of the complexes, influence of lanthanide contraction and actinide contraction in their coordination behaviour,

shapes of *f*-orbitals (4*f* and 5*f*), nature of bonding of *f*-orbitals with ligands, various types of coordination compounds of lanthanides and actinides, stereochemistry and reaction mechanism of *f*-block metal complexes.

Unit 4 Spectral Properties

Stabilization of unusual oxidation states, electronic spectra of transition metal complexes – color wheel, Russell-Saunders coupling schemes, term symbols for various d^n ions, Orgel diagrams for d^n systems, ligand field parameters, *Dq*, Racah parameter *B* and nephelauxetic constant *b*, Tanabe-Sugano (TS) diagrams, evaluation of *Dq* and other parameters from electronic spectra of transition metal complexes using TS diagrams, charge-transfer transitions, MLCT and LMCT, selection rules and band intensities, Laporte- and spin- selection rules, symmetry, spin-orbit and vibronic coupling effects. Photochemistry of transition metal complexes like $[Ru(bipy)_3]^{2+}$, spectral behaviour of *f*-block coordination complexes, special features of their absorption and emission properties.

Unit 5 Magnetic Properties

Magnetic properties of coordination complexes - magnetic susceptibility, contribution of spin-orbit coupling on μ_{eff}, types of magnetic behaviour - para-, ferro, anti-ferro and ferri-magnetic systems, Curie law, Curie-Wise law, Guoy, Faraday and superconducting quantum interference device (SQUID) methods, Kotani plots, giant magnetoresistance (GMR), anisotropic magnetoresistance (AMR) effect, effects of temperature on magnetic behaviour, tunnelling magnetoresistance (TMR). Magnetism of coordination complexes by multinuclear homo- and heterometallic 3*d* systems (also with exclusive 4*d* and 5*d* metal ions), mixed 3*d*-4*f* systems, importance of 4*f*-metal ions for functional applications. Nanoscale magnetic systems based on coordination complexes - Single Molecule Magnets (SMMs), Single Ion Magnets (SIMs), Single Chain Magnets (SCMs), Spin-crossover complexes, magnetic refringents (magnetic coolers), magnetic storage systems - magnetic random-access memory (MRAM).

TEXTBOOKS

1. *F. A. Cotton and G. Wilkinson, 'Advanced Inorganic Chemistry', John Wiley & Sons, 2009.*
2. *James E. Huheey, Ellen A. Keiter and Richard L. Keiter, 'Inorganic Chemistry, Principles of Structure and Reactivity', Pearson education, 5th edition, 2009.*
3. *J. D. Lee, 'Concise Inorganic Chemistry', 5th edition, John Wiley & Sons, 2009.*
4. *P Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, "Shriver & Atkins Inorganic chemistry", 4th Edition, Oxford University Press, 2008.*

REFERENCES

1. *B. Douglas, D. McDaniel and J. Alexander "Concepts and Models in Inorganic Chemistry", 3rd Edition, Wiley, 2006.*
2. *Sushanta Dattagupta, 'A Paradigm Called Magnetism', World Scientific Publishing Co. Pte. Ltd., 2008.*
3. *Helen C. Aspinall, 'Chemistry of the f-Block Elements', Volume 5 of Advanced chemistry texts, CRC Press, 2001.*
4. *N. N. Greenwood and A. Earnshaw, 'Chemistry of Elements', Butterworth and Heinemann, 2nd Edition, 2002*
5. *J. E. House, "Inorganic Chemistry", Academic Press, 2008.*
6. *T. Shinjo (Editor), 'Nanomagnetism and Spintronics', Elsevier, USA, 2nd Ed., 2014.*
7. *R. A. Layfield and M. Murugesu (Editors), 'Lanthanides and Actinides in Molecular Magnetism', Wiley-VCH Verlag& Co., 2015.*

22CHY505 Group Theory and its Applications 3 0 0 3

Unit I Introduction to molecular point groups

Definition of a mathematical group, Symmetry in molecules, elements of symmetry, , matrix representation of symmetry operations, molecular point groups, , abelian group, cyclic group, symmetry operations as group elements, similarity transformation and classes, group multiplication table, symmetry classification of molecules into point groups (Schoenflies symbol)

Unit II Construction and interpretation of character tables

Reducible and irreducible representations, Great Orthogonality Theorem and its consequences, character tables, reduction formula, construction of character tables for point groups with order ≤6, interpretation of character tables.

Unit III Applications of Group theory - I (vibrational and electronic spectroscopy)

Infrared and Raman activity of molecular vibrations in H_2O, N_2F_2, BF_3, AB_4type molecules (Td and D_4h) and AB_6 type (Oh) of molecules; selection rules; Electronic structure of free atoms and ions, splitting of terms in a chemical environment, construction of energy level diagrams, estimations of orbital energies, selection rules and polarizations, double groups, a brief idea on electronic spectra of transition metal complexes – selection rules, Orgel diagrams, Tanabe Sugano diagrams.

Unit IV: Applications of Group theory (Chemical bonding - Hybridization and molecular orbital formation)

Group theory to explain hybridization - wave functions as bases for irreducible representations, construction of hybrid orbitals for AB_3 (planar), AB_4 (Td), AB_5 (D_{3h}) and AB_6 (O_h) type of molecules, symmetry adapted linear combinations, projection operators, application of projection operators to pi-bonding in ethylene, cyclopropenyl systems and benzene, application of symmetry to predict polar and chiral compounds;

Unit V: Symmetry in solid state

Symmetry elements and operations in solid state – proper axis of rotation, mirror planes of symmetry, roto-reflection and roto-inversion axes of symmetry, screw axes of symmetry, glide planes; a brief introduction to the crystallographic point groups and space groups

TEXTBOOKS

1. *F. Albert Cotton, 'Chemical Applications of Group Theory', 3rd Edition, John Wiley, 1990.*
2. *A Salahuddin Kunju, G Krishnan; 'Group theory and its application in chemistry', second edition, PHI Learning private limited-2015*

REFERENCES

1. *Robert L Carter, 'Molecular symmetry and Group theory', John Wiley & Sons, Inc.*
2. *V. Ramakrishnan and M.S. Gopinathan, 'Group Theory in Chemistry', 2nd reprint edition, Vishal Publications, 1996.*
3. *P.H. Walton, "Beginning Group Theory for Chemistry", Oxford University Press Inc., New York, 1998.*

22CHY511 Chemical Thermodynamics and Equilibrium 3 1 0 4

Unit 1 Chemical Thermodynamics

First and second laws of thermodynamics, thermodynamic functions, heat capacity, thermochemistry, need for second law of thermodynamics, entropy and free energy functions, calculation of changes in thermodynamic function for ideal and non-ideal gases in isothermal and adiabatic process, relation between thermodynamic functions - Maxwell relations, Joule Thomson effect, coefficient of thermal expansion and compressibility factor, applications of free energy function to physical and chemical changes, equilibrium in chemical reactions, third law of thermodynamics - need for third law, calculation of absolute entropy, unattainability of absolute zero, thermodynamic systems of variable composition - fugacity functions, partial molar quantities, thermodynamics of ideal solutions, real solutions and regular solutions, dilute solutions of nonelectrolytes, Henry's law, Raoult's law, Gibbs-Duhem equations, Gibbs-Duhem-Margules equations, activity and standard states of non-electrolytes.

Unit 2 Irreversible Thermodynamics

Examples for irreversible process, entropy production, non-equilibrium, steady state and near equilibrium conditions, linear relation, phenomenological coefficients, Onsager reciprocal relations, one component systems with heat and matter transport, application of irreversible thermodynamics to thermal diffusion, thermal osmosis etc., electro kinetic effects, the Glansdorf-Pregogine equation.

Unit 3 Statistical Thermodynamics

Statistical concept, probability and thermodynamic states, entropy and probability, canonical ensemble, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics, electron gas concept, Bose-Einstein condensation, relation among MB, FD & BE Statistics, partition function, partition function for free linear motion, free motion in a shared space, linear harmonic vibration, translational, rotational and vibrational partition function, molecular partition functions, partition functions and thermodynamic properties, calculation of equilibrium constant, heat capacity of gases, mono atomic solids, Einstein's and Deby's theory.

Unit 4 Equilibrium

Gibb's free energy, direction of spontaneous change of a reaction, chemical potential, chemical potential and equilibrium, ΔG in terms of K, equilibrium constants – real gases and real reactions, equilibrium respond to catalyst, temperature, pressure and pH, application of ΔG and K – extraction of metals from their oxides, Ellingham diagram, and thermodynamics of ATP & respiration, biological energy conversion.

Unit 5 Phase Equilibrium

Gibb's Phase rule, one component system, two component systems, vapour pressure diagrams and their interpretation, lever rule, temperature-composition diagrams, liquid-liquid phase diagrams, distillation of partially miscible liquids, azeotropes, liquid-solid phase diagrams, phase diagram for the system Na/K/Na_2K, phase diagram - steel, alloys, Fe-C system, zone refining, three component system, triangular coordinates, three component system – partially miscible liquids - $H_2O/CHCl_3/CH_3COOH$, phase diagram - $NH_4Cl/(NH_4)_2SO_4/H_2O$

TEXTBOOKS

1. *Robert J. Silbey, Robert A. Alberty, Moungi G. Bawendi, Physical Chemistry 4th Edition, Wiley, 2004*
2. *Samuel H. Maron, Carl F. Prutton, Principles of Physical Chemistry, The Macmillan Company; 4th edition (1970)*
3. *Samuel Glasstone, 'Thermodynamics for Chemists', Lightning Source Incorporated, 2007.*

REFERENCES

1. *Francis Weston Sears and Gerhard L. Salinger, 'Thermodynamics, kinetic theory and statistical thermodynamics' 3rd edition, Addison-Wesley Publications, 1975.*
2. *Prigogine, 'Introduction to Thermodynamic Irreversible Processes', Interscience Publishers, 3rd edition, 1968.*
3. *R.P. Rastogi and R.R. Misra, 'An Introduction to Chemical Thermodynamics', 6th Revised edition, Vikas Publishing House Pvt. Ltd., 2006.*
4. *F.W. Sears, 'Introductions to Thermodynamics, Kinetic Theory of Gases and Statistical Mechanics', Addison Wesley Pub., Cambridge, 1972.*

22CHY512 Molecular Spectroscopy 3 1 0 4

Unit 1 Rotational and Vibrational Spectroscopy

Introduction to spectroscopy, rotation spectra - diatomic and polyatomic molecules, selection rules, intensities of spectral lines, stark effect, instrumentation of micro wave spectroscopy, applications and structural determinations, vibration spectra of diatomic molecules, harmonic and anharmonic vibrations, diatomic vibrating rotor, selection rule, breakdown of Born Oppenheimer approximation, rotational character of vibration spectra, different modes of vibrations, vibration-rotation spectra, Fermi resonance, vibration spectra of polyatomic molecules, IR spectra of organic and inorganic compounds, phase, temperature and solvent dependence, FTIR technique, instrumentation, Raman spectra (including the use of laser) - theory, relation with IR spectroscopy, mutual exclusion principle, resonance Raman, stimulated hyper and inverse Raman effects, instrumentation and applications of Raman spectroscopy.

Unit 2 UV-Visible and Fluorescence Spectroscopy

Electronic spectra of atoms - single and multi-electron systems, j-j and L-S coupling, electronic spectra of diatomic and polyatomic molecules, its relation to electronic arrangement and symmetry of molecules, application of group theory in electronic spectra, selection rules, nature of electronic excitation, principles of absorption spectroscopy, Beer-Lambert law, presentation of spectra, chromophores, forbidden transition, different types of electronic transitions, p-p*, n-p* etc transitions, nature of transitions in carbonyl compounds, the effect of conjugation, effect of conjugation on alkenes, HOMOs and LUMOs, Woodward-Fieser rules for dienes, spectra of carbonyl compounds, enones, Woodward rule for enones, spectra of aromatic compounds, effect of substituents, structural information from electronic spectra, excited states of molecules, fluorescence and phosphorescence, Jablonski diagram in detail, lifetime of excited states, quantum yields, photosensitization, application of UV-Visible and Fluorescence Spectroscopy for structural elucidation of organic compounds, and coordination complexes, diffuse reflectance spectra.

Unit 3 NMR Spectroscopy

Nuclear magnetic resonance phenomenon - theory, relaxation effects, NMR uses active nuclei, Fourier Transformation in NMR, measurement of relaxation time, chemical shift, magnetic anisotropic effect, multiplets in NMR, spin-spin splitting, n + 1 rule, Pascal's triangle, tree-diagram, spin-spin splitting constant, J, ^{2}J and ^{3}J and long-range coupling, measurement of J, Karplus relationship, first and second order spectra, AX, AB, AX_2, AX_3, A_2X_3, AMX type spectra, double resonance and spin tickling, chemical shift reagents, spectra in higher fields, spectra of conformational isomers, homotopic, enantiotopic and diastereotopic systems, C^{13} spectra, factors related to ^{13}C spectra, ^{1}H coupled ^{13}C spectra, ^{1}H decoupled ^{13}C spectra, chemical shift values, nuclear overhauser effect (NOE), cross-polarization, off-resonance resonance decoupling, application of ^{1}H and ^{13}C NMR spectroscopy for the structural elucidation of organic compounds, ^{11}B, ^{15}N, ^{19}F and ^{31}P NMR spectra, spectra of paramagnetic complexes, magnetic susceptibility, contact shift, fluxional molecules and their studies using NMR, solid state NMR. Homonuclear and Heteronuclear correlation NMR

Unit 4 ESR, NQR and Mossbauer Spectroscopy

ESR spectroscopy - theory, hyperfine and superfine splitting, ESR active simple organic systems, ESR of inorganic systems like Cu^{2+} and VO^{2+} complexes, 'g' markers like DPPH and TCNE, evaluation of spin Hamiltonian like A, g_{II}, g-, covalency factor in Cu^{2+} complexes, analysis of ESR spectra of VO^{2+} complexes, NQR spectroscopy - theory, relationship between electric field gradient and molecular structure, quadrupole coupling constant and structural information of compounds, Mossbauer spectroscopy, principle, Doppler effect, isomer shift, Zeeman splitting, quadrupole splitting, application of Mossbauer spectroscopy for studying Fe and Sn compounds and phase transformation, application of ESR spectroscopy.

Unit 5 Mass Spectrometry and PES

Mass spectroscopy, base peak and molecular ion peak, isotope ratio data, fragmentation patterns of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, aldehydes, ketones, esters, carboxylic acids, amines, methods of desorption and ionization (EI, CI, LD, MALDI, PD, FAB, SIMS), MS/MS and determination of molecular formula, metastable ions and their significance, study of fragmentation pattern, application of MS in structural elucidation and other frontiers of science, application of MS for quantitative analysis, photoelectron spectroscopy (PES), principle, application of PES. Structure determination using IR, UV-visible, NMR, MS and ESR spectral techniques.

TEXTBOOKS

1. *Colin N. Banwell and Elaine M. McCash, 'Fundamentals of Molecular Spectroscopy', 4th Edition, Tata McGraw Hill, 2007.*
2. *W. Kemp, Organic Spectroscopy, 3rd Edition, McMillan International Higher Education*
3. *D. L. Pavia, G. M. Lampman, G. A. Kriz, and J. R. Vyvyan, Introduction to Spectroscopy, 5th Edition, Brooks-Cole, 2009*
4. *G. M. Barrow, 'Introduction to Molecular Spectroscopy', McGraw Hill, 1962.*
5. *R. M. Silverstein, F. X. Webster, D.J. Kiemle, Spectroscopic identification of organic molecules, 7th Edition, John Wiley*
6. P. S. Kalsi, Spectroscopy of Organic Compounds: New Age International Pvt Ltd 6th edition, 2006

REFERENCES

1. *Hollas, J.M., Modern Spectroscopy, John Wiley & Sons, Fourth Edition, 2004*
2. *J. Keeler, Understanding NMR spectroscopy, Wiley, 2009*
3. *D. A. Skoog, F. J. Holler and S. R. Crouch, 'Principles of Instrumental Analysis', 6th Edition, Thomson Brooks/Cole, 2007.*
4. *W. Kemp, NMR in Chemistry, McMillan, 1988*
5. *J. E. Wertz and J. R. Bolton Electron Spin Resonance, Springer Science*

22CHY513 Organic Reaction Mechanism 3 1 0 4

Unit 1 Nucleophilic Substitution:SN_1, SN_2, and Borderline (ion pair), SNi, SET mechanisms, Neighboring group participation, substitution at allylic carbons, substitution at aliphatic trigonal carbon, substitution at vinylic carbon. Effect of substrate structure, nucleophile, leaving group and medium on reactivity. Ambident

nucleophiles and substrates. Aromatic nucleophilic substitution: SN_{Ar}, SN_1, benzyne and SRN_1 mechanisms. Effect of substrate structure, leaving group and attacking nucleophile on reactivity.

Unit 2 Electrophilic substitution: SE_2 and SE_i, SE_1, substitution accompanied by double bond shift. Effect of substrate, leaving group, and solvent on reactivity. Aromatic electrophilic substitution: arenium mechanism, structure – reactivity relationship, substituent effect, o/p ratio, ipso substitution, orientation and reactivity, quantitative treatment. Free radical reactions: radical addition. Effect of substrate (aliphatic, aromatic, bridgehead), nature of the radical and solvent on reactivity.

Unit 3 Addition reactions: mechanism of electrophilic, nucleophilic and radical addition. Addition to conjugated systems. Orientation and reactivity. Addition of hydrogen halides, oxymercuration, halogenation, sulphenylation, selenylation, addition involving epoxides, addition via organoborane. Addition of water, alcohol, sulphides, to aldehydes, ketones, imines, isothiocyanates, nitro compounds, nitriles. Mannich reaction, elimination reactions: mechanism of elimination reactions E_2, E_1, E_{1CB}, steric effect. Effect of substrate structure, base, leaving group and medium on reactivity. Mechanism of pyrolytic elimination.

Unit 4 Rearrangement reaction: mechanism of nucleophilic, electrophilic and radical rearrangements. Nature of migration, migratory aptitudes, memory effects. Wagner-Meerwein, Pinacol, Demyanov, dienone-phenol, benzil-benzilic acid, Favorskii, Wolff, Neber, Hofmann, Curtius, Lossen, Schmidt, Beckmann, Baeyer-Villiger, Stevens, benzidine, Hofmann-Loffler and Chapman rearrangements and their mechanisms.

Unit 5 Photochemistry and pericyclic reactions: general principles – fate of excited state – Jablonski diagram - chemical process – photochemistry of alkenes, dienes and polyenes, carbonyl compounds, Norrish type 1 and type 2, Patterno –Buchi reaction.
Pericyclic reactions: cyclo addition - Diels-Alder reaction, substituent effect on reactivity, regioselectivity and stereochemistry, catalysis of Lewis acids, synthetic applications, enantio-selective Diels-Alder reactions, Intramolecular Diels-Alder reactions. 1,3 dipolar cycloaddition – reactivity, regio and stereoselectivity, applications. [2+2] cycloaddition – ketenes and alkenes – photochemical electrocyclic reactions, orbital symmetry, charged species. Sigmatropic rearrangements – [1,3], [1,5], and [1,7] sigmatropic shifts – [3,3] sigmatropic rearrangements – Cope, Oxy-Cope and Claisen rearrangement. [2,3] rearrangements – oxides and ylides –Wittig and aza – Wittig rearrangements, cheletropic reactions.

TEXT BOOKS

1. *Michael B Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th edition, Wiley (2015).*
2. *Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part A: Structure and Mechanisms", 5th Edition, Springer, 2008*
3. *Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part B: Reactions and Synthesis", 5th Edition, Springer, 2008.*
4. *Singh S P and SM Mukherji, "Reaction Mechanism in Organic Chemistry", 2014*

REFERENCES

1. *Reinhard Bruckner, Advanced Organic Chemistry, Reaction Mechanisms, Elsevier, 2002*
2. *R.O.C. Norman and J.M. Coxon, "Principles of organic synthesis", CRC press, 2014*
3. *Ian Fleming, Frontier Orbitals and Organic Chemical Reactions 1st Edition, Wiley, 1991.*

22CHY514 Heterocyclic and Natural Product Chemistry 3 0 0 3

Unit 1 Heterocyclic Compounds

Nomenclature and general characteristics of heterocyclic compounds, study of three- and four-membered ring heterocycles containing one heteroatom, structure and synthesis of penicillin and cephalosporin-C, structure and synthesis of reserpine, heteroaromatic compounds (five- and six-membered rings) containing one and two heteroatoms, fused ring compounds - indole, quinoline, isoquinoline, coumarin, flavones, purine and pyrimidine, bases present in nucleosides.

Unit 2 Carbohydrates and Nucleic Acids

Nomenclature – aldoses, ketoses, furanoses, pyranoses. Classification – monosaccharides, disaccharides and polysaccharides. Structure (Fischer, Haworth and chair projection) of ribose, glucose, fructose, maltose, sucrose, lactose, starch, cellulose and cyclodextrins. Preparation of alditols, glycosides, deoxysugars.

Biosynthesis of vitamin C from glucose. Structure and synthesis of nucleic acids, genetic code, recombinant DNA. Biosynthesis of shikimic acid

Unit 3 Chemistry of Natural Products

Alkaloids - classification, structure elucidation based on degradative reactions (quinine atropine), terpenoids - classification, structure elucidation and synthesis of abietic acid, terpenoids. Total synthesis of quinine and papaverine (morphine, heroin).

Unit 4 Steroids

Steroids - classification, structure of cholesterol, conversion of cholesterol to progesterone, androsterone and testosterone, classification, structure and synthesis of prostaglandins, biosynthesis of fatty acids, prostaglandins, and steroids.

Unit 5 Amino acids, Peptides and Enzymes

Synthesis of amino acids - Strecker and azlactone synthesis, reactions of amino acids, structure of proteins, introduction to enzymes and coenzymes with special reference to the function of chymotrypsin, NAD, thiamine, pyridoxal, solid phase synthesis – choice of resin, classification and reactions leading to peptide formation.

TEXT BOOKS

1. *I.L. Finar Organic Chemistry vol 2 (3rd.ed.) Longmans Green & Co. 1964*
2. *Sujata V. Bhat, Bhimsen A. Nagasampagi, Meenakshi Sivakumar, Chemistry of Natural Products, Springer 2005*

REFERENCES

1. *K. C. Nicolaou, Eric J. Sorensen, Classics in Total synthesis, Wiley, 1996.*
2. *Ashutosh kar, Chemistry of Natural Products, (Volume I and II), CBS*

22CHY515 Organometallic Chemistry 3 0 0 3

Unit 1: Concepts and Metal Carbonyls

History and overview on organometallic compounds. Classification and nomenclature – hapticityof fragments, 18-electron and 16-electron organometallic compounds. Structure prediction based on ’18 electron rule’. Metal carbonyls – synthesis and bonding of metal carbonyls (based on MO theory), donor and acceptor properties of CO, different types of binding modes of CO, poly-nuclear carbonyls with and without bridging groups, metal-metal bonding in M-CO clusters, cluster valence electron (CVE) count, CVE based structure prediction. IR spectral features of metal carbonyls, activation of CO by bonding with metal ions.

Unit 2: Types of Organometallic Compounds

Metal phosphines compounds of transition metals, M-N_2 (metal dioxygen), M-O_2 (metal dioxygen), M-NO (metal nitrosyl) and M-CN (metal cyanide/isocyanide) complexes, bonding and structural features. Organometallic compounds with π-donor ligands like olefins, acetylenes and allyl moieties. Metal derivatives of cyclic π-donors (metallocenes, sandwich/half-sandwich compounds, bent metallocenes), metal-carbon σ-donors (metal carbenes – Fischer carbenes, Schrock carbenes and *N*-heterocyclic carbenes, metal polyenes, metal carbines, metal alkyl/aryl derivatives). Organometallic chemistry of lithium and magnesium, aluminium alkyls and all other main-group organometallics. Structural features and nature of bonding in above compounds.

Unit 3: Structure and Bonding

Fragment molecular orbitals (FMO) of various organic and inorganic moieties like CH_3, CH_2, CH, BH_2, BH, NH_2, NH. FMO’s (π-orbitals) of C_3H_5, C_4H_4, C_4H_6, C_5H_5, C_6H_6, C_8H_8. Inorganic fragments MLn with varying number of L’s. Symmetry and shape of their FMO’s. isolobal concept, iso-electronic and isolobal relationships between various organic and inorganic (ML_n) fragments. Structure and bonding between various organic and inorganic fragments based on MO level diagrams – metal-olefins, ML_n-cyclobutadiene, ML_n-carbene, ML_n-carbyne, ML_n-cyclopentadienyl systems, compounds with metal-metal multiple bonds (metal-metal σ, π and δ bonds).

Unit 4: Stereochemistry and reactions

Stereochemically non-rigid molecules, fluxional nature of organometallic compounds (including Li-C, Mg-C), characterization of non-rigidity of organometallic compounds by NMR spectroscopy. Difference in NMR spectra of fluxional organometallic compounds at high and low temperatures. Characterization techniques of organometallic compounds (by NMR – ^{1}H, ^{13}C and ^{31}P NMR spectroscopy, Dynamic NMR, Mass spectrometry). Reactions involving various organometallic compounds - oxidative addition reactions, reductive

elimination reactions, migratory insertion reactions, 1,1-type and 1,2-type insertion reactions, elimination reactions, β-hydride elimination reactions. Conditions for organometallic compounds to exhibit above reactions, cyclo-metalation and ortho-metalation reactions, agnostic interactions.

Unit 5: Organometallic Catalysis

Alkene hydrogenation using Wilkinson's catalyst, water-gas shift reaction, Mosanto process, Cativa Process. Reaction steps in the above catalytic processes. Hydro-formylation reactions, catalytic addition of molecular oxygen to alkenes (Wacker process), Ziegler-Natta polymerization of alkenes, Fischer-Tropsch process, olefin-metathesis (types of Grubbs catalysts and Hoveyda–Grubbs catalysts), oligomerization of alkynes, aluminium alkyls in polymerization of olefins. Palladium based reactions such as Heck, Stille, Suzuki, Sonogashira, Buchwald-Hartwig couplings; Tsuji-Trost C-C bond formations. Homogeneous vs. heterogeneous organometallic catalysis (principles, mechanism and their applications). Organometallics - in industry, in medicine, in agriculture and in environmental science.

TEXTBOOKS

1. *J.E. Huheey, R.A. Keiter, R.L. Keiter, 'Inorganic Chemistry-Principles of Structure and Reactivity', 4th Edn., Prentice Hall, 1997.*
2. *P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong,' Shriver and Atkins Inorganic Chemistry', 4th Edn., Oxford University Press, 2006.*
3. *F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, 'Advanced Inorganic Chemistry', 6th Edn.,Wiley-Interscience, 1999.*
4. *Anil Elias, Gupta B.D., "Basic Organometallic Chemistry", Universities Press; 2nd Edition 2013*
5. *J.D. Atwood, 'Inorganic and Organometallic Reaction Mechanism', 2nd Edn., Wiley-*

REFERENCES

1. *R. H. Crabtree, 'Organometallic Chemistry of the Transition Metals', John Wiley & Sons, 6th Ed.*
2. *VCH, 1997.*
3. *J. Tsuji, 'Transition metal reagents and catalyst innovations in organic synthesis', John-Wiley- & Sons, Ltd, New York, 2000*
4. *B.E. Douglas, D.H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., Wiley-India, 2007.*
5. *M. Bochmann, Orgaonometallics: Complexes with Transition Metal-Carbon Sigma Bonds, Oxford University Press, 1994.*
6. *J. P. Collman, R G Finke and J R Norton "Principles and Applications of Organo-transition metal Chemistry" University Science Books, 1987.*
7. *W.K. Li, G.D. Zhou, T. Mak, Advanced Structural Inorganic Chemistry, Oxford University Press, 2008.*
8. *K. C. Nicolaou, 'Classics in Total Synthesis', Vols I-III, Wiley-VCH, 1996; 2003; 2011*

22CHY581 Inorganic Semi-micro Qualitative Analysis Lab. 0 0 5 2

Semi micro Analysis of Mixtures

The mixture will include 4 cations including two common (e.g., cations of metals like Cu, Mn, Zn, Ni, Ca, Ba, Mg etc.) and two less common cations (e.g., cations of metals like Ti, Zr, V, W, Li, Ce, Th etc.).

(The student has to successfully analyze a minimum of 10 mixtures).

TEXTBOOKS

1. *A. I. Vogel, 'A text book of Qualitative Analyses', 4th edition, Longmans publications, 1985.*
2. *V.V. Ramanujam, 'Inorganic Semi-Micro Qualitative Analysis', 3rd edition, The National Publishing Company, 1974.*

REFERENCES

1. *G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, 'Vogel's Text Book of Qualitative Chemical Analysis', 5th edition, John Wiley & Sons Inc, 1989.*
2. *G.W. Parshall, 'Inorganic Synthesis', Vol. 15, Tata McGraw-Hill Education, 1974.*

22CHY582 Organic Quantitative Analysis Lab 0 0 5 2

A. Estimations:

Estimation of - equivalent weight of an acid, glucose, phenol, acetone, acid value of an oil, iodine value and sap value of an oil, Nitrogen (Kjeldahl method), formaldehyde, aniline

Estimation of ester.

Estimation of the following drugs: Aspirin (titrimetry), Ibuprofen (titrimetry), Analgin (titrimetry), ascorbic acid {titrimetry (Iodometry and Cerimetry), colorimetry}, Riboflavin (colorimetry), Zn ions in Bacitracin Zinc, Ca^{+2} ions in Calcium gluconate injection (complexometry), Diazepam (UV-Visible Spectrophotometer).

B. Preparations of Organic Compounds

Double stage preparations:
(a) m-nitro benzoic acid from ethyl benzoate
(b) p-bromobenzanilide from aniline
(c) p-nitro acetanilide from aniline

Single stage preparations:
(a) Benzimidazole
(b) Benzophenone oxime
(c) Dibenzilidene acetone (chalcone)
(d) Benzalacetophenone
(e) Benzanilide
(f) Acetanilide
(g) Acetyl salicylic acid (aspirin)

Name Reactions:
(a) Benzil-Benzilic acid rearrangement
(b) Cannizaro reaction
(c) Claisen condensation

Identification of unknown organic compounds from their IR, UV,1H NMR and Mass Spectral data: Analysis of recorded spectra of compounds belonging to i) alkynes, ii) alcohols and phenols iii) aldehydes and ketones iv) carboxylic acids,v) esters vi) acid amides and vii) primary and secondary amines.

For all preparations
1. TLC to be done and Rf values of each compound to be reported
2. Melting point of pure compounds to be found
3. A small portion should be recrystallized from suitable solvent
4. Purified products to be displayed
5. Mechanisms for each preparation should be suggested

REFERENCES

1. *P.W.G. Smith, A.J. Hannaford, B.S. Furnis and A.R. Tatchell, "Vogel's Textbook of Practical Organic Chemistry", ELBS/Longman, 1989.*
2. *Ralph L. Shriner, Christine K. F. Hermann, Terence C. Morrill, David Y. Curtin, Reynold C. Fuson, 'Systematic Identification of Organic Compounds', John Wiley & Sons, 2003.*
3. *Mann and Saunders, 'Practical Organic Chemistry', Pearson edition, 2009.*

22CHY583 ADVANCED PHYSICAL CHEMISTRY LAB. 0 0 5 2

1. Construction of phase diagram for three component system.
2. Determination of equilibrium constant of the reaction, $KI + I_2 = KI_3$ by partition method.
3. Determination of molecular weight of poly vinyl alcohol by viscosity method
4. Determination of energy of activation of acidic hydrolysis of methyl acetate.
5. Kinetic study of the second order reaction between potassium persulphate and potassium iodide.
6. Determination of equivalent conductance at infinite dilution of weak electrolytes.
7. Determine the acid and basic dissociation constants of an amino acid, and hence the isoelectric point of the acid pHmetrically.
8. Ostwald's dilution law: Dissociation constant of acetic acid conductometrically
9. Determination of solubility product and solubility of silver chloride potentiometrically using concentration

cell.

10. Determination of strength of a given dibasic acid by conductometric titration.Study the alkaline hydrolysis of ethyl acetate conductometrically.
11. To determine the amount of Fe (III) present in the given solution by using salicylic acid by colorimetric titration (Static method) at $\lambda = 525$ nm.
12. Determination of order of reaction for ion exchange reaction.
13. Extraction efficiency of solute from a solution by immiscible solvent method
14. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometerically.
15. Determination of flash point, fire point of a lubricant.

TEXTBOOKS

1. *Alexander Findlay, 'Practical physical chemistry', 9th edition, Wiley, 1972.*
2. *R.C. Das and B. Behera, 'Experimental Physical Chemistry', Tata McGraw-Hill, 1983.*

REFERENCES

1. *J.B. Yadav, 'Advanced Practical Physical Chemistry', Krishna Prakashan Media, 29th edition, 2010.*
2. *Francis William Gray, 'A Manual of Practical Physical Chemistry' Macmillan and Co., Limited, 1914.*

22CHY584 Inorganic Quantitative Analysis Lab 0 0 5 2

1. Estimation of Calcium (Permanganometry)
2. Estimation of Barium (Iodometry)
3. Estimation of Calcium as Calcium Carbonate (Gravimetry)
4. Estimation of Zinc using oxine (Gravimetry)
5. Estimation of Iron as Ferric Oxide (Gravimetry)
6. Analysis of Brass
7. Estimation of Copper and Nickel in a Mixture
8. Estimation of Copper and Iron in a Mixture
9. Preparation and Determination of Ferrous Oxalate
10. Estimation of Different Types of Hardness in the Given Water Sample
11. Estimation of Different Types of Alkalinities in the Given Water Sample
12. Estimation of Dissolved Oxygen in the Given Water Sample
13. Complexometric Estimations
14. Analysis of some typical alloys such as brass, bronze and type metal.
15. Ion exchange methods of analysis: (i). Determination of capacity of an ion exchange resin. (ii). Separation of Zinc and Magnesium on an anion exchange resin and estimation of Mg^{2+} and Zn^{2+}

TEXTBOOKS

1. *G. Svehla, 'Vogel's Qualitative Inorganic Analysis', 7th Edition', Prentice Hall, 1996.*
2. *D. A. Skoog and D. M. West, 'Analytical Chemistry - An Introduction', 4th Edition, CBS Publishing Japan Ltd., 1986.*

REFERENCES

1. *E.J. Meehan, S. Bruckenstein and I.M. Kolthoff and E.B. Sandell, 'Quantitative Chemical Analysis', 4th Edition, The Macmillan Company, 1969.*
2. *R.A. Day (Jr) and A.L. Underwood, 'Quantitative Analysis', 6th Edition, Prentice Hall of India, 1991.*

22CHY601 Electrochemistry Kinetics and Surface Chemistry 3 1 0 4

Unit 1 Surface Chemistry

Different types of interfaces, molecular and atomic surface structure, surface chemical reactions, surface tension of solutions, surface excess, thermodynamics of surfaces, Gibbs equation and its derivation, surface films, surface potential, adsorption by solids, Langmuir isotherm - its kinetic and statistical derivation, Freundlich equation, multilayer adsorption, BET isotherm - its kinetic derivation, measurement of surface area. Colloids - their preparation, purification, stability & electro kinetic phenomena, Donnan membrane equilibrium, micro and nano emulsions. Surface analysis using photoelectron spectroscopy, surface imaging techniques like SEM, TEM, AFM etc., sputter coating, ion beam principles, design of surfaces with novel properties.

Unit 2 Electrochemistry I

Review of Faraday's laws, conductivity of electrolytes, ionic mobility, transference number, Kohlrausch law, pH of acids, bases and buffers, solubility product and salt hydrolysis and Ostwald dilution law. Deviations from the Ostwald law, activity and activity coefficients in electrolytic solution, modern theory of conductance of strong electrolytes and its tests and improvements, Debye-Huckel-Onsager equation – theory of mean activity coefficients of strong electrolyte – Debye-Huckel limiting law and its testing and improvement.

Unit 3 Electrochemistry II

Electrochemical cells, standard electrode potentials, reversible cell, concentration cells with and without transference, standard electrode potentials, reversible cell, cell notation and calculation of emf – variation of potential with concentration, pressure and temperature, Liquid Junction Potential – its calculation and elimination - Thermodynamics of cell reactions and equilibrium constant - applications of e.m.f. measurements, potentiometric measurement of pH –reference electrodes - glass and quinhydrone electrodes and their performance and limitations, – ion selective electrodes – biomembranes, Interfacial region – electrical double layers and their structure – Helmholtz-Perrin, Gouy-Chapman and Stern models - charge transfer across interfaces, mass transport – diffusion and convection controlled transport – irreversible electrode processes - activation, concentration and IR polarisation, decomposition potential, Butler-Vohmer equation - over potential (hydrogen, oxygen and metal decomposition over voltage), theories of over voltage, Tafel equation, and Tafel plots – corrosion and its rate from Tafel equation.

Unit 4 Chemical Kinetics I

Reaction rates and order of reactions, determination of order of reactions, complex reactions, reversible, consecutive and concurrent reactions, reactions of variable order, steady state treatment, reaction mechanism and molecularity, theories of unimolecular reactions and termolecular reactions, Arrhenius equation, collision theory and transition state theory, comparative study of the theories of reaction rates, free energy of activation, effect of solvent on rate of reactions, ionic reactions and effect of ionic strength - salt effect, effect of pressure on velocity of gas reactions.

Unit 5 Chemical Kinetics II

Reaction dynamics, fast reactions, flash photolysis and relaxation methods, catalysis and inhibition, homogeneous catalysis, acid, base and enzyme catalysis, kinetics of enzyme catalysed reaction - the Michaelis-Menten equation. Photochemical kinetics, steady state treatment of photochemical reactions, Semenov-Hinshelwood theory of chain reactions and explosions, free radical reactions - the Rice-Herzfeld mechanism.

TEXTBOOKS

1. *Gilbert W. Castellan, "Physical Chemistry", 3rd Edition, Narosa Publishing House, 2004.*
2. *K. J. Laidler, 'Chemical-Kinetics', 3rd Edition, McGraw Hill, New York, 2004.*
3. *An introduction to Electrochemistry, Samuel Glassstone (*2007)

REFERENCES

1. *W. J. Moore and R. G. Pearson, 'Kinetics and Mechanism', 2nd edition, Wiley, 1981.*
2. *Physical Chemistry, Peter Atkins, Julio D Paula, OUP Oxford; 9 edition (19 November (2009)*
3. *Textbook of Physical Chemistry, Samuel Glassstone,* D. Van Nostrand company, inc; 2nd edition (1946)
4. *John O'M. Bockris, Amulya K.N .Reddy,Modern Electrochemistry 1: Ionics, 2nd Edition, Springer, 1998*
5. *John O'M. Bockris, Amulya K.N. Reddy, Maria E. Gamboa-Aldeco, Modern Electrochemistry 2A: Fundamentals of Electrodics 2nd Edition, Springer, 2001*

22CHY602 Synthetic Strategies and Reagents 3 1 0 4

Unit 1 Synthetic Strategies

Synthetic strategies: Functional group inter-conversion – conversion of one functional group to other. Nitrogen, oxygen, sulphur protection and deprotection – utilization of protection groups in organic synthesis. Retro synthetic analysis, functional group equivalents, use of retrosynthesis in organic synthesis. Reversal of reactivity (Umpolung), Introduction to combinatorial chemistry. Application of phase transfer catalysts.

Unit 2 Oxidation and Reduction:

PCC, DDQ, DMSO, Dess-Martin Reagent, TEMPO, osmium tetroxide, ruthenium tetroxide, selenium dioxide, peracids, hydrogen peroxide, singlet oxygen, aluminum isopropoxide, periodic acid, lead tetraacetate. Swern, Jones, Oppeneur oxidation, Woodward and Prevost hydroxylation, Sharpless asymmetric epoxidation, catalytic hydrogenations (heterogeneous and homogeneous), Clemmenson, Wolff Kishner, Rosenmund and MPV

reductions, metal hydrides as reagents (aluminium/boron hydrides and hydroboration reaction), Birch reduction, Borche Reduction, hydrazine and diimide reduction.

Unit 3 Organometallic Reagents

Preparation, properties and reactions of organolithium, organosilicon, organozinc (Reformatsky reaction) and organomagnesium reagents (Barbier and Grignard), organocadmium, organomercury reagents based organometallic reactions involving C-C bond formation. Selected functional group transformations in organic synthesis. Preparation and reactions of organocopper, organopalladium,- Wacker process – Heck reaction, cross coupling, carbonylation reaction, organonickel, organocobalt and organorhodium reagents – olefin metathesis reaction. Reactions and applications of organoboron, organosilicon and organotin compounds.

Unit 4 C-C Bond Formation

C-C bond formation – aldol, Arndt-Eistert, Bardhan-Sengupta, Baker-Venkataraman,Barbier, Baylis-Hillman, Benzoin, Heck, Fukuyama, Dieckmann, Friedel–Crafts, Michael, Perkin, Claisen, Robinson annulations, Vilsmeier, Wittig, Knoevenagel, Michael additions.

Unit 5 C-N, C-O Bond Formations

C-O bond formation – Barton, Fischer esterification, Prins, Darzen, Baeyer-Villiger, Mitsunobu, Williamson's ether synthesis, Ullman Coupling with Boronic Acids.

C-N bond formation – Mannich, Fukuyama, Mitsunobu, Ritter, Gabriel Synthesis, Ugi, Doebner Reaction, Buchwald-Hartwig, Stork-enamine, formation of azides and hydrazines, formation of amides and peptides, coupling reactions.

TEXT BOOKS

1. *Modern Organic Synthesis, Dale L. Boger, The Scripps Research Institute, Rush Press, San Diego, California, 2001*
2. *Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part B: Reactions and Synthesis", 5th Edition, Springer, 2008.*
3. *R.O.C. Norman and J.M. Coxon, "Principles of organic synthesis", CRC press, 2014*

REFERENCES

1. *Stuart Warren, Designing Organic Synthesis: A programmed introduction to the synthon approach, JOHN WILEY & SONS, 2nd edition, 2008*
2. *Name Reactions: A collection of detailed Mechanisms and synthetic applications, Jie Jack Li, Springer, fourth edition (expanded edition), 2009.*
3. *Michael B Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th edition, Wiley (2015).*
4. *Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part A: Structure and Mechanisms", 5th Edition, Springer, 2008*

22CHY603 Solid State Chemistry and Materials Science 3 0 0 3

Unit 1 Introduction to Crystal Systems

Introduction to solids - solid state chemistry, close packing, hcp, fcc, density, coordination numbers, tetrahedral and octahedral holes, body centred and primitive structures, symmetry, proper rotation, mirror planes, inversion, improper axis symmetry elements, symmetry in crystals, Schoenflies and Hermann-Mauguin notations, unit cells, glide plane, screw axis, atom occupancy in cubic unit cells, seven crystal systems/classes, space groups, Miller indices, Bravais lattices, reciprocal lattice, inter-planar spacing in different crystal systems, fractional coordinates, ionic solids, structures of CsCl, NaCl, NiAs, zinc blende and wutzite structures, MX_2 type solids, fluorite and antfluorite structures, $CdCl_2$ and CdI_2 structures, rutile and anti-rutile, ReO_3, spinel and inverse spinel, pervoskite structures, ionic radii, crystal radii, radius ratio, Extended covalent array, diamond, graphite. Liquid crystals: Mesomorphic state, types, examples and application of liquid crystals.

Unit 2 Bonding in Solids and Electronic properties

Bonding in crystals, metallic bonding, ionic bonding, covalent bonding, silicates, Born-Haber cycle, Hess's law, lattice energy (L) and calculation of L, free electron theory, density of states, electronic conductivity, molecular orbital theory, overlap and bonding, linear chain of H atoms, LCAO, Fermi Level, conductors, insulators and semiconductors, n- and p-type semiconductors, bands in compounds, band-gap energy, direct and indirect band gaps in semiconductors, band-gap measurements, electrical conductivity, photo-conductivity.

Unit 3 Magnetic and Optical Properties of Solids

Behaviour of substances in magnetic field, magnetic moments, para magnetism, diamagnetism, ferro- and anti-ferromagnetism, ferrimagnetism, effects of temperature of magnetism, Curie & Curie-Weiss laws; mechanism of ferro- and anti-ferromagnetic ordering, super exchange. Luminescence and phosphorescence of solid materials, phosphors, lasers, non-stoichiometry and its effect in properties of solids, electronic properties of non-stoichiometric oxides. Defects in solids, Schottky defects, Frenkel defects, doping in crystals and colour features, ruby, diamond, organic conductors, preparation, mechanism of conduction in organic semiconductors, photoconductivity of polymers.

Unit 4 Materials Science-Structure and properties

Solid materials of importance. Structure and properties of SiO_2, ZrO_2, SiC, BN, ZnO, TiO_2, CdS, CdTe, GaAs, MoS_2. Band-gap properties of semiconductors like ZnO, TiO_2, CdS, CdSe, CdTe, GaAs, MoS_2 and $(CH_3NH_3)[PbX_3]$-type perovskites. Photo-catalytic properties of ZnO and TiO_2 – principle and applications. Inorganic-organic hybrid materials. High Tc superconductors (HTS) like Bi-Sr-Ca-Cu oxide based HTS (BSCCO) and Y-Ba-Cu-oxide (YBCO), their structure and properties. Metal-organic framework (MOF) materials, special features of MOF materials. Synthesis, special features and properties of MOF materials like HKUST-1 and MOF-8. Gas storage and emission properties of MOF materials. MOFs as sensors, MOFs in pharmaceuticals, Zeolites, their special features and properties.

Unit 5 Materials Science-Synthesis, processing and characterization

Sol and gel, their properties, xerogels. Sol-gel synthesis - synthesis of SiO_2 and TiO_2 through sol-gel process. Calcination and sintering. Characterization of processed materials, PXRD, IR, Raman, Uv-visible and solid-state NMR spectral techniques. Understanding morphological features through, SEM, EDAX and TEM methods. Chemical vapour deposition (CVD) method. Solid state synthesis, synthesis of High Tc superconducting materials like YBCO and BSCCO. Synthesis of inorganic-organic hybrid materials. Solvo-thermal and high-pressure synthesis.

TEXTBOOKS

1. *L V Azaroff, 'Introduction to Solids', Tata McGraw-Hill publishing company*
2. *L. E. Smart and E. A. Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2016.*
3. *A. R. West, Solid State Chemistry and its Applications, Wiley, 2014*
4. *C N R Rao, K Biswas, Essentials of Inorganic Materials Synthesis, John Wiley, 2014*
5. *C N R Rao Chemical Approaches to Synthesis of Materials, Wiley, 1994*

REFERENCES

1. *D. Jiles, "Magnetism and Magnetic Materials", Chapman and Hall, London, 1991.*
2. *R. E. Hummel, "Electronic Properties of Materials", 3rd ed., Springer-Verlag, New York, 2001.*
3. *Schubert, U. and Hüsing, N, Synthesis of Inorganic Materials, 3rd edn, VCH-Wiley Verlag GmbH, Weinheim, 2012*
4. *W.D. Kingery, H.K. Dowen and R.D. Uhlman, Introduction to Ceramics, John Wiley.*
5. *F.H. Norton, Elements of Ceramics,.*
6. *M.W. Barsoum, Fundamentals of Ceramics, McGraw Hill.*
7. *Material Science and Engineering, S.K. Hajra Choudhury, Indian Book Dist.*
8. *B D Fahlman, Materials Chemistry, 2nd Edition, Springer, 2011*
9. *Stefan Kaskel, The Chemistry of Metal–Organic Frameworks: Synthesis, Characterization, and Applications, Wiley-VCH Verlag GmbH, 2016*

22CHY604 Bioinorganic Chemistry 3 0 0 3

Unit 1: Basics in Bio-Inorganic Chemistry

Essential elements in biological systems, transport of ions across biological membranes, active and passive transport, metal transport and metallochaperons, Na^+/K^+ pump and active transport. Metal complexation with biological molecules. Electron transport in biology, electron transport chain (ETC), role of ETC in biological systems. Amino acids, peptides and proteins, primary and secondary structure of proteins, α-helix and β-sheets forms of proteins and their special features; tertiary and quaternary structures of proteins the type of molecular interactions involved in them. Reactive oxygen species (ROS), generation and function of organic free radicals, action of ROS in biological systems, oxidative stress, antioxidants. Photosynthesis, PS-I and PS–II.

Unit 2: Oxygen Take-Up, Transport and Storage Proteins

Porphine, corrin, corrole, chlorin and bacteriochlorin. Myoglobin (Mb) and haemoglobin (Hb), their prosthetic groups and functions, mechanism for reversible binding of O_2 in Mb and Hb. Cooperative effect in Hb and its consequence. Behaviour of bound O_2 to Fe(II). Difference between O_2 and CO binding to Hb and Mb, CN^- poisoning. Structure and functions of haemerythrin (Hr) and haemocyanin (Hc), O_2 binding nature in Hr and Hc, electron transfer processes in them. Cytochromes and their role in biology, cytochrome P-450, cytochrome C-oxidase and oxygen transfer from O_2 to non-activated substrates, monooxygenases, methane monooxygenase (MMO). Fe-S and other non-haeme iron proteins, ferredoxins-their structure and special properties, transferrin, ferritin, siderophores, enterobactin, uptake, transport and storage of iron. Sickle-cell anaemia.

Unit 3: Metallo-Enzymes

Catalases – structure and properties reaction mechanism. Peroxidases- glutathione peroxidase, HRP, structure and properties and enzyme reaction mechanism. Cytochrome c peroxidase and lignin peroxidase. Copper enzymes-structure and function, azurin, plastocyanin. Type I, II and III copper proteins. Superoxide dismutase (SOD) - structure and enzymatic reaction mechanisms. Tyrosinase, reaction mechanism. Zn-containing enzymes, carbonic anhydrase and carboxy-peptidases-structure and enzymatic reactions. N_2 fixation, nitrogenase enzyme, Fe-S clusters, Fe-protein structure, Mo-Fe protein structure, P-cluster and M-centre, their model compounds.

Unit 4: Other Functional Roles of Metal Ions

Zn in biological systems, Zn-finger proteins – structural features and properties, classifications and their roles in biological systems. Ca^{2+} binding proteins, calmodulins. Metal ion based (Pt, V, Au) drugs, anticancer agents. Cis-platin and its properties. Chelation therapy, macrocyclic antibiotics. Role of Mn, Ni, Mo and Cr in biological systems, metal toxicity and homeostasis, therapeutic complexes. Diseases caused by both excess and deficiency of metal ions, thalassaemia, Wilson disease. DNA intercalators, diagnostic agents, MRI imaging and contrast agents, the role of Gd^{3+} and other metal ions as contrast agents.

Unit 5: Biomimetic Compounds, Metals in Medicine

Porphyrins (H_2P) and metalloporphyrins (MP), spectral, fluorescence and redox properties of H_2P and MP. Biomimetic compounds. Fe(II), Co(II) and Cu(II) based model compounds model compounds of Mb and Hc – .'picket-fence' porphyrin and its special features. Photodynamic therapy (PDT), principles and applications. Natural and synthetic ionophores, crown ethers, interaction and uptake of alkali metal and alkaline earth metal ions with crown ethers, cryptands and cryptates, calixarenes and their special properties, cyclo-dextrins and their special properties.

TEXTBOOKS

1. *J.E. Huheey, R.A. Keiter, R.L. Keiter, Inorganic Chemistry-Principles of Structure and Reactivity, 4th Edn., Prentice Hall, 1997.*
2. *F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, Advanced Inorganic Chemistry, 6th Edn., Wiley-Interscience, 1999.*
3. *P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, Shriver and Atkins Inorganic Chemistry, 4th Edn., Oxford University Press, 2006.*

REFERENCES

1. *S. J. Lippard, J. M. Berg, Principles of Bioinorganic Chemistry, University Science Books, 1994.*
2. *J. D. Atwood, Inorganic and Organometallic Reaction Mechanism, 2nd Edn., Wiley-VCH, 1997.*
3. *B.E. Douglas, D.H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., Wiley-India, 2007.*
4. *W. Kaim, B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, 1994.*
5. *M. N. Hughes, The Inorganic Chemistry in Biological Processes, Wiley (1981)*

22CHY631 Applied Electrochemistry 3 0 0 3

Unit 1 Electrodics

Electron transfer under an interfacial electric field, A two way traffic across the interference: equilibrium and exchange current density. Dependence of the electrochemical reaction rate on over potential-Quantitative version of the Butler Volmer equation. Electrode kinetics involving the semiconductor/solution interface. Techniques of electrode kinetics-preparation of electrode surface. Microelectrodes-applications.

Unit 2: Industrial Cathodic Process

Electrodeposition of copper, nickel and chromium over mild steel – zinc plating on MS – decorative plating of silver and cold – nano plating and microstructure of deposits - Tests for adhesion, hardness, thickness, uniformity and corrosion resistance of the electro deposits-post plating passivation processes-barrel plating of small components - Electroless deposition of nickel, copper, gold on metal components – making of waveguides and plated through hole boards.

Unit 3: Industrial Anodic Processes

Anodizing of aluminium and its alloys – baths used, operating conditions and sequence determination of thickness – industrial applications- nano anodizing of titanium, and tantalum – application to sensor field. Electropolishing of ferrous and non-ferrous metals and alloys - mechanism of electropolishing – Electrochemical etching of ferrous and non-ferrous metals – Special processes: Electrolysis of water – electrowinning of aluminium and sodium – electrolysis of brine-photo electrochemistry

Unit 4 Electrochemical energy systems

Primary batteries: Zinc-carbon (Leclanche type), zinc alkaline (Duracell),; lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra-thin lithium polymer cells (comparative account) Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries. Reserve batteries thermally activated batteries - remote activation - pyrotechnic materials: Fuel Cells: principle, proton exchange membrane (PEM), direct methanol(DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Unit 5 Electrochemical Sensors

Potentiometric sensors, solid state potentiometric chemical sensors, polymeric membrane sensors, ion selective field effect transistor, application, hydrovolumetric technique-hydrodynamic voltammetric-application, voltammetric sensors-electrode modification application, optical sensors, bioamperometric titration. Methods involving forced convection-hydrodynamic methods.

TEXT BOOKS

1. *Allen J. Bard and Larry R. Faulkner, 'Text book for Electrochemical Methods',2nd edition, Wiley, 2000.*
2. *Derek Pletcher and Frank C. Walsh, 'Industrial Electrochemistry', Blackie Academic and Professional, (1993).*

REFERENCES

1. *Christopher M A, Brett, 'Electrochemistry – Principles, Methods and Applications', Oxford University, (2004).*
2. *Watanabe T, 'Nano-plating: microstructure control theory of plated film and data base of plated film microstructure', Elsevier, Oxford, UK (2004).*
3. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Curtis, 'Electroforming', London, (2004).*
5. *Rumyantsev E and Davydov A, 'Electrochemical machining of metals', Mir, Moscow, (1989).*
6. *Peter G Sheasby 'Basics of aluminium anodizing', Banbury, Oxon (2001)*
7. *Robert Brugger 'Nickel Plating' Robert Draper Ltd, Teddington, (1970)*
8. *J. K. Dennis, T. E. Such, 'Nickel and Chromium Plating, Third Edition' Woodhead Publishing Series in Metals and Surface Engineering, 3rd Edition,(1993)*

22CHY632 Bioanalytical Chemistry 3 0 0 3

Unit 1 Enzymes

Enzyme nomenclature, Enzyme commission numbers, Enzymes in bioanalytical chemistry, Enzyme kinetics - Enzyme activators, Enzyme inhibitors.

Unit 2 Quantification of Enzymes and their Substrates

Instrumental methods, optical detection - absorbance, Fluorescence, Luminescence, Nephlometry Electrochemical detection - amperometry, potentiometry, conductometry, other detection methods - radiochemical, manometry, calorimetry.

Unit 3 Immobilized Enzymes

Immobilization methods - nanopolymerizing covalent immobilization, Crosslinking with bifunctional reagents. Properties of immobilized enzymes, immobilized enzyme reactions, theoretical treatment of packed bed enzyme reactors.

Unit 4 Antibodies

Structural and functional properties of antibodies, polyclonal and monoclonal antibodies. Antibody-antigen interactions, analytical application of secondary antibody-antigen.

Unit 5 Biosensors

Response of enzyme-based biosensors, examples of Biosensor Configuration, Ferrocene-mediated amperometric glucose sensor, potentiometric biosensor for phenyl acetate, potentiometric immunosensor for digoxin, optical biosensor for glucose-based on fluorescence energy transfer, piezoelectric sensor for nucleic acid detection, enzyme thermistors.

TEXTBOOKS

1. *Susan R. Mikkelsen, and Eduardo Corto´n 'Bioanalytical Chemistry', 1st edition, Wiley Interscience, 2003.*
2. *Andres Manz, Nicole Pamme and Dimitri Lossifidis, 'Bioanalytical Chemistry', World Scientific Publishing Company, 2004.*

REFERENCE

1. *Robert W. Cattrall, 'Chemical Sensors', Oxford University Press, 1997.*

22CHY633 Chemistry of Biomolecules 3 0 0 3

Unit 1 Amino acids, Proteins and Peptides

Classification, stereochemical aspects, physical properties, ionic properties, spectral properties, essential and non-essential amino acids, chemical reactions of amino acids, industrial preparation and chemical synthesis of amino acids. Ionic properties of proteins, protein structure, protein purification, protein structure determination, proteomics and protein function, solid phase peptide synthesis, biologically important peptides.

Unit 2 Enzymes

Introduction to enzymes, classification of enzymes, mechanism of enzyme action, immobilized enzymes and enzyme technology, enzyme analogue built polymers, design of molecular clefts, enzymes in synthetic organic chemistry. Enzymes in biological systems

Unit 3 Molecular Biology and Bioinformatics

Structure of nucleic acids, genes and genome complexity, functions of nucleic acids, isolation and separation of nucleic acids, molecular analysis of nucleic acid sequences, nucleotide sequencing of DNA.

Unit 4 Immunochemical Techniques

Production of antibodies, purification and fragmentation of immunoglobulins, immunoprecipitation, labelling antibodies, immunoblotting, immunoassays, immunohisto/cytochemistry.

Unit 5 Recombinant DNA and Genetic Analysis

Constructing gene libraries, cloning vectors, hybridization and gene probes, application of gene cloning, expression of foreign genes, pharmacogenomics.

REFERENCES

1. *Hermann Dugas, 'Bioorganic Chemistry - A Chemical Approach to Enzyme Action', 3rd edition, Springer.*
2. *Keith Wilson and John Walker, 'Principles and Techniques of Biochemistry and Molecular Biology', 6th edition, Cambridge University Press.*

22CHY634 Industrial Chemistry 3 0 0 3

Unit 1 Water Treatment

Softening of water, ion exchange process, lime soda process, modified lime soda process, zeolite process, chemical and physical method of sterilization, desalination, boiler problems. Corrosion of boiler units, industrial water treatment, water analysis.

Unit 2 Fuels

Calorific value, determination of calorific value, classification of fuels, solid fuels, properties of fuels, classification of coal, coking and non-coking coals, advantages and disadvantages of solid fuels. Liquid fuels,

gaseous fuels, analysis of fuel gases, distillation of petroleum. Processing & purification of petroleum and petroleum products, flash point, fire point, knocking, ant knocking, cetane number, octane number, natural gasoline, cracking, polymerization, alkylation, isomerisation, rocket fuels, fossil fuels, nuclear fuels.

Unit 3 Energy Resources

Renewable and non-renewable sources of energy, conventional and non-conventional sources of energy, solar energy, solar technology, solar photovoltaic cell - application, PV lantern system, Radiotelephone system, application of solar energy, environmental implication, nuclear energy, nuclear fuel cycle in India, energy conservation and waste heat boilers, fuel cells, hydrogen cells.

Unit 4 Paints and Pigments

White pigment, blue, green, yellow, black and red pigments - manufacture, physical properties, characteristics, Manufacture of paints, setting of paints, requirement for good paints, emulsion paint, latex paint, luminescent paint, fire retardant paints, heat resistant paints, varnishes, manufacture of varnishes, enamels, lacquers.

Unit 5 Explosives and Toxic Chemical Weapons

Introduction, classification. Deflagrating or low explosives. Characteristics of explosives, nitrocellulose, PETN, DNB, TNB, TNT, Picric Acid, nitroglycerine, dynamite, cirdite, gun powder, RDX, EDNA, HMX, tetryl, pentyl, hexyl, dinol. Toxic chemical weapons, screening smokes, incendiaries, pyrotechniques, explosives in India

TEXTBOOKS

1. *B. K. Sharma, 'Industrial Chemistry', Goel publishing.*
2. *James A Kent, 'Riegels Hand book of Industrial chemistry', 10th edition, Kluwer Academic/Plenum publishers, 2003.*

REFERENCES

1. *Alan Heaton, 'An Introduction to Industrial chemistry', 3rd edition, Blackie Academic and professional, 1996.*
2. *Chris A Clausen and Guy Mattson, 'Principles of industrial chemistry', 2nd edition Wiley, 1978.*
3. *Jonathan Steed, 'Core Concepts on supramolecular chemistry and nanochemistry', Wiley Eastern Publishers, 2006.*

22CHY635 Industrial Stoichiometry 3 0 0 3

Unit 1 Introduction to process calculation - dimensions and systems of units - fundamental quantities of units, derived quantities, definition and units of force, volume, pressure, work, energy, power, heat-unit conversions in FPS, MKS and SI systems.

Unit 2 Mixtures and solutions - methods of expressing compositions of mixture and solutions, wet and dry basis concept. Ideal and real gas laws – Gas constant – normal molal volume, calculations of pressure, volume and temperature using ideal gas law. Gas mixtures – Use of partial pressure and pure component volume in gas calculations. Dissociating gases. Relation between mole%, volume% and pressure% of ideal gases calculation of average molecular weight, density, mole%, weight% in gas mixture in SI/MKS systems – applications of real gas relationship in gas calculation.

Unit 3 Description and simple material balance calculation of physical processes such as drying, distillation, absorption, mixing, crystallization, Evaporation.

Unit 4 Single stage material balance calculation of leaching and extraction, calculations involving recycling and bypassing operation - limiting reactant, excess reactant, conversion, yield and selectivity - simple numerical for finding yield, conversion and composition.

Unit 5 Calculation of material and energy balance based on reactions involving heat capacity and specific heat - mean heat capacity of gases - heat capacity of gas mixture and liquid mixture. Calculations of heat capacity by integral equation up to three terms - sensible and latent heats of fusion, sublimation, vaporization. Calculations of standard heat of formation from heat of combustion data. Calculations for heat of reaction from heat of formation and heat of combustion data – Fuels - calorific values proximate and ultimate analysis - air requirement and composition of flue gases.

TEXTBOOKS

1. *Bhatt, B. L. Vora S. M., "Stoichiometry", 3rd Edition, Tata McGraw-Hill (1996).*

2. *Felder, R. M. and Rousseau ,R. R. "Elementary Principles of Chemical Processes" 3rd Edn., John Wiley & Sons, New York 2000.*

REFERENCES

1. *Hougen O.A., Watson K.M. and Ragatz R.A., "Chemical Process Principles" Part I, CBS Publishers (1973).*
2. *Warren. K Lewis, Arthur H. Radash & H. Clay Lewis, "Industrial Stoichiometry", McGraw Hill Book C., NY 1995.*

22CHY636 Material Science and Nanochemistry 3 0 0 3

Unit 1 Introduction to Nanomaterials. Introduction to Material Science, interdisciplinary nature, structure of nanomaterials, length scales, de-Broglie wavelength & exciton Bohr radius, foundations of quantum mechanics: wave function, Schrödinger equation, uncertainty principle, quantum wells, quantum wires, quantum dots, articles.

Unit 2 Nanomaterials: synthesis, properties, size effect and properties of nanoparticles - particle size - particle shape - particle density, specific surface area and pore - composite structure, crystal structure - functionality of nanostructures and their characteristic evaluation - optical properties - catalytic property; synthesis - methods and strategies, top-down and bottom-up approaches, chemical vapor deposition, laser ablation, electric-arc, sol-gel processing, lithography - surface modification of inorganic nanoparticles by organic functional groups.

Unit 3 Surface Science and Characterization of Nanomaterials - electron microscopy, MFM, SNOM, SEM, TEM, EDAX, X-ray diffraction and electron diffraction, atomic force microscopy, scanning tunneling microscopy, spectroscopy: UV-visible spectroscopy, photoluminescence spectroscopy, IR spectroscopy, FTIR and ATR, Raman spectroscopy, self-assembled monolayers.

Unit 4 Nanotechnology: applications and devices. Nanoscale materials, nano transfer printing, biomaterials applications, MEMS and NEMS, self-organization, nanoscale (opto) electronics, fullerenes, devices - actuators and motors for nanodisplacements, nanosensors, development of optical memory using semiconductor nanoparticles - nozzle-free inkjet technology - dendrimers and their application to organic electronics devices - nanomedicines, bio-imaging with quantum dots.

Unit 5 Environmental Issues in Nanotechnology - nanoparticles and environment - nanoparticles in atmosphere - ground water, exhaust gases – wastewater and indoor environments; safety of nanoparticles - problems caused by nanoparticles, safety assessment for the nanoparticles; removal of nanoparticles.

TEXTBOOKS

1. *T. Pradeep, 'Nano - The Essentials Understanding Nanoscience and Technology', McGraw-Hill Professional Publishing, 2008.*
2. *Charles P. Pool and Frank J. Ovens, 'Introduction to Nanotechnology', John Wiley and sons, 2006.*

REFERENCES

1. *Ozin, Geoffrey Alan, Arsenault, 'Nanochemistry: A Chemical Approach to Nanomaterials', Royal Society of Chemistry, 2008.*
2. *C.N.R. Rao, A. Muller, A.K. Cheetham, 'The Chemistry of Nanomaterials: Synthesis, Properties and Applications', Wiley-Vch Verlag Gmbh & Co., 2004.*
3. *Alexei Nabok, 'Organic and Inorganic Nanostructures', Artech House, 2005.*
4. *C. Richard Brundle, Charles A. Evans Jr., and Shaun Wilson, 'Encyclopedia of Materials Characterization', Butterworth-Heinemann Publishers, 1992.*
5. *Masuo Hosokawa, Kiyoshi Nogi, Makio Naito and Toyokazu Yokoyama, 'Nanoparticle Technology Handbook', Elsevier Publishers, 2007.*

22CHY637 Medicinal Chemistry 3 0 0 3

Unit 1 Medicinal Chemistry

Introduction, drugs – classification of drugs – mechanism of drug action. Drug-receptor complex, nomenclature – agonist.

Unit 2 Physicochemical Properties of Drugs in Relation to Biological Action

Solubility**,** Partition coefficient, dissociation constant, hydrogen bonding, ionization, drug shape, surface activity, complexation, protein binding, molar refractivity, bioisosterism – stereo chemical aspects of drug action.

Enzymes, hormones and Vitamins - representative cases, nomenclature, classification and characteristics of enzymes, mechanism of enzyme action, factors affecting enzyme action, co-factors and co-enzymes, enzymes in organic synthesis, mechanism of enzyme catalysis, enzyme inhibition. Hormones and vitamins – representative cases.

Unit 3 Essentials of Drug Design

Molecular mimetics, drug-lead modification, drug design using QSAR and computer assisted design, assessment of drug activity, receptors and drug action, mechanism of drug action, drug metabolism pathways, Drug potentiation, drug antagonism and drug resistance

Unit 4 Medicinal Agents from Natural Products

History of the use of natural products as therapeutic agents, medicinal plants, active principle, Isolation methods of alkaloids, terpenes, antioxidants, natural oils from plants.

Unit 5 Medicinal Agents

Medicinal agents belonging to alkaloids, steroids, polypeptides, modified nucleic acid bases, sulphonamide and sulpha drugs, antibacterials - sulpha drugs, substituted sulphonamides, anticonvulsants, anticoagulants, antiamoebic agents, antihelmintic agents, anti-malarial agents, diuretics and cardio vascular agents, , medicinal agents affecting CNS, analgesics, antipyretics, antiseptics and disinfectants, Histamine and anti-histaminic agents.

Infectious and non-infectious diseases (malaria, AIDS, Cancer) introduction, mechanism of action types of cure.

TEXTBOOKS

1. *John M beak and John H Block, 'T Wilson, O. Gisvold and R. F. Deorge - Text book of Organic, Medicinal and Pharmaceutical Chemistry', 7th edition, J.B. Lippincott Williams and Wilkons Company, 1977.*
2. *A. Burger, 'Medicinal Chemistry', 3rd edition, Wiley Interscience, 1970.*
3. *V.K. Ahluwalia and Madhu Chopra, 'Medicinal Chemistry', Ane Books pvt Ltd, 2008.*

REFERENCES

1. *V. Kothekar, 'Essentials of Drug Designing', 14th edition, Dhruv publications, 2005.*
2. *V.K. Ahluwalia, Lalita S. Kumar and Sanjiv Kumar, 'Chemistry of Natural Products', Ane Books India.*
3. *L.P. Graham 'An introduction to Medicinal Chemistry', 3rd edition, Oxford University Press, 2005.*

22CHY638 Supramolecular Chemistry 3 0 0 3

Unit 1 Introduction to Supramolecular Chemistry

From molecular to supramolecular chemistry: Factors leading to strong binding, hydrogen bonding and stacking interactions, Bottom-up approach, Top-Down Approach, Energy and Signals Semiochemistry, photo switching devices, electro switching devices, mechanical switching processes.

Unit 2 Processing of Energy and Signals by Molecular and Supramolecular System

Fundamental principles of photo induced electron and energy transfer, Molecular electronics, Molecular photonics, molecular chemionics, molecular electro photonics, molecular photochemionics.

Unit 3 Molecular Recognition

Molecular receptors: crown ethers, siderophores, cyclophanes, cyclodextrin and their application in specific recognition processes. Metal guided self-assembly reactions, molecular knot with double helical complexes, Self-assembly of polynuclear metal complexes.

Unit 4 Electrochemistry of Supramolecular Systems

Electroluminescent systems as sensors and devices, Redox controlled molecular switches, Biohybrid electrochemical devices, Dendrimers as multielectron storage devices, Redox-active Metal-Polypyridine dendrimers as light harvesting antennae.

Unit 5 Molecular Scale Mechanical Devices

Introduction to mechanical devices, spontaneous mechanical like motions, allosteric movements, tweezers and harpoons, a natural proton pump, twisters, tweezers, threading-dethreading movements, ring switching processes in rotaxanes and catenanes, molecular valves, molecular muscles.

TEXTBOOKS

1. *Vincezo Balzani, 'Supramolecular Chemistry', Kluwer Academic, 1992*
2. *Vincenzo Balzani, Alberto Credi and Margherita Venturi, 'Molecular Devices and Machines: A Journey into the Nanoworld', Wiley, 2006.*
3. *Paola Ceroni, Alberto Credi and MargheritaVenturi, 'Electrochemistry of Functional Supramolecular Systems', Wiley, 2010.*

REFERENCES

1. *Jonathan W. Steed Atwood, Jerry L. Chich, 'Supramolecular Chemistry', 2nd edition, Wiley, 2009.*
2. *Fritz Vögtle and F. Alfter 'Supramolecular Chemistry: An Introduction', John Wiley & Sons, 1999.*
3. *Jean-Marie Lehn, 'Supramolecular Chemistry', RCS pubs., 2005*
4. *Jonathan Steed, David Turner and Carl Wallace, 'Core concepts in Supramolecular Chemistry and nanochemistry', John Wiley & Sons, 2007*
5. *Katsuhiko Ariga and Toyoki Kunitake, 'Supramolecular chemistry – Fundamentals and applications advanced textbook', Springer-Verlag, 2000.*

22CHY639 Nanomaterials for Biomedical Applications 3 0 0 3

Unit 1 Introduction to Nanomaterials

Size dependence of properties – Surface to volume ratio and Quantum confinement. Microscopic techniques to study nano structures - SEM, AFM – TEM and STM. Spectroscopic techniques to characterize nanostructures - Raman, XPS, Auger, EDAX.

Unit 2 Synthetic Approaches

Colloidal, self-assembly (Self assembled monolayers-SAMs) and electrostatic self-assembly, electrochemical methods (cathodic and anodic processes), sol-gel, Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling, lithography.

Unit 3 Electrical, optical, mechanical, chemical and magnetic properties of nanomaterials. Surface Plasmon resonance – Fluorescence Resonance energy transfer (FRET).

Unit 4 Carbon Clusters

Synthesis, properties and biomedical applications of fullerenes, carbon nanotubes and graphenes. Quantum dots, wells and wires (metallic and semiconducting) - preparation, properties and biomedical applications. Dendrimeric structures and their applications.

Unit 5 Biofunctionalization of Nanomaterials

Noncovalent assembly - covalent assembly - biofunctional nanomaterials - semiconductor nanoparticles - magnetic nanoparticles. Applications of biofunctional nanomaterials – optical and electrochemical sensing.

REFERENCES

1. *Alexei Nabok, "Organic and Inorganic Nanostructures", Artech House, Inc., 2005*
2. *Huangxian Ju, Xueji Zhang and Joseph Wang, "Nano Biosensing, Principles, Development and Application", Springer, 2011.*
3. *M. Reza Mozafari (Editor), "Nanomaterials and Nanosystems for Biomedical Applications", Springer 2007.*
4. *Zhong Lin Wang (Editor), "Characterization of Nanophase Materials", Wiley VCH, 2000.*

22CHY640 Industrial Metal Finishing Processes 3 0 0 3

Unit 1 Background Theory: Review of reversible and irreversible processes - electrodes, indicator and reference - Nernst and Butler-Volmer equation - phenomenon of polarization - factors influencing - Tafel experiment and Tafel plot - Significance.

Unit 2 Electrodeposition

Industrial plating of copper-nickel (dull and bright) - chromium on mild steel – operating conditions and sequence – pre-treatment processes - plant layout – electroplating of zinc on MS and post plating chromating,

yellow and blue passivation processes – decorative plating of silver and gold on non-ferrous metals – brief discussion on nano plating of metals and micro structure of the deposition.
Properties of deposits: Tests for adhesion, hardness, thickness, uniformity and corrosion resistance of the electro deposits.
Electroless deposition: Nickel, copper, gold on metal components – bath composition and operating conditions - immersion plating - plating on plastics – pre-treatment processes – long duration plating – electroforming, operating conditions and sequence.

Unit 3 Anodizing
Industrial anodizing of aluminium and its alloys – baths used, operating conditions and sequence – plant layout – effect of temperature and current density on the thickness of anodic film – determination of thickness – industrial applications. Nano anodizing of titanium, aluminium and tantalum – application to sensor field.
Plasma electrolytic oxidation: power supply requirements – baths used – process sequence for aluminium, magnesium and titanium – properties of the coating and industrial applications.

Unit 4 Electropolishing
Mechanism of electropolishing – electropolishing of ferrous and non-ferrous metals – industrial baths used – operating conditions and sequence - industrial applications.

Unit 5 Electrochemical Etching
Etching of ferrous and non-ferrous metals – special properties of matt and satin finish – DC and AC processes – operating conditions and sequence.
Special Topics: Electrochemical and chemical metal colouring of ferrous and non-ferrous metals.
Black nickel coating – hard chromium deposition – hard anodizing of aluminium – electrochemical machining of hard steels – Electro-winning process – barrel plating – electrodeposition of paint.

TEXTBOOK

1. *Derek Pletcher and Frank C. Walsh, 'Industrial Electrochemistry', Blackie Academic and Professional, (1993).*

REFERENCES

1. *Christopher M A, Brett, 'Electrochemistry – Principles, Methods and Applications', Oxford University, (2004).*
2. *Watanabe T, 'Nano-plating: microstructure control theory of plated film and data base of plated film microstructure', Elsevier, Oxford, UK (2004).*
3. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Curtis, 'Electroforming', London, (2004).*
5. *Rumyantsev E and Davydov A, 'Electrochemical machining of metals', Mir, Moscow, (1989).*
6. *Peter G Sheasby 'Basics of aluminium anodizing', Banbury, Oxon (2001)*
7. *Robert Brugger 'Nickel Plating' Robert Draper Ltd, Teddington, (1970)*
8. *J.K. Dennis, T.E. Such, 'Nickel and Chromium Plating, Third Edition' Woodhead Publishing Series in Metals and Surface Engineering, 3rd Edition, (1993)*

22CHY641 Biosensors: Fundamentals and Applications 3 0 0 3

Unit 1 Introduction to Biosensor
Classification based on the signal transduction and biorecognition element. Enzymatic and non-enzymatic sensors, DNA and protein-based sensors-immunosensors.

Unit 2 Biosensing using nanomaterials
Concepts of surface to volume ratio, quantum confinement, surface plasmon resonance, fluorescence, chemiluminescence and electroluminescence and FRET in biosensing. Application of metal, semiconducting quantum dots, carbon nanotubes, graphene and carbon dots in biosensing.

Unit 3 Electrochemical principle in biosensing

Principles of potentiometry, voltammetry, amperometry and impedimentary in biosensing. Principle, fabrication and working of optical, electrochemical biosensors. Construction and working of potentiometric, amperometric and impedimetric sensors. Development and applications of piezoelectric sensors.

Unit 4 Optical and electrochemical sensors for glucose, vitamins, cholesterol, dopamine, nitric oxide, nitrates, and pesticides. Biocompatibility of sensors.

Unit 5 Biochips and Wearable Devices

lab-on-a-chip - fabrication of microfluidics- lithography, wearable sensors, epidermal electronic system, lab-on-skin-devices.

REFERENCES

1. *Xueji Zhang, Huangxian Ju, Joseph Wang, "Electrochemical Sensors, Biosensors and Their Biomedical Applications", Elsevier, 2008*
2. *Joseph Wang, "Analytical Electrochemistry", Wiley, 2006*
3. *Huangxian Ju, Xueji Zhang, Joseph Wang, "Nano Biosensing: Principles, Development and Application", Springer, 2011.*
4. *Peter Grundler, "Chemical Sensors – An Introduction for Scientists and Engineers", Springer-Verlag, Berlin Heidelberg, 2007*
5. *Arben Merkoci, "Biosensing using nanomaterials" Wiley, 2009.*

22CHY642 Computational Chemistry 3 0 0 3

Unit 1 - Introduction

Introduction to computational chemistry (molecular modelling), questions commonly investigated computationally, principle and application of methods (tools) of computational chemistry - molecular mechanics, ab initio method, semiempirical methods, density functional theory and molecular dynamics, STOs, GTOs, basis sets, specification of molecular geometry using Cartesian coordinates and internal coordinates, Z-matrix, Z-matrix of simple molecules (water, ethanol), potential energy surface (PES), potential energy surface of diatomic molecules and triatomic molecules (H_2O and HOF) - hypersurface and process of "slicing", stationary points on potential energy surface - potential energy surface of the isomerization reaction of ozone to isoozone, stationary points (ozone, isoozone and transition state), intrinsic reaction coordinate, minimum, relative minimum, saddle-shaped surface, saddle point, higher-order saddle point and mathematical treatment of stationary points, Born-Oppenheimer approximation and its significance and frozen-nuclei energy.

Unit 2 - Molecular Mechanics

Introduction to molecular mechanics, forcefield, developing a force field - expression for potential energy of a molecule, bond stretching term, angle bending term, torsional term and nonbonded interaction term, parameterizing a forcefield - parameterizing bond stretching term, angle bending term, torsional term and nonbonded interaction term, calculation using forcefield - compare the energies of two 2, 2, 3, 3-tetramethylbutane geometries, illustration of application (use) of molecular mechanics - calculation of geometries and energies of small-sized and medium-sized molecules, polymers and transition states (transition state for the Diels-Alder reaction of butadiene with ethene to form cyclohexene), in organic synthesis for predicting the more suitable path for carrying out the synthesis and calculation of normal-mode vibrational frequencies for characterizing a species as a minimum or a transition state or higher-order saddle point, for obtaining zero-point energies to correct frozen-nuclei energies and for interpreting or predicting IR spectra, strength (merit) and weakness (demerit) of molecular mechanics.

Unit 3 Semiempirical Methods Part 1

Introduction to semiempirical (SE) methods, Simple Huckel Method (SHM) - theory - expression for calculating energy of a molecular species, expression for molecular wave function based on LCAO approximation, secular equations and the single matrix equation, H, C, S and ε matrices and their interpretation, the values of H_{ij} as zero, coulomb integral α and bond integral β and their physical significance, the H matrix in terms of α, β and zero for ethene system(ethene neutral molecule, ethene radical cation and ethene radical anion), propenyl system (propenyl cation, propenyl neutral radical and propenyl anion) and cyclobutadiene system (square cyclobutadiene dication, square cyclobutadiene neutral molecule and square cyclobutadiene

dianion), the H matrix in terms of zero, $\alpha = 0$ and $\beta = -1$for ethene systems (ethene neutral molecule, ethene radical cation and ethene radical anion), propenyl system (propenyl cation, propenyl neutral radical and propenyl anion) and cyclobutadiene system (square cyclobutadiene dication, square cyclobutadiene neutral molecule and square cyclobutadiene dianion), result of diagonalization of the H matrices written for ethene system, propenyl system and cyclobutadiene system, molecular orbital energy level diagrams and expressions for energy and molecular wave functions for ethene system, propenyl system and cyclobutadiene system based on the result of diagonalization of the H matrices, and molecular orbital energy level diagrams for ethene system, propenyl system and cyclobutadiene system showing ground state and excited state electronic configurations.

Unit 4 Semiempirical methods Part 2

Application of SHM - nodal properties of molecular orbitals and Woodward-Hoffmann orbital symmetry rule, stability towards oxidation and reduction of various species in ethene system, propenyl system and cyclobutadiene system, geometry of cyclobutadiene molecule as predicted by SHM and its Jahn-Teller distortion, aromaticity and Huckel's $(4n + 2)\ \pi$ electron rule, and calculation of resonance (stabilizing) energy, bond order and atomic charges of various species in ethene system, propenyl system and cyclobutadiene system, strength of SHM, weakness of SHM (detailed explanation) - basis set is limited to p orbitals (p_z orbitals), it treats only π electrons, and the overlap integrals, Fock matrix elements, electron spin and electron-electron repulsion are not calculated/accounted properly, extended Huckel method (EHM) - minimal valence basis set, calculation of Fock matrix elements, and calculation of overlap integrals by Lowdin orthogonalization, EHM procedure, EHM calculation on protonated helium molecule, application of EHM - an overall idea, strength and weakness of EHM, SCF SE methods - Pariser-Parr-Pople (PPP) method and complete neglect of differential overlap (CNDO) method - basic principle (an exhaustive treatment is **not** expected).

Unit 5 Density Functional Theory and ab initio Method

(An exhaustive treatment is **not** expected)

Introduction to Density Functional theory and calculations, Kohn-Sham approach - the first and the second Hohenberg-Kohn theorems, introduction to ab initio method and calculation, basis sets for H, He and first, second and third row elements used in ab initio calculations - STO-3G, 3-21G, 3-21G$^{(*)}$ and 6-31G*****, these basis sets for a few molecular species (water, methane and carbene), basic principles of ab initio method (an idea only).

TEXTBOOK

1. Computational Chemistry-Introduction to the Theory and Applications of Molecular and Quantum Mechanics - Errol Lewars

22CHY643 Sustainable Chemical Science 3 0 0 3

Unit 1 Green Chemistry and Sustainability

History of green chemistry, Chemical composition of the, environment (Air, water & soil- Role of organic and inorganic molecules in pollution), the twelve principles of green chemistry (detailed description with examples), green chemistry as an expression of environmental ethics (Thrift Chemistry),the concept of sustainability, from green to sustainable chemistry, sustainable use of chemical feedstock, water and energy, quantifying greenness of a chemical reaction, green chemistry metrics- mass based, energy and environmental metrics, designing greener process, life cycle assessment (introduction and scope),Green toxicology- the need, principles of toxicology, Disposition of Toxicants in Organisms, Non-Organ System Toxicity, Mechanistic Toxicology, Quantitative Structure–Activity Relationships, (Environmental Toxicology-Persistence and bioaccumulation), Non-Cancer risk assessment, Cancer risk assessment, stakeholders in sustainable policy implementation.

Unit 2 Chemistry in Water

Definition and attributes of a green solvent, the principle and reasons for use of water in green chemistry- hydrophobicity- cyclodextrin chemistry, Lewis acids in aqueous media, Michael addition in water using triflates, green processes with base in water, green oxidations and reduction in water, on water conditions, use of water in microwave and ultrasonic technology.

Unit 3 Green Solvents

Ionic liquids as green solvents - definition and notation - properties, synthesis and use in organic reactions, oxidation, oxidative carbonylation of aniline, Friedel–Crafts reaction, Michael addition, Fischer Indole

synthesis, Benzoin condensation, dimethyl carbonates synthesis in ionic liquids. Super critical fluids- super critical water and carbon dioxide- properties and organic transformations. (Diels Alder, Claisen rearrangement, Fisher Indole, Friedel–Crafts reaction, oxidation and hydrogenation. Properties and application in organic transformation of green solvents like polyethylene glycol, glycerol, cyclopentyl methyl ether, 2-methyltetrahydro furan, perfluorinated (fluorous) solvents- fluorous biphase concept and dimethyl carbonate.

Unit 4 Green Chemistry and Catalysis

Importance of catalysis, turn over number and frequency, the basis of catalysis-kinetic phenomenon, basics of homogeneous, heterogeneous and biocatalysis, Sabatier's principle, catalyst - deactivation, sintering, thermal degradation, inhibition and poisoning, catalyst promoters, modifiers, supported catalysts and reagents for green chemistry - heterogenized reactions for green chemistry, preparation of solid catalyst-slurry and co-precipitation, impregnation, hydrothermal synthesis- drying, calcination, activation and forming, selecting the right support, catalyst characterization- surface characterization methods, temperature programmed techniques, spectroscopy and microscopy. Common mechanism in enzyme catalysis immobilized enzymes, developing biocatalyst- rational design and directed evolution, non-enzymatic biocatalysts.

Unit 5 Green Chemistry Technologies and Alternate Energy Sources

Design for Energy Efficiency, Photochemical Reactions Advantages of and Challenges Faced by Photochemical Processes (Examples). Microwaves as energy source in chemistry- properties of microwaves, microwave heating (Effects), Approaches to Microwave-assisted Organic Chemistry- solvent free methods, MORE chemistry, continuous microwave reactor (CMR)-microwave batch reactor (MBR), examples of organic transformations. Sonochemistry and Green Chemistry-Theoretical Basis- Cavitation Inception, Nucleation-Bubble Dynamics- examples of organic transformations, Sono-chemical synthesis of nano-structured materials, Electrochemical Synthesis- materials manufactured using the process, organic electrosynthesis- 3-bromothiophen from thiophene. Renewable Sources of Energy, Solar Energy, Wind Power, Geothermal Solution, Hydropower (Sources, Merits and Difficulties in widespread applications), Indian Energy scenario-Energy Conservation act (2001)- features.

REFERENCES

1. *Green chemistry and engineering A Pathway to Sustainability, Anne E. Marteel-Parrish, Martin A. Abraham, American Institute of Chemical Engineers, Inc, John Wiley & Sons, Inc 2014.*
2. *Synthetic organic Sonochemistry, Jean-Louis luche, Springer Science Business Media New York, 1998*
3. *New Methodologies and Techniques for a Sustainable Organic Chemistry, Alessandro Mordini and Ferenc Faigl, Springer, 2008.*
4. *Green chemistry, Fundamentals and Applications, Suresh C. Ameta and Rakshit Ameta, CRC press, Taylor & Francis Group, 2013*
5. *Handbook of Green Chemistry, Vol5 Green Solvents- Reactions in Water, Paul T Anastas, Chao Jun Li*
6. *Sonochemistry: theory, reactions, syntheses, and applications, Filip M. Nowak, Nova Science Publishers, Inc, 2010.*
7. *Green Chemistry Metrics, A Guide to Determining and Evaluating Process Greenness, Dicks, Andrew, Hent, Andrei, Springer, Briefs in Green Chemistry for Sustainability, 2015*
8. *Catalysis: concepts and applications, Gadi Rothenberg, Wiley-VCH Verlag& Co. KGaA, Weinheim, Germany, 2008*

22CHY644 Sustainable Techniques in Chemical Sciences 3 0 0 3

Unit 1 From Industrial to Sustainable Chemistry

Industrial sustainable Chemistry- Managing Intraorganizational Sustainability, Managing Horizontal Interorganizational Sustainability, Managing Vertical Inter organizational Sustainability. Integrated Pollution Prevention and Control- Best Available Techniques reference documents(BREFs), From Industrial Emissions Directive (IED) to Voluntary Systems, Policy Drivers for Sustainable Chemistry (Transition Concept), Development of a CSR Management System Framework. Sustainability Assessment Methods and Tools-Sustainability Assessment Framework, Impact Indicators and Assessment Methodologies, Environmental Impact Assessment, Economic Impact Assessment, Social Impact Indicators, Understanding Industrial Symbiosis-Cluster Management. Sustainability of Logistics in the Chemical Sector, Basic Principles of Chemical Leasing (ChL), Differences between Chemical Leasing and Other Alternative Business Models for Chemicals, Sustainable Chemical Warehousing- Risk Management in the Chemical Warehouse, F^3-Factory concept, Indian energy security scenarios (IESS) 2047.

Unit 2 Process Intensification I

Opportunities and perspectives for a sustainable process design, definition and concept, reaction engineering, mixing principles, transport processes, enhanced transport processes, integrating process steps. Moving from Batch to Continuous Processing, Spinning Disc Reactor (Design, Operating Features and Characteristics of SDRs- green synthesis of nanoparticles using SDR), micro process technology-Transport Intensification, Chemical Intensification, Process Design Intensification. Oscillatory Baffled Reactors- Design and operations. Monolith Reactors for Intensified Processing- Design, Hydrodynamics, Advantages and Applications- Cleaner Production of fuels and removal of toxic emissions. Cavitational reactors, mechanism, reactor configurations, transesterification of vegetable oils using alcohol using cavitation

Unit 2 Process Intensification II

Membrane Technology- definitions, functions and operations, biocatalytic membrane reactors (Entrapment, Gelification and Chemical Attachment), biofuel production using enzymatic transesterification. Membrane technology in metal ion removal from waste water, membrane operations for the production of optically pure enantiomers, integrated membrane processes for water desalination. Reactive distillation technology and reactive extraction technology- principles, control design and applications. Reactive absorption technology in carbon dioxide capture, removal of nitrogen oxides, desulphurization, and in sulfuric and nitric acid production.

Unit 4 Computer Applications in Catalytic Research

Computers as research tools in catalysis- a brief overview, a short over view of modelling methods, Data-mining methods in catalysis (PCA, PLS and Artificial Neural networks)

Unit 5 Successful Example of Sustainable Industrial Chemistry

Detailed process chemistry of the current technologies and routes for the following chemicals in industry. Industrial propene oxide production (CHPO (Chlorohydrin) technology, PO/TBA technology, PO/SM technology, PO-only Routes). Synthesis of adipic acid (current technologies for AA production- two-step transformation of cyclohexane, alternatives for AA production). Ecofining- New process for green diesel production from vegetable oil. Direct oxidation of benzene to phenol, Friedel–Crafts acylation of aromatic ethers using zeolites, sustainable chemistry in the production of nicotinates. Homogeneous catalysis: The Shell higher olefin process (SHOP) and Du Pont synthesis of adiponitrile. Heterogeneous catalysis: The BP AVADA ethyl acetate process

REFERENCES

1. *Management Principles of Sustainable Industrial Chemistry, Genserik L.L. Reniers, Kenneth Sorensen, ¨ and Karl Vrancken (Eds), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2013*
2. *Sustainable Development in Practice, Azapagic, A., Perdan, S. (eds.), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2011*
3. *The Art of Process Chemistry, Yasuda, N. (ed.), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2011*
4. *Sustainable Industrial Chemistry, Centi, G., Trifiro, F., Perathoner, S., Cavani, F. (eds.), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2009*
5. *Green chemistry, Fundamentals and Applications, Suresh C. Ameta and Rakshit Ameta, CRC Press, Apple Academic Press, Inc, Taylor & Francis Group, 2013*
6. *Catalysis: concepts and applications, Gadi Rothenberg, Wiley-VCH Verlag& Co. KGaA, Weinheim, Germany, 2008*

22CHY681 Organic Qualitative Analysis Lab 0 0 5 2

1. Separation of Binary Mixtures

Includes separation, preliminary investigations, determinations of saturation/unsaturation, detection of elements by Lassaigne's test, functional group identification, derivative preparation, determination of melting points of the derivatives and calculation of Rf values from TLC

The following mixtures can be given:

(a) Acid and hydrocarbon
(b) Phenol and aldehyde
(c) Phenol and acid
(d) Phenol and amine

(e) Acid and ester
(f) Halo compound and aldehyde
(g) Acid and aldehyde
(h) Amine and aldehyde
(i) Amine and ketone
(j) Alcohol and hydrocarbon

2. Thin layer chromatography to determine Rf values of compounds
(a) 2-nitroaniline
(b) 4-nitroaniline
(c) Cinnamic acid and 2-nitroaniline
(d) Acetophenone
(e) Ethyl benzoate

3. Simple column chromatography to separate the components of binary mixtures
(a) Hydrocarbon and ester
(b) Aldehyde and amine

REFERENCES

1. *P.W.G. Smith, A.J. Hannaford, B.S. Furnis and A.R. Tatchell, "Vogel's Textbook of Practical Organic Chemistry", ELBS/Longman, 1989.*
2. *Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill, David Y. Curtin, Reynold C. Fuson, 'Systematic Identification of Organic Compounds', John Wiley & Sons, 2003.*
3. *Mann and Saunders, 'Practical Organic Chemistry', Pearson edition, 2009.*

22CHY682 Instrumental and Analytical Methods Lab 0 0 5 2

1. Determination of strengths of halides in a mixture potentiometrically**.**
2. To find the redox potential of the given sample using cyclic voltammetry.
3. Determination of half wave potential of Cd & Zn by polarography.
4. Determination of pKa of an indicator in aqueous and micellar medium using UV-Vis spectroscopy.
5. Determination of stoichiometry and stability constant of inorganic (ferric-salicylic acid) and organic (amineiodine) complexes using UV–Vis spectroscopy.
6. Determination of copper and cadmium in a mixture by electrogravimetry.
7. Determination of rate constant for enzyme kinetics-inversion of sucrose.
8. Determination of a molecular weight of a solute using Beckmann thermometer.
9. Refractometric determination of composition of solutions.
10. Spectrophotometric determination of the amount of Cr (VI) in the given solution as dichromate by the method o least squares.
11. Spectrophotometric determination of the amount of fluoride present in the given solution.
12. Determination of the amount of acetic acid in a sample of vinegar by potentiometric titration with a standard bas using quinhydrone.
13. Determination of vitamin C content of a given tablet pHmetrically.
14. Spectrophotometric determination of Fe in Water Sample using Standard Addition.

TEXTBOOKS

1. *Alexander Findly, 'Practical physical chemistry', 9th edition, Wiley, 1972.*
2. *R.C. Das and B. Behera, 'Experimental Physical Chemistry', Tata McGraw-Hill, 1983.*

REFERENCES

1. *J. B. Yadav, 'Advanced Practical Physical Chemistry', Krishna Prakashan Media, 29th edition, 2010.*
2. *Francis William Gray, 'A Manual of Practical Physical Chemistry' Macmillan and Co., Limited, 1914.*

22CUL501 Cultural Education 2 0 0 P/F

1. Invocation, Satsang and Question – Answers
2. Values - What are they? Definition, Guiding Principles with examples sharing own experiences
3. Values - Key to meaningful life. Values in different contexts

4. Personality - Mind, Soul and Consciousness - Q and A. Body-Mind-Intellect and the Inner psycheExperience sharing
5. Psychological Significance of samskara (with eg. From Epics)
6. Indian Heritage and Contribution and Q and A; Indian Ethos and Culture
7. Self-Discipline (Evolution and Practice) – Q and A
8. Human Development and Spiritual Growth - Q and A
9. Purpose of Life plus Q and A
10. Cultivating self-Development
11. Self-effort and Divine Grace - their roles – Q and A; - Vedanta and Creation - Understanding a spiritualMaster
12. Dimensions of Spiritual Education; Need for change Lecture – 1; Need for Perfection Lecture – 2
13. How to help others who have achieved less - Man and Nature Q and A,Sharing of experiences

REFERENCES

1. *Swami AmritaswaroopanandaPuri - Awaken Children (Volume VII and VIII)*
2. *Swami AmritaswaroopanandaPuri - Amma's Heart*
3. *Swami RamakrishnandaPuri - Rising Along the Razor's Edge*
4. *Deepak Chopra - Book 1: Quantum Healing; Book 2: Alpha and Omega of God; Book 3: Seven SpiritualRules for Success*
5. *Dr. A. P. J. Abdul Kalam - 1. Ignited Minds 2. Talks (CD)*
6. *Swami RamakrishnandaPuri - Ultimate Success*
7. *Swami JnanamritanandaPuri - Upadesamritham (Trans: Malayalam)*
8. *Vedanta Kesari Publication - Values - Key to a meaningful life*
9. *Swami Ranganathananda - Eternal values for a changing society*
10. *David Megginson and Vivien Whitaker - Cultivating Self Development*
11. *Elizabeth B. Hurlock - Personality Development, Tata McGraw Hill*
12. *Swami Jagatatmananda - Learn to Live (Vol.1 and 2), RK Ashram,Mylapore*

SYLLABUS FOR 2021 ADMISSION ONWARDS

21OEL631 ADVANCED STATISTICAL ANALYSIS FOR RESEARCH
2 0 0 2

Objective: To familiarize students in application of statistical tool to enable them to easily perform complicated quantitative analysis.

Unit 1
Relevance of statistical analysis in research – scope of analysis in research - types of research – types of analysis in different areas.

Unit 2
Test of hypothesis - hypothesis testing procedure – significance level – steps for testing.

Unit 3
Chi-Square – t Test.

Unit 4
Tools for statistical analysis – familiarising the tool window – common buttons – available menu – entering and editing data.

Unit 5
Different types of analysis using tool.

REFERENCE BOOK:
C, R Kothari, Research methodology – Methods and techniques, New Age International Publishers

21OEL632 BASICS OF PC SOFTWARE 2 0 0 2

Objective: The main objective of this course is to familiarize the basic concepts of Microsoft Office 2007 applications which promote students to build their knowledge in business applications.

Unit 1
Word Processing Basic - An Introduction to Word Processing, Opening Word Processing package, menu bar, Using the help, Using he Icons below menu bar. Opening, saving and closing documents. Page setup, Page background, Printing of documents, Display/Hiding of Paragraph Marks and inter word Space. Moving around in a document - Scrolling the Document, Scrolling by line/paragraph, Fast scrolling and Moving Pages Text creation and manipulation - Paragraph and Tab setting, Text selection, cut, copy and paste, font and size selection, bold, italic and underline, Alignment of text: center, left, right and justify. Formatting the Text - Changing font, size and color, Paragraph indenting, bullets and numbering, Use of tab and Tab setting, changing case. Inserting – header and footer, page number, date & time, symbols, comments, auto texts, footnotes, citations, caption, index, pictures, files & objects, bookmark, hyperlink.

Unit 2
Handling multiple documents, Opening and closing of multiple documents, cut, copy and paste across the documents. Table Manipulation - Concept of table, rows columns and cells, draw table, changing cell width and height, alignment of text in cell, copying of cell, delete/insertion of row and columns, borders for table. Printing
– printing, print preview, print a selected page. Language Utilities – spelling & grammar- Mail merge options, password locking, View – Macros, document views

Unit 3
Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Opening of spreadsheet, and menu bar, Creation of cells and addressing of cells, cell inputting. Insert – tables, charts. Illustrations, links, texts. Page Layout – Themes, set up, scale, sheet, arrange. Practicing auto formatting and conditional formatting - Spelling and auto correct – Arranging windows – Freeze panes – Hiding windows. Providing Formulas - Using basic functions/ formalism a cell, Sum function, Average, Percentage, Other basic functions Data – connections,

sort & filter, data tools, outline

Unit 4

Inserting slides – new slides, existing slides, duplicate slides, slides from Auto layout. Slide views – normal, slider sorter. Slide layouts, design templates. Deleting slides. Slide show – start with first slide, current slide, customize show. Inserting header & footer, Date and Time, Hyperlink, Format – Font, Bullet & Numbering. Custom animation, slide Transition.

Unit 5

Internet: Introduction to networks and internet, history, working of Internet, Modes of connecting to internet, ISPs, Internet address, standard address, domain name, Modems.

World Wide Web-Introduction, Miscellaneous Web Browsers details, searching the w w w - Directories search engines and meta search engines, search fundamentals, search engines, working of the search engines, Telnet and FTP.

TEXTBOOK:

Alexis Leon & Mathews Leon: Fundamentals of Information Technology, Vikas Publishing

REFERENCE BOOKS:

1. Microsoft Office 2000 Complete, BPB publications
2. Dennis P.Curtin, Kim Foley, Kunal Sen, Cathleen Morin: Information Technology - The Breaking Wave, TATA McGraw-Hill Edition

21OEL633 COMPUTER HARDWARE AND NETWORKING 1 0 1 2

Objectives: The course aims to give a general understanding of how a computer works. Students will be able to understand the basics of hardware and Networking technologies.

Unit 1

Hardware Basics - Basic Terms, Concepts, and Functions of System Modules, Front and rear panel view of system – Motherboards: Components and Architecture. Popular CPU Chips and their Characteristics, Processor Architecture - Processor specifications - installing and uninstalling processor - CPU Overheating issues – common problems and solutions

Unit 2

Memory and Storage: Memory features – Types of memory – working - Installing and uninstalling memory modules –maintenance and troubleshooting – common problems and solutions. Storage devices – Hard disk details – Working and parts of hard disks – Installing hard disks – maintenance and troubleshooting.

Unit 3

Power supply – SMPS – features – types – installing SMPS – Specification for SMPS.

Maintenance and Troubleshooting: Preventive Maintenance and Safety Procedures - Managing Replaceable Components.

Unit 4
Introducing Computer Networks: Overview - Types - Topology - Networks Defined by Resource Location - Client-Server Networks - Peer-to-Peer Networks - Dissecting the OSI Model - The TCP/IP Stack Layers of the TCP/IP Stack - Common Application Protocols in the TCP/IP Stack.

Unit 5
Networking Devices – Repeater, Hub, Switch, Router – Basics of Types of cabling – Crimping - Setting up a LAN.

TEXT BOOKS / REFERENCE BOOKS

1. James K L, ”Computer Hardware: Installation, Interfacing Troubleshooting and maintenance”, PHI Learning Press (Eastern Economy Edition, 2013)
2. Mark Dye, Rick McDonald, Antoon Rufi, ”Network Fundamentals: CCNA Exploration Companion Guide”, Cisco Networking Academy, 2008
3. Kaveh Pahlavan, Prashant Krishnamurthy,” Networking Fundamentals: Wide, Local and Personal Area Communications “, Paperback, 2014

21OEL634 CONSUMER PROTECTION ACT 2 0 0 2

Objective: To know about consumer rights and to understand the grievances redressal forums established under the Consumer Protection Act,1986.

Unit 1
Consumerism in India (Historical Background), Consumers: the concept, definition and scope. Object of Consumer Protection Act, 1986.

Unit 2
Unfair Trade Practice, Restriction Trade Practice, Defect in goods, Deficiency in service: Medical, Lawyering, Electricity, Housing, Postal services etc.

Unit 3 Consumer rights and its protection; consumer protection councils, powers and functions.

Unit 4 Judicial Enforcement of Consumer Rights: Consumer Forum under C.P.Act - Jurisdiction, Powers and functions, Exceptions of order, Judicial Review, PIL, Class action, Remedies, Appeal, Administrative Remedies, C.P.Courts.

Unit 5 Appeals and orders: enforcement of orders of the consumer forum, Appeals against orders, Administrative control; Dismissal of frivolous and vexatious complaints, Penalties.

REFERENCE TEXTS:

1. Saraf D.N., Law of Consumer Protection in India, 1995
2. R.K.Bangia, Consumer Protection Act

3. P.K.Majumdar, The Law of Consumer Protection in India, 1998 Orient Publishing Co. Delhi

21OEL635 CORPORATE COMMUNICATION 2 0 0 2

Unit 1
Structure and characteristics of an organization; Factors influencing communication - Flow of communication in an organization - Bottom step, top down vertical and horizontal barriers to communication; Organization of a PR department and counselling firms.

Unit 2
Role of PR in an organization; PR processes - image building - PR and various publics - internal & external; PR and crisis management- national community, labour unrest, and accidents.

Unit 3
PR tools - House journals - kinds and production of house journals; Open house; New media; Gossip, rumour mongering and criticism.

Unit 4
Media Relations - press conference, press releases, press visit, interviews, preparations and distributions of publicity materials to media.

Unit 5
PR for Govt. PR for Non Govt. organizations, PR for armed forces, PR for entertainment and sports, PR for tourism, PR for philanthropic organizations, PR for celebrities. Event management, Ethics in PR.

BOOKS RECOMMENDED:
Balan K.R.: Lectures on applied Public Relations.
Dennis L. Wilcox, Philip H. Ault & Warren K. Agee: Public Relations strategies & tactics.
Mehta D.S.: Handbook of Public Relations in India
Scott M.Cutlip, Allen H. Centre & Glen M. Broom: Effective Public Relations.
Philip Lesley: Lesley's Public Relations Handbook
Kaul J.M.: Public Relations Handbook.
Frank Jefkins: Planned Public Relations
Sam Black: The role of Public Relations in Management.

21OEL636 DESIGN STUDIES 2 0 0 2

Objective: To introduce the students to the field of visual design.

Unit 1
Drawing and illustration.

Unit 2
Design basics.

Unit 3
Principles of composition.

Unit 4
Introduction to type design.

Unit 5
Usage of images, colour in terms of visual design.

REFERENCES:
1. Thinking with Type by Ellen Lupton
2. How to be a Graphic Designer Without Losing Your Soul by Adrian Shaughnessy

21OEL637 DISASTER MANAGEMENT 2 0 0 2

Objectives: To appreciate the fundamentals of disaster management and to introduce the fundamentals procedure and working during the contingency.

Unit 1 Introduction & Dimensions of Natural & Anthropogenic Disasters, Principles/ Components of Disaster Management, Organizational Structure for Disaster Management,

Unit 2 Disaster Management Schemes/ standard operating procedures, Natural Disasters and Mitigation Efforts, Flood Control, Drought Management, Cyclones, Avalanches, Mangroves, Land Use Planning, Inter-Linking of Rivers, Role of Union/ States, Role of Armed Forces/ Other Agencies In Disasters, Important Statutes/ Legal Provisions, Improvised Explosive Device/ Bomb Threat Planning, Nuclear, biological and chemical threat And Safety Measures, Forest Fires, Oil Fires, Crisis In Power Sector, Accidents In Coal Mines, Terrorism And Emergency Management.

Operations Management (OM), Risk Assessment and Disaster Response, Quantification Techniques, NGO Management, SWOT Analysis based on Design & Formulation Strategies,

Unit 3 Insurance & Risk Management, Role of Financial Institutions in Mitigation Effort, Group Dynamics, Concept of Team Building, Motivation Theories and Applications, School Awareness and Safety Programmes, Psychological and Social Dimensions in Disasters, Trauma and Stress, Emotional Intelligence, Electronic Warning Systems, Recent Trends in Disaster Information Provider, Geo Informatics in Disaster Studies, Cyber Terrorism, Remote Sensing & GIS Technology, Laser Scanning Applications in Disaster Management, Statistical Seismology, Quick Reconstruction Technologies,

Unit 4 Role of Media in Disasters, Management of Epidemics, Bio-Terrorism, Forecasting/ Management of Casualties.

Unit 5 Case Studies - Natural Disaster and Man-made Disasters.

REFERENCES:
1) Disaster Management - Harsh K Guptha
2) Disaster Management - Damon.P

21OEL638 ESSENTIALS OF CULTURAl 2 0 0 2

Uniqueness of Indian culture.
Real Indian History.
Heritage – spiritual and cultural heritage.
Glory of ancient India – inventions and discoveries in all fields.
Importance of festivals.

REFERENCE TEXTS:
1. Swami Harshananda – Hindu Culture
2. Amma – Eternal Truth

21OEL639 FOUNDATIONS OF MATHEMATICS 2 0 0 2

Objectives: To develop an understanding of problem solving methods, to understand the basic concepts of mathematics and to apply the results to real life business problems

Unit 1
Matrices: Type of matrices, addition, subtraction, multiplication of matrices, transpose, determinant of a matrix, adjoint and inverse of a matrix.

Unit 2
System of equations - Solution of equations in one(linear, quadratic), two and three variables, Solution of a system of linear equation having unique solution and involving not more than three variables by matrix method, Cramer's rule.

Unit 3
Financial mathematics: Simple interest and compound interest.

Unit 4
Simple differentiation: functions, simple differentiation of algebraic functions, first and second order derivatives, maxima and minima.

Unit 5
Elementary integral calculus: Integration of simple algebraic functions.

REFERENCES:
1. P.R Vittal - Business mathematics and statistics, Margham Publications, Chennai.
2. Dr. Amarnath Dikshit, Dr. Jinendra Kumar Jain - Business mathematics, Himalaya publishing House.
3. V.K Kapoor - Introductory Business mathematics, Sultan chand & Sons, New Delhi.

21OEL640 FOUNDATIONS OF QUANTUM MECHANICS 2 0 0 2

Unit 1
Historical Perspective of Quantum Physics: Failure of classical mechanics - Planck-Einstein,

Bohr-de Broglie-Heisenberg's Uncertainty.

Unit 2

Empirical confirmations of Wave Particle Duality. Schrödinger Equation - Particle in a box-Tunnel effect.

Unit 3

Paradoxes in QM - de Broglie paradox - Schrödinger's cat, Mach-Zhender type interferometers - EPR paradox - Bell-type Inequalities.

Unit 4

Various interpretations - Statistical, Copenhagen, Bohm's formulation, Transactional, Wheeler's Participatory Universe, Many World, Decoherence, consciousness interpretation.

Unit 5

Uncertainty-Nonlocality, Holistic universe, Violations of causality-Retro influence-Philosophy of Advaitha (non-Duality).

TEXT AND REFERENCES:

1. Quantum Enigma: Physics Encounters Consciousness by Bruce Rosenblum and Fred Kuttner (Aug 1, 2011)
2. The New Physics and Cosmology Zanjoc, Oxford 2004

21OEL641 GLIMPSES OF LIFE THROUGH LITERATURE 2 0 0 2

Unit 1

1 Introduction – What literature is – Language and literature – Indian literature – Values through literature – Literature and culture – Enjoying literature
2 Father Giligan – WB Yeats

Unit 2

3 The West Wind – PB Shelley
4 Chicago Address – Swami Vivekananda

Unit 3

5 On Saying Please – AG Gardiner
6 My Lost Dollar – Stephen Leacock
7 The Importance of Being Earnest – Oscar Wilde (extracts)

Unit 4

8 The Refugee – AK Abbas
9 The Mirrored Hall – Swami Chinmayananda

Unit 5

10 The Windhover – GM Hopkins

21OEL642 INFORMATION TECHNOLOGY IN BANKING 2 0 0 2

Objective: To provide an understanding on the technology enabled banking services and their applications.

Unit 1
Bank and Banking: Meaning and definition, development of banking in India, types banks, banking systems, types of banking systems, commercial banks, functions, nationalization of commercial banks in India.

Unit 2
Central Banking, functions, Reserve Bank of India, State Bank of India.

Unit 3
Banker and Customer, opening an account, Pass Book and Pay–in Slip, Cheques, types of cheques, crossing of cheques.

Unit 4
Role of information technology in banking services, Core Banking, Automated Teller Machine (ATM), Electronic Clearing Service (ECS), NEFT and RTGS, Mobile Banking.

Unit 5
Debit Card and Credit Card, banking and E-Commerce, Point of Sales (PoS), Online bill payment and ticket reservation – future of electronic banking.

REFERENCE BOOKS:
1. Sundaram and Varshney – Banking Law, Theory and Practice, Sultan Chand
2. B. Santhanam – Banking and Financial Systems, Margham Publications
3. S.N. Maheswari – Banking Law, Theory and Practice, Kalyani Publications
4. Parameswaran – Indian Banking, S.Chand and Co

21OEL643 KNOWLEDGE MANAGEMENT 2 0 0 2

Objective: To enable students to understand the basics of Knowledge Management and its applications in organizations

Unit 1
Knowledge management concepts – Introduction - Definitions of Knowledge – Data-information and knowledge - basic thoughts on knowledge - difference between wisdom and knowledge - information Management and knowledge Management - hierarchy model - knowledge types – explicitness – reach - abstraction level – propositionality – Earl's schools of knowledge management.

Unit 2
Knowledge management and process - Becerra-Fernandez and Stevenson knowledge process - Nonaka's Knowledge Spiral – dynamics of knowledge creation – knowledge management

systems – knowledge management sub – processes – knowledge discovery – knowledge capture – knowledge sharing –knowledge application.

Unit 3

Organizational knowledge – Need – benefits - components and functions - Knowledge management in virtual organizations - knowledge management in professions - a study of IT and ITES business - knowledge management system requirements - Organizational knowledge measurement techniques - organizational implementation barriers.

Unit 4

Designing Enterprise Knowledge Management System architecture – Multi-layer architecture for Knowledge Management Systems - knowledge management in decentralized and heterogeneous corporations - Web based knowledge management support for document collections.

Unit 5

Recent Tools for KM - Intelligent support systems - intelligent systems and artificial intelligence - comparing artificial and neural intelligence - conventional vs. Artificial intelligence - Emerging technology - virtual reality - Intellectual capital.

TEXTBOOKS AND REFERENCES:

1. Knowledge Management – Sudhir Warier, Vikas Publications.
2. Knowledge Management Systems – Stuart Barnes, Thomson Learning.
3. Key issues in the New Knowledge Management – J.M. Firestone, M.W. Mcelroy.
4. Developing Expert System for Business – Chandler/Liang.
5. Knowledge Management – Pankaj Sharma, APH Pub

21OEL644 MARKETING RESEARCH 2 0 0 2

Objective: To provide a basic knowledge on research methodology and market research.

Unit 1

Definition of Marketing Research, Objective of Marketing Research, Application of Marketing Research, Limitation of Marketing Research, Marketing Research Process.

Unit 2

Research Design: Various Method of Research Design, Important Experimental Research Designs.

Primary and Secondary Data: Methods of Collecting Primary Data, Advantages & Disadvantages of Primary Data & Secondary Data, Essentials Characteristics for Selecting Secondary Data. Basic Methods of Collecting Data: Questionnaire Method/ Observation Method - Advantages & Disadvantages, Methods of Observation, Precautions in Preparation of Questionnaire & Collection of Data.

Unit 3

Measurement and Scaling: Types of Scales, Difficulty of Measurement, Sources of Error,

Criteria for a Good Scale, Development of Marketing Measures.

Sampling: What is Sampling, Objective of Sampling, Steps in Sample Design, Various Techniques of Sampling, Advantages & Disadvantages of Different Techniques of Sampling, Difference between Probability and Non-probability Sampling, Problem Associated with Sampling, Determining Sample Size.

Unit 4
Data Processing, Analysis and Estimation

Unit 5
Report Preparation: Types and Layout of Research Report; Precautions in Preparing the Research Report, Bibliography and Annexure in Report, Drawing Conclusions, Giving Suggestions and Recommendation to the Concerned Persons.

REFERENCE TEXTS:
1. Nargundkar - Marketing Research, Tata McGraw Hill, 2nd Ed.
2. Luck and Rubin - Marketing Research, Prentice Hall of India, 7th Ed.
3. Tull & Hawkins - Marketing Research: Measurement & Method, Prentice Hall of India, 6th Ed.
4. Beri - Marketing Research, Tata McGraw Hill, 4th Ed.

21OEL645 MEDIA FOR SOCIAL CHANGE 2 0 0 2

Unit 1 Health Communication
Introduction to theories in Health Communication. Awareness on Health Issues – Epidemic Diseases, knowledge about vaccination for various diseases - Health campaign will be organized with the help of Medical Practitioner.

Unit 2 Radio for Social Change
Awareness on Edaphic Issues - Soil Pollution, Water Pollution and other forms of pollution. Anti–Pollution campaign will be organized with the help of Environmental Scientist or Journalist.

Unit 3 Social Media Activism
Awareness on Blood Donation – How a tiny red drop makes someone’s life Green. Awareness campaign will be organized based on Eye Donation.

Unit 4 Development Communication and Social Learning
Locating the remote village where basic amenities like Water, Toilet facilities are not available - A campaign with the involvement of government officials and social scientists.

Unit 5 Participatory Communication for Social Change
Organic Farming - Awareness of Organic Farming. Benefits of organic farming in the materialistic world. A campaign cum workshop will be conducted by inviting experts from Agricultural Husbandry.

REFERENCES

1. Tillman, C. (2006). Principles of occupational health and hygiene: an introduction. Allen & Unwin.
2. Thayer, Lee, (2014) Mental Hygiene: Communication and the Health of the Mind.
3. Harrison, R. M. (2001). Pollution: causes, effects and control. Royal Society of Chemistry. Wilhelm, J. (2016). Environment and Pollution in Colonial India: Sewerage Technologies Along the Sacred Ganges. Routledge.
4. Charbonneau, J., & Smith, A. (Eds.). (2015). Giving Blood: The Institutional Making of Altruism. Routledge.
5. Agarwal, Arun K (2007) Standard Operating Procedures(sop) For Hospitals In India. New Delhi:
6. Atlantic Publishers
7. Hall-Matthews, D. N. J. (2005). Peasants, Famine and the State in Colonial Western India.
8. Basingstoke: Palgrave Macmillan.
9. Thottathil, S. E. (2014). India's Organic Farming Revolution: What it Means for Our Global Food System. University of Iowa Press.

21OEL646 MEDIA MANAGEMENT 2 0 0 2

Unit 1

Management concept – Principles of Management - Factors influencing Management decision in media – Structure and characteristics of media organizations – Newspapers and Magazines, Radio, Television, Cinema - Ownership in Media Industries – Merits and de-merits.

Unit 2

Economics of newspaper – Advertising vs circulation – Management problems of small, medium, large newspapers: gathering, processing, printing, circulation, distribution, advertising, professionalism, trade unionism, News room diversity.

Unit 3

Economics and Administrative concerns of government owned electronic media-market driven media: private channels – Social commitment vs Profit making.

Unit 4

Economics of film Industry – creativity, production, marketing distribution, exhibition, ownership vs piracy.

Unit 5

News agencies and syndicates: Ownership and organization structures – committees to study the problems of various media in India.

BOOKS RECOMMENDED:

1. Aggarwal S.K : Press at the crossroads in India.
2. William and Rucker: Newspaper Organization and Management
3. Sarkar R.C: The press in India
4. Noorani A.G: Freedom of Press in India

5. Frank Thayer: Newspaper Management
6. Gulab Kothari: Newspaper Management in India
7. Reports of the enquiry committees appointed by the Ministry of Information and Broadcasting.

21OEL647 OBJECT-ORIENTED PROGRAMMING 2 0 0 2

Unit 1
Introduction to OOPS: Object Oriented Programming features, Applications, History, Difference from structured Programming, Object Oriented Programming Languages, Program execution.

Unit 2
Object Oriented Concepts: Abstraction, Encapsulation, Polymorphism, Inheritance, Classes and Objects, Programming Basics - Data types, Conditional Statements, Loops, arrays, Functions, Structures.

Unit 3
Implementing Class, Object Data Types, User Defined Data Types, Defining a Class, e Access specifiers, The Scope Resolution Operator, Using Class Objects Like Built-in Types, Scope, Constructors, Member Initialization, Constructor Overloading, Destructors.

Unit 4
Inheritance: Introduction, The protected Access Level, Assignments Between Base and Derived Objects, Types of Inheritance, Compile-Time vs. Run-Time Binding, virtual Functions, Polymorphism, Abstract Base Classes.

Unit 5
The iostream Library, Predefined Streams, Stream States, Formatted I/O, Disk Files, Reading and Writing Objects.

TEXTBOOKS
1. E Balaguruswamy “Object Oriented Programming Using C++” 6th Edition, TMH Publications
2. Lalit Kishore Arora , Dr. Vikesh Kumar, “ Object Oriented Programming Using C++ “,S.K. Kataria & Sons; 2011 edition (2011)

21OEL648 PAINTING AND SCULPTURE 1 0 1 2

Objective: To make students develop critical thinking skill as well as make them creative in their field of painting and sculpture.

Unit 1
Pencil drawing, life study.

Unit 2
Basics of water colour painting, Clay modelling.

Unit 3

Anatomy and figure study, Basics of oil and acrylic painting.

Unit 4
Basics of Figure modeling.

Unit 5
Moulding and casting.

REFERENCE BOOKS
1. Indian Sculpture and Painting – by E.B. Havell (Author)
2. Modern Painting And Sculpture: 1880 To Present From The Museum Of Modern Art – by John Elderfield (Editor)

21OEL649 PERSONAL FINANCE 2 0 0 2

Objective: To analyse the process of making personal financial decisions, develop personal financial goals and identity the strategies for their achievement.

Unit 1
Basics of Personal Financial Planning, Time Value of Money, Planning tax strategies.

Unit 2
Introduction to Consumer Credit, sources of credit, Consumer Purchasing, strategies for housing decisions.

Unit 3
Insurance: types, selecting the right insurance policy, property and motor vehicle insurance, health insurance policies, Retirement Planning, NPS.

Unit 4
Investing fundamentals, investing in shares, bonds and mutual funds, investment in gold and real estate.

Unit 5
Investing in Schemes of Government: National Savings Certificates, KVP, Post Office Recurring Deposits and term deposits, PPF.

REFERENCE TEXTS:
1. Jeff Madura – Personal Finance, Pearson Education
2. Manish Chauhan – 16 Personal Finance Principles every Investor should know, Network18 Publishers
3. Jack R Kapoor, Les R Dlabey – Personal Finance, McGraw Hill

21OEL650 PRINCIPLES OF ADVERTISING 2 0 0 2

Objective: The objective of this paper is to help student to make basic understanding on advertising, providing understanding on the processes behind successful advertising. The

students are introduced to the processes, tools and techniques used in developing advertising concepts with the study areas including creative thinking and visualizing.

Unit 1 Introduction
History of advertising, Advertising-meaning and definition, Advertising as a tool of communication, Features of advertising.

Unit 2 Types of Media – Advantages & Disadvantages
Types of advertising, Types of media in advertising – Features – advantages – disadvantages – Print, Television, Radio, Internet, OOH.

Unit 3 Structure of an Advertising Agency
Structure of advertising agency – Small, Medium, National, In-house.

Unit 4 Other Promotion
Sales Promotion, Direct Marketing, Public Relations, Publicity and Corporate Advertising, Unconventional Promotional Media.

Unit 5 Case Studies

REFERENCE BOOKS:
Advertising, Frank Jefkins Revised by Daniel Yadin
Kleppner's Advertising Procedure

21OEL651 PRINCIPLES OF PACKAGING 2 0 0 2

Objective: To analyse the process of making personal financial decisions, develop personal financial goals and identity the strategies for their achievement.

Unit 1
Packaging: Meaning and importance, functions, marketing considerations of packaging.

Unit 2
Design of package, materials used for packaging, selection criteria of packaging materials, packing techniques.

Unit 3
Packaging systems, future of packaging.

Unit 4
Provisions of the Legal Metrology (Packaged Commodities) Rules 2011.

Unit 5
Provisions of Food Safety Standards (Packaging and Labelling) Regulations, 2011.

REFERENCE TEXTS:
1. Gordon Robertson – Food Packaging: Principles and Practice, CRC Press
2. Frank Paine – A Handbook of Food Packaging, Springer

21OEL652 SCRIPTING FOR RURAL BROADCASTING 1 0 1 2

Unit 1
Introduction to rural broadcasting. Rural life and issues. Cultural ecology - Anthropological approaches - traditional social activities-translocal ruralistic features. Practical: Visit any rural area for making detail analysis on the topics during weekends.

Unit 2
Rural communities. Analysis of social and political life in a rural community. Caste / class dynamics and regional influences.

Unit 3
Scope and Impact of broadcast journalism in rural development. Two day workshop by an external expert from the broadcast industry on the rudiments of script writing focusing on rural aspects/ communities.

Unit 4
Practice on Scripting. Focus on covering special issues concerning rural women, youth, farmers, self-help groups cottage industries etc.

Unit 5
Developing the final script for rural broadcasting that will have practical application in the field. Final evaluation by the external expert.

REFERENCES

1. Eschenbach, J. (1977). The role of broadcasting in rural communication.
2. Friedrich-Ebert-Stiftung. George, A. M. (2004). India untouched: The forgotten face of rural poverty. East West Books.
3. Kumar, K. (2003). Mixed signals: Radio broadcasting policy in India. Economic and political weekly, 2173-2182.
4. Maddison, J. (1971). Radio and television in literacy. Unesco.
5. Manyozo, L. (2011). People's radio: communicating change across Africa. Southbound Penang
6. Neurath, P. M. (1962). Radio farm forum as a tool of change in Indian villages. Economic Development and Cultural Change, 10(3), 275-283.

7. Onabajo, F. (2003). 37 Message Design & the Appropriateness of Language in Rural Broadcasting. Four Decades in the Study of Languages & Linguistics in Nigeria: O'Hare, K. (1992). Scripts: Writing for Radio and Television. Canadian Journal of Communication, 17(4).
8. Sharma, A., & Kashyap, S. K. (2013). Information need assessment for empowering rural women through community radio programmes: A study in Tarai region of Uttarakhand. Journal of
9. Community Mobilization and Sustainable Development, 8(2), 169-173.

21OEL653 SOCIAL MEDIA WEBSITE AWARENESS 1 0 1 2

Objectives; To understand the history, theory, technology and uses of social media; to create, collaborate, and share messages with audiences of all sizes; to know and explore the possibilities and limitations of social media. Hands on experience with several forms of social media technology; to understand and use social media productively and to evaluating new tools and platforms.

Unit 1
Introduction to Social media; Definition - Social Media and Digital transformation; Social Networking and online communities; Social support and service; Wikipedia, Facebook, Instagram, Tagging, LinkedIn; Social mobile applications; Security settings in Facebook, Whatsapp.

Unit 2
Blogging – History; Creating blog, effect of blogging, micro blogging; Protocol, Platform, Content strategies.

Unit 3
Tweeting - Introduction, History, Protocol; Twitter; Twitter apps; Managing Twitter; #hashtag# creation and following; Security settings in Twitter.

Unit 4
Social media sharing – History, Protocol; YouTube, Flickr, Slide share, Social news; News apps – Newshunt and others; Bookmarking - History, Digg, Reddit, Delicious.

Unit 5
Social theory in the information age; Social Network for professional, business, Digital Marketing; Using social networking sites for research, Security aspects of social networking.

REFERENCES:
1. Social Networking - Digital and Information Literacy Series by Peter K. Ryan, The Rosen Publishing Group, 2011 ISBN 1448823463, 9781448823468
2. The Social Media Marketing Book Dan Zarrella "O'Reilly Media, Inc.", 13-Nov-2009

21OEL654 THEATRE STUDIES 1 0 1 2

Objective: To provide students with a firm grounding in the discipline of Theatre and Performance Studies.

Unit 1
Breathing exercises, warming up exercises.

Unit 2
Voice modulation, Monologue practice.

Unit 3
Facial expressions, emoting a character.

Unit 4
Stage direction, Makeup and costumes.

Unit 5
Choreography, Producing a play.

REFERENCES:

1. Theatre as Sign System: A Semiotics of Text and Performance by Elaine Aston, George Savona
2. Theatre Semiotics: Text and Staging in Modern Theatre by Fernando de Toro
3. Acting For Real: Drama Therapy Process, Technique, and Performance by Renee Emunah

21OEL655 WRITING FOR TECHNICAL PURPOSES2 0 0 2

Overview: The course aims at developing skills that will enable students to produce clear and effective scientific and technical documents as required in their work-life. Though the focus of the course is on writing, oral communication of scientific and technical information forms an important part of the course.

Objectives: To familiarize the students with the requirements of effective technical writing; to enable students to independently work on their publication and presentation of papers; developing skills required for presentation of reports, papers and proposals

Unit 1
What is Technical Writing? - Purpose and characteristics of technical writing and need for developing technical writing skill. Use of Technical terms, Defining terms, Style and tone.

Unit 2
Use of resources, documentation style and citation; Standard operation procedures, Instruction Manuals and Handbooks.

Unit 3
Oral presentations, Analysis of published papers – format, content and style.

Unit 4
Drafting a research paper for publication; Grammar check and editing; proof reading.

Unit 5
Submission of term paper.

REFERENCE BOOKS:

1. Mcmurrey David, Technical Writing,
2. Manser Martin H. Guide to Style: an essential guide to the basics of writing style, Viva books

21OEL656 YOGA AND PERSONAL DEVELOPMENT 1 0 1 2

Objective: To give an understanding on the concept and advantages of yoga and simple yoga practices.

Unit 1
Yoga and Modern Life – Introduction - understanding Yoga – definition - four streams of yoga - Why yoga?

Unit 2
Breath – The Bridge – Introduction - Breathing Practices – Standing - Sitting – Supine.

Unit 3
Loosen Yourself – Introduction – Jogging – Bends - Twisting – Pavanamuktasana Kriya.

Unit 4
Asanas – Suryanamaskar - Standing Posture - Sitting postures - Prone Postures - Supine – Topsy Turvy - Relaxation techniques.

Unit 5
Pranayama, Meditation.

REFERENCE TEXTS:
1. N.S. Ravishankar – Yoga for Health, Pustak Mahal
2. BKS Iyengar – Yoga: The Path to Holistic Health, DK Publishers

21OEL657 FUNDAMENALS OF LEGAL AWARENESS 2 0 0 2

Objective: This course is intended to give the student the power to make a difference in personal and professional life through sound legal knowledge and to be aware of rights and responsibilities towards society and nation.

Unit 1
Law and classification: definition, meaning, functions, classification- public and private law, civil law and criminal law, substantive and procedural law, municipal and international law, written and unwritten laws

Unit 2
Law of contracts: overview of Indian Contract Act, definition, meaning, essentials-offer and acceptance, invitation to offer, cross offers, intention to create legal obligation, lawful consideration, lawful object, competency of parties, free consent, agreement not to be void, illegal, immoral or opposed to public policy, agreement v. contract, breach and remedies for breach.

Unit 3
Law of torts: Definition, meaning, essentials, damages- injuria sine damnum and damnum sine injuria, general defences in torts, exceptions to tortious liability: vicarious liability- master servant relationship, Principal- agent relationship, Partner- partnership firm, Major torts: Nuisance, Negligence
Tress pass: Tresspass to a person- Battery, Assault, False Imprisonment, defamation- libel and slander,

essentials, defences to defamation, liability in torts- strict liability, absolute liability, damages in torts- meaning, types of damages- nominal, compensatory, exemplary, aggravated, prospective, contemptuous

Unit 4

Criminal law: introduction of criminal law- subject matter, General introduction to the Indian Penal Code, Criminal Procedure code, Indian Evidence Act, mental element- stages of crime, guilty intention, General exceptions- Intoxication, Insanity, Mistake of Fact, Accident, Acts done under compulsion, public duty etc., Right of Private Defence, Major offences: Theft, Extortion, Robbery, Dacoity, Sedition, Abduction, Kidnapping, Unlawful Assembly, Dowry Death, Abetment, Murder, Culpable Homicide

Unit 5

Family law: subject matter and Introduction, Laws Involved, Marriage – validity and degree of prohibited relationship, Divorce Family Court, Grounds for divorce, orders- judicial separation, restitution of conjugal rights, maintenance, Section 125 Criminal Procedure code, Adoption- difference between guardianship and adoption, General outline of Hindu Adoption and Maintenance Act, Guardianship and Wards Act, Succession- Testamentary and Intestate- Testator, Executor, Administrator and Probate