MSc Chemistry
Faculty of Physical Sciences

(Revised with effect from 2022-23 AY onwards)
# M. Sc. Chemistry Curriculum 2022

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## Core Electives

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## Open Electives

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*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.
**Unit I: Quantum Chemistry - Introduction**

**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**

**REFERENCES**

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**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**

**REFERENCES**

**22CHY503 Principles in Organic Chemistry**

**Unit 1 Aromaticity**: Review of inductive and field effects – Resonance effects. Criteria for aromaticity – structural and electronic. Types – Hückel 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, metalloccenes, 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 carboxations - 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 pKa, 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 bifurcations, allenes, spirals 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 regioispecific 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, anomic effect - cycloalkenes and cycloalkynes - kinetically and thermodynamically favoured products stereochemistry of SN1, SN2, SNi, E1 and E2


TEXT BOOKS

REFERENCES

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 basedmetal-metal σ, π and δ bonds in compounds like [Re2Cl6]2-, [Os2Cl6]2-, Cr2(CH3COO)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 (4f and 5f), 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 ions, Orgel diagrams for d 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)]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 μeff, 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 3d systems (also with exclusive 4d and 5d metal ions), mixed 3d-4f systems, importance of 4f-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

REFERENCES

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 H2O, N2F2, BF3, AB4 type molecules (Td and D4h) and AB5 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 AB3 (planar), AB4 (Td), AB5 (D5h) and AB6 (O6) 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

REFERENCES

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 Glansdorff-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, $\Delta G$ in terms of $K$, equilibrium constants – real gases and real reactions, equilibrium respond to catalyst, temperature, pressure and $p\text{H}$, application of $\Delta G$ 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$_2$K, phase diagram - steel, alloys, Fe-C system, zone refining, three component system, triangular coordinates, three component system – partially miscible liquids - $\text{H}_2\text{O}/\text{CHCl}_3/\text{CH}_3\text{COOH}$, phase diagram - $\text{NH}_4\text{Cl}/(\text{NH}_4)\text{2SO}_4/\text{H}_2\text{O}$

**TEXTBOOKS**


**REFERENCES**


22CHY512 Molecular Spectroscopy 3104

**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, 2J and 3J and long-range coupling, measurement of J, Karplus relationship, first and second order spectra, AX, AB, AX2, AX3, A2X3, AMX type spectra, double resonance and spin tickling, chemical shift reagents, spectra in higher fields, spectra of conformational isomers, homotopic, enantiotropic and diastereotopic systems, C13 spectra, factors related to 13C spectra, 1H coupled 13C spectra, 1H decoupled 13C spectra, chemical shift values, nuclear overhauser effect (NOE), cross-polarization, off-resonance resonance decoupling, application of 1H and 13C NMR spectroscopy for the structural elucidation of organic compounds, 11B, 15N, 19F and 31P 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 Cu2+ and VO2+ complexes, ‘g’ markers like DPPH and TCNE, evaluation of spin Hamiltonian like A, gA, g-, covalency factor in Cu2+ complexes, analysis of ESR spectra of VO2+ 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

REFERENCES
2. J. Keeler, Understanding NMR spectroscopy, Wiley, 2009
5. J. E. Wertz and J. R. Bolton Electron Spin Resonance, Springer Science

22CHY513

Organic Reaction Mechanism

Unit 1 Nucleophilic Substitution:SN1, SN2, 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: SNAr, SN1, benzyne and SRN1 mechanisms. Effect of substrate structure, leaving group and attacking nucleophile on reactivity.

Unit 2 Electrophilic substitution: SE2 and SEi, SEi1, 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 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 2, Patterno –Buchi reaction.


**TEXT BOOKS**

**REFERENCES**

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
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
2. Sujata V. Bhat, Bhimsen A. Nagasampagi, Meenakshi Sivakumar, Chemistry of Natural Products, Springer 2005

REFERENCES
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 – hapticity of 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-N2 (metal dioxygen), M-O2 (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 (metalallocenes, sandwich/half-sandwich compounds, bent metalallocenes), 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 CH3, CH2, CH, BH2, BH, NH2, NH, FMO’s (π-orbitals) of C2H5, C4H4, C6H6, C5H5, C6H6, C5H6. Inorganic fragments MLn with varying number of L’s. Symmetry and shape of their FMO’s. isosbestic concept, iso-electronic and isosbestic relationships between various organic and inorganic (MLn) fragments. Structure and bonding between various organic and inorganic fragments based on MO level diagrams – metal-oleins, ML₆-cyclobutadiene, ML₆-carbene, ML₆-carbene, ML₆-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 – ¹H, ¹³C and ³¹P 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**


**TEXTBOOKS**

5. J.D. Atwood, ‘Inorganic and Organometallic Reaction Mechanism’, 2nd Edn., Wiley-

**REFERENCES**


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**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**


**REFERENCES**

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), Riboflavin (colorimetry), Zn ions in Bacitracin Zinc, Ca²⁺ 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-bromobenzenilide from aniline
(c) p-nitro acetonilide from aniline

Single stage preparations:
(a) Benzinimidazole
(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

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 + I₂ = KI₃ 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. Ostwold’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.
15. Determination of flash point, fire point of a lubricant.

**TEXTBOOKS**

**REFERENCES**

**22CHY584 Inorganic Quantitative Analysis Lab**

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 Alkalinites 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**

**REFERENCES**

**22CHY601 Electrochemistry Kinetics and Surface Chemistry**

**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**

**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 e.m.f – 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-Volmer 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**

**TEXTBOOKS**

**REFERENCES**

22CHY602 Synthetic Strategies and Reagents 3 1 0 4

**Unit 1 Synthetic Strategies**

**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

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.

TEXT BOOKS

REFERENCES

22CHY603 Solid State Chemistry and Materials Science

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-Maugin 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 wurtzite structures, MX2 type solids, fluorite and antifluorite structures, CdCl2 and CdF2 structures, rutile and anti-rutile, ReO3, spinel and inverse spinel, perovskite 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

Unit 4 Materials Science-Structure and properties
Solid materials of importance. Structure and properties of SiO₂, ZrO₂, SiC, BN, ZnO, TiO₂, CdS, CdTe, GaAs, MoS₂. Band-gap properties of semiconductors like ZnO, TiO₂, CdS, CdSe, CdTe, GaAs, MoS₂ and (CH₃NH₃)[PbX₃]-type perovskites. Photo-catalytic properties of ZnO and TiO₂ – 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

TEXTBOOKS

REFERENCES
5. F.H. Norton, Elements of Ceramics.,

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 monoxygenase (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**


**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**

Porphyins (H$_2$P) and metalloporphyrins (MP), spectral, fluorescence and redox properties of H$_2$P 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**


**REFERENCES**


**22CHY631 Applied Electrochemistry 3 0 0 3**

**Unit 1 Electrodes**

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

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 batteries (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

REFERENCES

22CHY632 Bioanalytical Chemistry

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, Nephelometry 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

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

REFERENCE
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**

**REFERENCES**

22CHY635

**Industrial Stoichiometry**

*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 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**

REFERENCES

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

REFERENCES

22CHY637 Medicinal Chemistry 3 0 0 3

Unit 1 Medicinal Chemistry

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**


**REFERENCES**


**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**

**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, twist, tweezers, threading-dethreading movements, ring switching processes in rotaxanes and catenanes, molecular valves, molecular muscles.
TEXTBOOKS

REFERENCES

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

REFERENCES

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**
*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.

**TEXTBOOK**

**REFERENCES**

**22CHY641 Biosensors: Fundamentals and Applications**

**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**

**Unit 3 Electrochemical principle in biosensing**

**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**


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 (H₂O 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 H₀ 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, α = 0 and β = -- 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) π 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 (p₂ 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(α) 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- cycloextrin 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

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

REFERENCES

Unit 1 From Industrial to Sustainable Chemistry
Unit 2 Process Intensification I

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


22CHY681 Organic Qualitative Analysis Lab

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

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.
10. Spectrophotometric determination of the amount of Cr (VI) in the given solution as dichromate by the method of 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 base using quinhydrone.
13. Determination of vitamin C content of a given tablet pHmetrically.

TEXTBOOKS

REFERENCES

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 Spiritual Rules 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

SYLLABUS FOR 2021 ADMISSION ONWARDS

21OEL631 ADVANCED STATISTICAL ANALYSIS FOR RESEARCH

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

BASICS OF PC SOFTWARE 2002

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

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
tools, outline

Unit 4

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:

REFERENCE BOOKS:
1. Microsoft Office 2000 Complete, BPB publications

21OEL633 COMPUTER HARDWARE AND NETWORKING 1 0 1

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

Unit 2

Unit 3

Unit 4

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

TEXT BOOKS / REFERENCE BOOKS

21OEL634 CONSUMER PROTECTION ACT 2002
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 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:
2. R.K.Bangia, Consumer Protection Act

21OEL635 CORPORATE COMMUNICATION 2002

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.
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
Frank Jefkins: Planned Public Relations
Sam Black: The role of Public Relations in Management.

21OEL636 DESIGN STUDIES 2002

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 2002

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,


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
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 2002

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:
2. Dr. Amarnath Dikshit, Dr. Jinendra Kumar Jain - Business mathematics, Himalaya publishing House.

21OEL640 FOUNDATIONS OF QUANTUM MECHANICS 2002

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 Advaita (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 2002

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 2002

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 of 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

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
4. Parameswaran – Indian Banking, S.Chand and Co

21OEL643 KNOWLEDGE MANAGEMENT 2002

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

Unit 5

TEXTBOOKS AND REFERENCES:
5. Knowledge Management – Pankaj Sharma, APH Pub

MARKETING RESEARCH 2002

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


Unit 3
Measurement and Scaling: Types of Scales, Difficulty of Measurement, Sources of Error, Criteria for a Good Scale, Development of Marketing Measures.

Unit 4
Data Processing, Analysis and Estimation

Unit 5

REFERENCE TEXTS:
2. Luck and Rubin - Marketing Research, Prentice Hall of India, 7th Ed.

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
6. Atlantic Publishers

21OEL646 MEDIA MANAGEMENT 2002

Unit 1

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

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

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

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

TEXTBOOKS

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)

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

Unit 1

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

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 2002

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

Unit 5

REFERENCE TEXTS:
2. Frank Paine – A Handbook of Food Packaging, Springer

21OEL652  SCRIPTING FOR RURAL BROADCASTING  1 0 1 2

Unit 1

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

21OEL653 SOCIAL MEDIA WEBSITE AWARENESS

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:
2. The Social Media Marketing Book Dan Zarrella "O'Reilly Media, Inc.”, 13-Nov-2009

21OEL654 THEATRE STUDIES

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 PURPOSES 2002

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,
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

Unit 3

Unit 4

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

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 Trespass: Trespass 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

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