SYLLABUS

MANONMANIAM SUNDARANAR UNIVERISTY, TIRUNELVELI-12

PG - COURSES – AFFILIATED COLLEGES Course Structure for

M.Sc. CHEMISTRY

(Choice Based Credit System) (with effect from the academic year 2021- 2022 onwards)

Semester-II				
Part	Subject Status	Subject Title	Subject Code	Credit
III	Core - 7	Stereochemistry, Organic Reagents and Photochemistry		4
	Core - 8	Coordination Compounds and Solid State Chemistry		4
	Core - 9	Electrochemistry and Spectroscopy - II		4
	Elective – II	(Choose any One)2.1 Nanoscience And Nanotechnology2.2 Medicinal Chemistry2.3 Industrial processes and Catalysis		4
	Core - 10 Practical - 4	Organic Chemistry Practical – II		2
	Core - 11 Practical - 5	Inorganic Chemistry Practical – II		2
	Core – 12 Practical - 6	Physical Chemistry Practical – II		2

STEREOCHEMISTRY, ORGANIC REAGENTS AND PHOTOCHEMISTRY

Objectives:

- To understand the concept of Stereochemistry and conformation of organic molecules.
- To study synthetic utility of important organic reagents.
- To understand Photochemistry and Pericyclic reactions.

UNIT I

STEREOCHEMISTRY

Concept of chirality: – Stereogenicity – Topicity - Enantiotopic, diastereotopic hydrogens and prochiral centres – axial and planar chirality – stereochemistry of compounds containing two dissimilar asymmetric carbons, ansa compounds and para cyclophanes.

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R/S notations of Spiranes, allenes and Biphenyl ortho derivatives - E/Z notation of compounds containing one and two double bonds.

Regiospecific, Regioselective and chemoselective reactions - Stereospecific and stereoselective synthesis – Methods of Asymmetric synthesis including enzymatic and catalytic process – SAMP/RAMP as chiral auxiliaries - Cram's rule and Prelog's rule – Cram chelation model and Felkin – Aln model.

UNIT II

CONFORMATIONAL ANALYSIS

Conformation and configuration-conformational free energy-conformational analysis of mono substituted (alkyl, halogens) and 1,1-disubstituted (alkyl) and 1,2-1,3-and 1,4-dimethyl substituted cyclohexanes - compounds existing in boat form-conformation of cyclohexanone, decalin and perhydrophenanthrene-Curtin-Hammett principle- conformation and reactivity of acyclic and cyclic compounds (6membered).

UNIT III

REAGENTS IN ORGANIC SYNTHESIS

Gilman's reagent – LDA – DCC – 1,3 – dithane (umpolung synthesis) – Selenium dioxide. Fetizon's reagent – Dimethyldioxirane (DMDO) – Pyridinum chloro chromate (PCC) – Luche reagent – IBX - Lemieux – Von Rudloff reagent – Lemieux–Johnson reagent – Woodward and prevost hydroxylation. Merrifield resin – Vaskas catalyst.

UNIT IV

ORGANIC PHOTOCHEMISTRY

Introduction – Difference between Thermal and Photochemical reactions - Jablonskii diagrams - intersystem crossing - energy transfer process – Quantum efficiency -

Photosensitization – Geometry of excited states – Possible electron transitions in saturated ketones - Reactivity of electronically excited ketones - alpha cleavages or Norrish type-I and Norrish Type II cleavages - Paterno-Buchi reaction – Photo reduction – Photo addition – Photo oxidation - Barton reaction – Photo Fries rearrangement - cis-trans isomerisation – Photo chemistry of α , β unsaturated carbonyl compounds – Photochemistry of arenes – Photochemistry of vision - Di- π methane rearrangement.

UNIT V

PERICYCLIC REACTIONS

Atomic and molecular orbitals - Woodward-Hoffmann rules, FMO and correlation diagram approaches:

Electrocyclic reaction: Concepts of con and dis rotatory motions for 4n and 4n+2system – Cyclisation of butadiene and 1,3,5-hexatrienes - Stereochemical course of electrocyclic reaction in terms of conservation of orbital symmetry.

Cycloaddiation: suprafacial and antarafacial, [2+2] and [4+2] cyclo addition reactions - Dimerisation of ethylene and Diels-Alder reaction.

Sigmatropic rearrangements: Sigmatropic migration of hydrogen and carbon - (1,3) and (1,5) shifts. (3,3) shift – Claisen, Cope and Aza-Cope rearrangements – Fluxional tautomerism.

PRESCRIBED BOOKS

- 1. I.L. Finar, Organic Chemistry, Vol I, 6th edn, Pearson Education, 2002.
- 2. P.S. Kalsi, Stereochemistry: Conformation and Mechanism, 9th edn, New Age International Private Limited, 2017.

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- 3. D. Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, Fourth edition, New Academic Science Publisher, 2012.
- 4. G.L. David Krupadanam, Fundamentals of Asymmetric Synthesis, University Press (India) Private Ltd. 2013.
- 5. B.P.Mundy, M.G.Ellerd, F.G.Favaloro, Name Reactions and Reagents in Organic Synthesis, 2nd Ed., 2005.
- 6. Dr Jagdamba Singh & Dr. L.D.S Yadav, Orgnic Synthesis: Design, Reagents, Reactions and Rearrngements, A Pragati Second Revised Edition, 2007.
- 7. Raj K. Bansal, Organic Reaction mechanisms, Tata Mc Graw Hill, Third Editon, 2007.
- 8. Gurdeep R. Chatwal, Reaction mechanism and Reagents in organic chemistry, Himalaya publishing House, Bombay 1992.
- 9. Sanyal and Sanyal, Reactions, Rearrangements and Reagents, 4th edn, Bharati Bhawan Publishers and Distributors, 2003.
- 10. S.M. Mukherjee and S.P. Singh, Reaction Mechanism in Organic Chemistry, Trinity Press, 2014.
- 11. J. Singh, Photochemistry and Pericyclic Reactions, Third edition, New Age International Publishers, 2012.
- 12. S. Sankararaman, Pericyclic Reactions Applications and Theory, Wiley VCH, 2005.

- 1. E.L. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2013.
- 2. R. Noyori, Asymmetric Catalysis in Organic Synthesis, John Wiley & Sons 1994.
- 3. W. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, Fourth edition, Cambridge University Press, 2015.
- 4. F.A. Carey and J. Sundberg, Advanced Organic Chemistry, Part B: Reaction and Synthesis, Fifth edition, Springer, 2007.
- 5. I. Fleming, Pericyclic Reactions, Second edition, Oxford University Press, Oxford, 2015.
- 6. N.J. Turro, J.C. Scaiano, and V. Ramamurthy, Modern Molecular Photochemistry of Organic Molecules, University Science Books, 2010.



COORDINATION COMPOUNDS AND SOLID STATE CHEMISTRY

Objectives:

- To know the nature of metal-ligand bond and to study various theories of bonding in coordination compounds.
- To study the stability, chemical reactions and magnetic properties of coordination compounds.
- To study the crystal structures, defects in solid crystals, band theory of solids and super conductors.

UNIT I

CRYSTAL FIELD THEORY

Basic concepts - Splitting of d - orbitals in Oh, Td, Tetragonal distortions and square planar symmetries – Crystal field stabilization energy [CFSE] in Oh and Td complexes – Factors affecting CFSE – Applications of CFSE - Jahn-Teller distortion - Static and dynamic Jahn Teller effect. – Limitations of CFT.

MOT: Ligand Field theory - sigma and pi bonding in Oh complexes – MO of Td and square planar complexes - Application of MOT to explain spectrochemical series.

UNIT II

STABILITY AND REACTIONS OF COORDINATION COMPOUNDS

Stability of complexes - Thermodynamic and kinetic stabilities - stepwise and overall stability constants of the metal complexes - factors affecting stability - chelate and template effects – Template Synthesis. Determination of stability constants: Bjerrum's method, spectrophotometric method, continuous variation (Job's) method.

Reactions of complexes: Lability – inertness - Ligand substitution reactions of square planar complexes - Trans effect and trans influence - Theories of trans effect - use of trans effect in synthesis of complexes - Substitution reactions in octahedral complexes - acid hydrolysis, base hydrolysis and anation reactions – Racemization and isomerisation reactions - Electron transfer reactions - Inner sphere and outer sphere processes - complementary and non-complementary reactions-Electron transfer reactions in mixed valence complexes.

UNIT III

MAGNETIC PROPERTIES OF METAL COMPLEXES

Magnetic Susceptibility – Types of Magnetic behaviours – Magnetically diluted and concentrated materials – Determination of magnetic susceptibility: Guoy Balance and Faraday methods – temperature dependence of magnetic susceptibility – Quenching of orbital contribution and effect of Spin –orbit coupling to magnetic moment – Spin – state cross over –Magnetic properties of complexes with A, E and T terms; Magnetic properties of Lanthanides and Actinides – Comparison of magnetic properties of Oh, Td and square planar complexes of Fe(II), Co(II), Ni(II) and Cu(II).

UNIT IV

SOLID STATE – I

Efficiency of Packing in crystals – Limiting radius ratio – Description of crystal structures - calcite, zinc blende, wurtzite, rutile, fluorite, antifluorite, CsCl, CdI₂, K₂NiF₄ - spinels and perovskite. Crystal defects in solids - line and plane defects - Point defects:



Schottky and Frenkel defects - Non-stoichiometric defects - Colour centres. Determination of crystal structures – Powder method and Rotating Crystal method.

UNIT V – SOLID STATE – II

Free electron and Band Theory – Types of Solids: Conductors and insulators – intrinsic and extrinsic semi conductors – p-n and n-p-n junctions. Optical and electrical properties of Semiconductors: Photo voltaic effect – Hall effect. Super conductivity - high temperature super conductors - BCS theory - Cooper electrons - Meissener effect and levitation.

PRESCRIBED BOOKS

- 1. James E. Huheey, Ellen A. Keiter and Richard L. Keiter, Inorganic chemistry: principles Structure and Reactivity, 4th Edition, Pearson education, 2006.
- 2. J.D. Lee, Concise Inorganic Chemistry, Wiley, 5th edition, 2014.
- 3. Wahid U. Malik , G.D. Tuli and R.D. Madhan, Selected Topics in Inorganic Chemistry, S. Chand & Company Ltd, New Delhi , 2009.
- 4. Anthony R. West, Solid State Chemistry and its Application, Wiley, 2nd Edition, 2014.
- 5. P.Atkins , T.Overton , J.Rourke , M.Weller and F.Armstrong , Inorganic Chemistry , 5th edition , Oxford University press, 2010.
- 6. L.V. Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Ltd., India, 1992.
- 7. H.V. Keer, Principles of the Solid State, Wiley Eastern Ltd., 1993.
- 8. D.K. Chakrabarthy, Solid State Chemistry, New Age Publisheres, 1996.
- 9. D. Bannerjee, Coordination Chemistry, Tata McGraw Hill, 1993.

- 1. F. Albert Cotton, Geoffrey Wilkinson, Carlos A. Marilo and Manfred Bochman, Advanced Inorganic Chemistry, Wiley Interscience Publication, 6th Edition, 2008.
- 2. K.F. Purcell and J.C. Kotz , Inorganic Chemistry , Cengage Learning , 2012.
- 3. C.E. Housecraft and A.G.Sharpe, Inorganic Chemistry, 4th edition, Pearson, 2012.
- 4. M.C. Day Jr and J. Selbin , Theoretical Inorganic Chemistry , Literary Licensing, LLC, 2012.
- 5. S.F.A. Kettle, Physical Inorganic Chemistry A Coordination Chemistry Approach, Springer-Verlag, 1996.
- 6. R.Gopalan and V.Ramalingam, Concise Coordination Chemistry, Vikas Publishing House (p) Ltd, New Delhi, 2003.
- 7. G. Chatwal and M.S. Yadu, Coordination Chemistry, 1st edition, Himalaya publishing House, 1992.
- 8. C. Kittel, Introduction to Solid State Physics, Wiley Eastern Ltd., 5th Edition, 1993.
- 9. D.M. Adams, Inorganic Solids: an Introduction to Concepts in Solid state structural Chemistry, Wiley, 1974.



ELECTROCHEMISTRY AND SPECTROSCOPY - II

Objectives:

- To understand the concepts of Electrochemistry.
- To analyze the applications of Electrochemistry.
- To know quantization of energy and the interaction of electromagnetic radiation with matter.
- To learn the fundamentals of molecular spectroscopy.
- To know the application of spectroscopy to study the structure of molecules.

UNIT I

ELECTROCHEMISTRY - I

The nature of electrolytes - ion-ion and ion-solvent interactions. Mean ion activity -The Debye-Huckel equation – Bjerrum equation - Conductivity - transport numbers - Nernst Einstein equation - Stork Einstein equation - Debye-Huckel Onsager equation - Conductivity at high frequency and at high field strength. Double layer-polarized and non-polarized electrodes - Lippmann equation - Models for doublelayer - Helmholtz, Guoy&Chapmann – Stern models - Zeta potential - Electro-kinetic phenomena – Electro-osmosis. Streaming potential - electrophoresis.

UNIT II

ELECTROCHEMISTRY - II

Electrode potential - Types of potential generation - Nernst equation - Hydrogen scale - other reference electrodes - concentration cells - Liquid junction potential - membrane equilibria. Butler-Volmer equation - Tafel equation - electrolysis \Box overvoltage - Theories of hydrogen overvoltage - Application of EMF measurements & conductivity. Batteries - fuel cells - corrosion. Zero current potentiometry - constant current potentiometry. Polarography – pulse polarography - Differential pulse polarography - Stripping voltammetry. Cyclic voltammetry - electrogravimetry - colorimetric methods.

UNIT III

ELECTRONIC SPECTROSCOPY

Electronic spectra of molecules: Born-Oppenheimer approximation, Franck-Condon Principle, selection rules, intensity of electronic transition, vibronic coupling, types of electronic transitions. Chemical analysis by electronic spectroscopy: assignment of electronic transitions, application to the study of organic compounds.

Emission spectroscopy: fate of electronically excited molecules-dissociation, reemission, fluorescence, phosphorescence; emission spectra of molecules.

Lasers: Nature of stimulated emission - coherence and monochromaticity, population inversion, cavity and mode characteristics, Q-switching, mode locking; types of lasers - solid-state, gas, chemical, and dye lasers.

Photoelectron spectroscopy (PES): Principle and technique of PES, ultraviolet PES, X-ray PES and Auger electronic spectroscopy.



MAGNETIC RESONANCE SPECTROSCOPY (NMR AND EPR)

Theory of NMR spectroscopy: Nuclear spin and magnetic nuclei, nuclear magnetic moment, behavior of a bar magnet in a magnetic field, the NMR transition, the Bloch equations, relaxation mechanisms. Parameters of NMR: measuring the chemical shift, shielding and deshielding of magnetic nucleus, chemical shifts in aliphatic and aromatic compounds, factors affecting chemical shift - inductive effect, anisotropy of chemical bonds, hydrogen bond, temperature, solvent. Spin-spin splitting: effect of spin-spin splitting on the spectrum, mechanism of spin. Spin splitting, chemical exchange, coupling constants; application of spin-spin splitting to structure determination - germinal and vicinal long-range coupling; factors influencing geminal and vicinal coupling. FT NMR spectroscopy: principle of FT NMR-FIDs, Fourier transformation; ¹³C, ¹⁹F, ³¹P NMR - range of chemical shift values, **Electron paramagnetic resonance (EPR) spectroscopy**: Theory of EPR spectroscopy, presentation of the spectrum, nuclear hyperfine splitting in isotropic systems. EPR spectra of anisotropic systems: anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, EPR spectra of triplet states and zero field splitting.

UNIT V

NQR AND MOSSBAUER SPECTROSCOPY AND MASS SPECTROMETRY

Principle of NQR spectroscopy: Nuclear charge distribution and quadrupole moment, quadrupole nucleus and its interaction with electric field gradient, nuclear orientations, the asymmetry parameter , quadrupole transitions in spherical and axially symmetric fields, quadrupole energy levels, field gradient. NQR spectra: effect of magnetic field on the spectra, relationship between electric field gradient and molecular structure.

Principle of Mössbauer spectroscopy: Doppler shift, recoil energy, experimental technique- sources, absorber, calibration.Mössbauer spectra: isomer shift, quadrupole splitting, magnetic hyper fine interaction, chemical applications- isomer shift and quadrupole splitting in iron complexes.

Mass spectrometry: Ion production-electron impact and chemical ionization, field desorption, FAB, electrospray ionization, Determination of molecular formula: molecular ion and isotope peaks, fragmentation, rearrangements; mass spectra of different classes of organic compounds.

PRESCRIBED BOOKS

- 1. S. Glasstone, An Introduction to Electrochemistry, East-West Press Pvt. Ltd., 2006.
- 2. J.O.M. Bockris and A.K.N. Reddy, "Modern Electrochemistry" vol.1, 2A & 2B, Plenum Press, Springer US, 2007.
- 3. D.R. Crow, Principles and applications of electrochemistry, 4th Edition, CRC Press, 1994.
- 4. K.V. Raman, R. Gopalan and P. S. Raghavan, Molecular Spectroscopy, Thomson and Vijay Nicole, Singapore, 2004.
- 5. C.N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, McGraw Hill Education, 2016.
- 6. D.H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 6th Edition, Tata McGraw Hill, 2011.
- 7. R.M. Silverstein and F. X. Webster, Spectroscopic Identification of Organic Compounds, 7thEdition, John Wiley & Sons, 2005.



- 1. P. Atkins and J.D. Paula, Atkins' Physical Chemistry, 9th Edition, Oxford University Press.2009.
- 2. I.N. Levine, Molecular Spectroscopy, John Wiley & Sons, New York, 1975.
- 3. A.U. Rahman, Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York, 1986.
- 4. D.L. Andrews, Lasers in Chemistry, 3rdEdition, Springer-Verlag, 1997.
- 5. R.S. Drago, Physical Methods in Chemistry; Saunders: Philadelphia, 1977.
- J.A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Elementary Theory and Practical Applications, Wiley Interscience, 1994.
- 7. B.P. Straughan and S.Walker. Spectroscopy, Volume-3, Chapman & Hall, 1976.





ELECTIVE - II 2.1 NANOSCIENCE AND NANOTECHNOLOGY

Objectives:

- To study structure, properties and synthetic methods of nanomaterials.
- To understand nano composites and carbon nanostructures.
- To learn nano medicines, nano robots and dendrimers.

UNIT I

NANOSTRUCTURE AND NANOMATERIALS

Definition and terminology of Nano particles and Nano structural materials - crystalline and amorphous materials – surface energy – surface area to volume ratio – surface relaxation – Types of nanostructured materials - One dimensional (thin films, layers, coatings), Two dimensional (Nanotubes, Nanofibers, Nanowires) and Three dimensional nanostructured materials (Nano particles, Nano shells, Nano rings),-properties of nanomaterials - Mechanical properties, Optical properties, Magnetic properties, electrical conductivity – electronic properties – Engineered nanomaterials - Quantum dots, Buckyballs/nanotubes, Metal oxides, Nano capsules.

UNIT II

SYNTHETIC METHODS OF NANOMATERIALS

Top-down and bottom-up approaches– nucleation and growth -homogeneous nucleation and heterogeneous nucleation-Synthesis of Nano particles by Physicalmethods-Mechanical milling, Physical vapor deposition, Laser ablation, Sputter deposition, Photo lithography– Chemical reductionmethod -Reduction of metal ions by Citrate and borohydride- capping agents-role of capping agents, Polyol synthesis - Biological methods - green synthesis – Viral nanotechnology.

UNIT III

NANO COMPOSITES

Nanocomposites - Polymer-based Nanocomposites - Polyamide/clay Nano composites - Synthesis, characterization and properties of Nylon 6 - clay hybrid - Polystyrene/clay Nanocomposites - syndiotactic polystyrene/clay Nano composites, properties. Poly(butylenes terephthalate) (PBT) based nano composites. Bio-Nanocomposites - properties and applications.

UNIT IV

CARBON NANOSTRUCTURES AND FUNCTIONALIZATION

Carbon nanotube (CNT) and its Applications: Carbon nanotube (CNT), structure of CNT, synthesis and functionalization of CNT, electronic, vibrational, mechanical and optical properties of CNT, applications of CNT and Fullerenes.

Graphene: Graphene, structure of Graphene, synthesis and functionalization of Graphene, electronic application of Graphene, Electrochemical deposition, Graphene Oxide and its application.

UNIT V

BIOMEDICAL NANOTECHNOLOGY

Nanomedicines - Diagnosis of diseases, treating and preventing of diseases – targeted drug delivery systems – Tissue Engineering - scaffolds for tissue fabrications –

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materials for scaffolds – materials for hydrogel scaffolds - Medical Devices - Imaging, implantable sensors, cell specific gene therapy – nano robots and their bio-medical applications. Dendrimers - structural description and its biomedical applications.

PRESCRIBED BOOKS

- 1. C.N.R. Rao, A. Muller and A.K. Cheetham, The Chemistry of Nanomaterials Synthesis, properties and Application, Wiley – VCH – verlog GMOH & Co., Wilhelm, 2004.
- 2. C.P.Poole Jr., and F.J. Owens, Introduction to Nanotechnology, John Wiley &Sons, 2006.
- 3. Rajendra Kumar Goyal, Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques, and Applications, First edition, CRC Press, 2018.
- 4. Joseph Koo, Polymer Nanocomposites, First Edition, McGraw-Hill, 2006.
- 5. Ahmet Gürses, Introduction to Polymer–Clay Nanocomposites, CRC Press, 2016.
- 6. Edited by Vinod Labhasetwar and Diandra L.Leslie-Pelecky, Biomedical Applications of Nanotechnology, John Wiley & Sons, 2007.
- 7. Editor Stergios Logothetidis, Nanomedicine and Nanobiotechnology, Springer, 2012.

- 1. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao, Introduction to Nanoscience, CRC Press, Taylor & Francis Group, 2008.
- 2. Guozhong, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press, 2004.
- 3. Edited by Vikas Mittal, Synthesis Techniques for Polymer Nanocomposites, Wiley-VCH, 2015.
- 4. Sati N. Bhattacharya, Musa R. Kamal and Rahul K. Gupta, Polymeric Nanocomposites -Theory and Practice Hanser Gardner Publications, 2008.
- 5. Yury Gogotsi, Carbon Nanomaterials, CRC Press, First Edition, 2006.
- 6. Daniel Alfonso Melendrez Armada, John Edward Proctor and Aravind Vijayaraghavan, An Introduction to graphene and carbon nanotubes, CRC Press, 2016.
- 7. K. Tanaka and S. Iijima, Carbon Nanotubes and Graphene, Elsevier, Second Edition, 2014.
- 8. Editor M. Reza Mozafari, Nanomaterials and Nanosystems for Biomedical Application, Springer, 2007.
- 9. Editor Ajay Kumar Mishra, Nanomedicine for Drug Delivery and Therapeutics, John Wiley & Sons, 2013.



MEDICINAL CHEMISTRY

Objectives:

- To introduce the mechanism of drug action, drug delivery systems and molecular docking.
- To learn drug design and drug synthesis.
- To learn various types of drugs and their mode of action.

UNIT I

GENERAL ASPECTS OF MEDICINAL CHEMISTRY

Medicinal chemistry - Definition and major processes involved in drug action – pharmacokinetics - Definition and elementary aspects of ADME – Pharmacodynamics – Definition - receptors and their structures - agonist and antagonist - concept of bioisosterism - prodrugs and soft drugs. Drug delivery systems - Definition and types - Carrier based drug delivery system, Transdermal drug delivery system, Mucoadhesive drug delivery system. Molecular docking - Definition and types - Rigid docking (Lock and Key), Flexible docking (Induced fit).

UNIT II: DRUG DESIGN

Development of new drugs - Lead identification and optimization - Structure and Ligand based drug design - Structure Activity Relationship (SAR) of morphine and Penicillin - Physico – chemical parameters, Lipophilicity, partition coefficient, electronic ionization constants - Quantitative Structure Activity Relationship. Free – Wilson analysis, Hansch analysis, relationships between Free– Wilson and Hansch analysis – case study. Elementary treatment of Drug receptor interactions.

UNIT III

ANTISEPTICS, ANTIBIOTICS AND CELL MEMBRANE

Structure and function of bacterial cell wall, Gram-positive and Gram-negative bacteria, comparison of bacterial and fungal cell wall - Microbe killers: Antiseptics and Disinfectants - Definition and mode of action. Antibiotics - Definition, classification and uses - Structure and mode of action of Bacitracin, Fosfomycin, Isoniazid, Ethambutol, β -Lactam antibiotics - Synthesis of penicillin G, ampicillin, amoxicillin, Cephalosporin. Mutations and origins of drug-resistance.

UNIT IV

DRUG SYNTHESIS

Definition, synthesis and mode of action of following classes (i) Anxiolytics – Benzodiazepines (ii) Neuroleptics – Phenothiazines (iii) Hypnotics and Sedatives – Piperidinediones (iv) Local anesthetics – Aminobenzoic acid and its derivatives (v) Anti – coagulants – 1,3 – Indandione derivatives (vi) Hypoglycemic agents – Sulfonyl ureas (vii). Antihistaminic agents – Ethylenediamine derivatives (viii) Antimalarials – Aminoquinolines (ix) Analgesics and Antipyretics – Paracetamol, Phenylbutazone. (x) Anti – inflammatory – Diclofenac.

UNIT V -

ANTINEOPLASTIC AGENTS AND CARDIOVASCULAR DRUGS

Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of



alkylating agents and antimetabolites in treatment of cancer - Introduction of carcinolytic antibiotics and mitotic inhibitors - Synthesis of mechlorethamine, cyclophosphamide, melphalan, and uracil - Recent development in cancer chemotherapy.

Cardiovascular Drugs: Introduction and classification, cardiovascular diseases - Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol.

PRESCRIBED BOOKS

- 1. Ashutosh Kar, Medicinal Chemistry, New Age International Ltd, fourth edition, 2007.
- 2. Graham L. Patrick, An Introduction to Medicinal Chemistry, Oxford University Press, fifth edition, 2013.
- 3. Gareth Thomas, Fundamentals of Medicinal chemistry, Wiley-Blackwell, First Edition, 2003.
- 4. D. Sriram and P. Yogeeswari, Medicinal Chemistry, Pearson India, second edition, 2010.
- 5. N. Weaver, Medicinal Chemistry, Oxford, 2006.
- 6. G.R. Chatwal, Medicinal Chemistry, Himalaya, New Delhi, 2002.
- 7. P. Graham, Instant Notes Medicinal Chemistry, Viva, New Delhi, 2002.

- 1. Thomas Lemke and David A. Williams, Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams & Wilkins Pulications, 2012.
- 2. John M. Beale and John H. Block, Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, Lippincott Williams & Wilkins Publications, 2010.
- 3. Ruben Vardanyan and Victor Hruby, Synthesis of Essential Drugs, 1st edition Elsevier Science, 2006.
- 4. Richard B. Silverman, The Organic Chemistry of Drug Design and Drug Action, 2nd edition, Elsevier Academic Press, 2004.
- 5. Camille Georges Wermuth, David Aldous, Pierre Raboisson, and Didier Rognan, The Practice of Medicinal Chemistry, 4th edition, Elsevier Academic Press, 2015.
- 6. T. J. Franklin and G. A. Snow, Biochemistry and Molecular Biology of Antibacterial Drug Action, 5th edition, Springer Science, 1998.



INDUSTRIAL PROCESSES AND CATALYSIS

Objectives:

- To learn unit operations and reverse osmosis in industrial plants.
- To study catalyst and homogeneous and heterogeneous catalysis in industries.
- To understand the environmental impact of chemical industries.

UNIT I UNIT OPERATIONS

Concepts of unit operation and unit process. Basic Unit operation – batch and continuous, Distillation – azeotropic, steam and extractive distillation, Evaporation – single effect and multiple effect, Extraction – liquid-liquid and solid – liquid extractions, Crystallization – evaporative, cooling, precipitation and fractional crystallization. Size reduction and size separation – definition and objectives, factors affecting size reduction, Law governing Energy & Power requirements in comminution - size reduction equipment – ball mill, hammer mill and fluid energy mill.

UNIT II –

REVERSE OSMOSIS

Principle of Reverse Osmosis, dead - end filtration, cross – flow filtration, Industrial applications of reverse osmosis. Basic terms and definitions – recovery, rejection, flux, concentration polarization, beta, fouling, scaling, silt density index, modified fouling index, langelier saturation index. Membrane types and function – cellulose acetate membranes, polyamide and composite membranes. Membrane modules – plate and frame modules, tubular modules, spiral wound modules. Pretreatment of water – mechanical and chemical pretreatments.

UNIT III -

CATALYST AND CATALYSIS

Catalyst – general features and industrial applications, Catalysis – homogeneous catalysis and its limitations, heterogeneous catalysis – general kinetic behavior - chemisorption and active sites - physical form and preparation of bulk and supported catalysts – catalytic deactivation and reusability – advantages and operational modes of heterogeneous catalysis in industry.

UNIT IV -

CATALYSIS IN PETROCHEMICAL INDUSTRY

Overview of Petrochemical Industry and Refinery processes – importance of catalysis. Catalytic selectivity – mesoporous materials and shape selectivity – zeolites and zeotypes –zeolites in petrochemistry and refining – shape selective catalysis by zeolites – shape selectivity in conversion of methanol to hydrocarbon – shape selectivity in hydrocracking – shape selectivity in carbonylation.

UNIT V

ENVIRONMENTAL IMPACT OF CHEMICAL INDUSTRIES

Environment and human interactions, Sources of Pollution – Atmospheric pollution, Aquatic pollution, land pollution, Control and treatment of pollution and wastes from industry – Control of atmospheric discharges, control of aquatic discharges, disposal

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of solid wastes from industrial sites. Hazards of the chemical industry – chemical exposure and toxicity – control techniques used in chemical plants.

PRESCRIBED BOOKS

- 1. Alan Heaton, An Introduction to Industrial Chemistry, Springer, Third Edition, 1996.
- 2. M. Gopala Rao and Marshall Sittig, Dryden's Outlines of Chemical Technology, East West Press, Third Edition, 1997.
- 3. Jane Kucera, Reverse Osmosis: Design, processes and applications, Scrivener Publishing LLC and Wiley, Second Edition, 2015.
- 4. B.K Sharma, Industrial Chemistry, Goel Publishing House, Fifteenth Edition, 2006.

- 1. Editor James A. Kent, Handbook of Industrial Chemistry and Biotechnology, Vol 1 &2, Springer, Twelfth Edition, 2012.
- 2. Editors Lawrence K. Wang, Yung-Tse Hung, Howard H. Lo and Constantine Yapijakis, Waste Treatment in the Process Industries, CRC Press, First Edition, 2006.
- 3. Editors Adriano Zecchina, Silvia Bordiga and Elena Groppo, Selective Nanocatalysts and Nanoscience, Wiley VCH, 2011.
- 4. Editor John Regalbuto, Catalyst Preparation: Science and Engineering, CRC Press, 2007.



ORGANIC CHEMISTRY PRACTICAL - II

Objectives:

- To enable the students to develop analytical skill in organic quantitative analysis.
- To understand the techniques involved in the preparation of standard solutions, standardization and calculations in the estimations of compounds.
- To develop preparative skills in organic preparations.

Estimation, Single stage preparations and chromatographic techniques have been included as the practical components.

Microscale preparations are recommended for the simple reasons, as they are both economic-friendly and eco-friendly.

A. Estimation

- 1. Estimation of Ethyl Methyl ketone
- 2. Estimation of phenol
- 3. Estimation of aniline
- 4. Estimation of ascorbic acid in tablets

B. List of single stage preparations:

- 1. Preparation of 1,2,3,4 -tetrahydro carbazole from cyclohexanone.
- 2. Preparation of Resacetophenone from Resorcinol.
- 3. Preparation of p-benzoquinone from hydroquinone.
- 4. Preparation of Dibenzylidene acetone.
- 5. Preparation of anthraquinone from anthracene
- 6. Preparation of benzophenone oxime from benzophenone
- 7. Preparation of Benzilic acid from Benzil
- 8. Preparation of Bis-2- naphthol from 2-naphthol.
- 9. Prepartion of m-dinitrobenzene from Nitrobenzene.

Note: Each student is expected to submit both Crude and recrystallized samples of the preparation during their regular practical for evaluation at the time of practical examinations.

For Class work Only:

- 1. Isolation of carotene from carrot.
- 2. Isolation of casein from milk
- 3. Isolation of Citric acid from Citric fruits.

PRESCRIBED BOOKS

- 1. A.I. Vogel, Elementary Practical Organic Chemistry: Small Scale Preparations, Qualitative Organic Analysis, Quantitative Organic Analysis, Pearson Education, 2011.
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- 4. V. Venkateswaran, R. Veeraswamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, 2004.
- 5. V.K. Ahluwalia, and R. Aggarwal, Comprehensive Practical Organic Chemistry, Universities Press, 2004.



- 1. R.G. Engel, D.L. Pavia, G.M. Lampman and G.S. Kriz, A Microscale approach to Organic Laboratory, 5th edition, Paperback International Edition, 2012.
- 2. P.B. Cranwell, L.M. Harwood and C.J. Moody, Experimental Organic Chemistry, 3rd edn, Wiley-Blackwell, 2017.
- 3. J. Leonard, B. Lygo and G. Procter, Advanced Practical Organic Chemistry, 3rd edn, CRC Press, 2013.
- 4. Moore, Dalrympk and Rodig, Experimental methods in organic chemistry, 3rd edition, Saunders College publishing, The Oxford Press, 1982.



INORGANIC CHEMISTRY PRACTICAL - II

Objectives:

- To understand the principles and various analytical methods of quantitative analysis of cations present in a mixture.
- To improve the skill in quantitative estimation of metal ions by complexometric titration.
- To understand the preparation and analysis of coordination complexes.

A. Quantitative Analysis of Cations by Complexometric Method.

1. Estimation of Cu (II) in a solution containing Pb (II) or Ba (II) (Separation of Pb (II) or Ba(II) by Precipitation).

2. Estimation of Zn(II) in a solution containing Pb(II) or Ba(II) (Separation of Pb(II) or Ba(II) by precipitation).

3. Estimation of Mg(II) in a solution containing Pb(II) or Ba(II) (Separation of Pb(II) or Ba(II) by precipitation).

4. Estimation of Ca(II) in diet supplement pill.

5. Estimation of Pb and Sn in Solder alloy [Demasking by F-].

B. Preparation and Analysis of Inorganic Complexes by Volumetric Method

1. Preparation and analysis of potassium tris(oxalato)ferrate(III) trihydrate $K_3[Fe(C_2O4)_3].3H_2O$

2. Preparation and analysis of tris(thiourea)copper(I) sulphate dihydrate, $[Cu(tu)_3]_2SO_4.2H_2O$

3. Preparation, and analysis of potassium tris(oxalato)chromate(III) trihydrate $K_3[Cr(C_2O_4)_3].3H_2O$

C. Photo colorimetric analysis of Fe and Ni (Course work)

PRESCRIBED BOOKS

- 1. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, Revised 5th edition, ELBS, 1989.
- Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Brooks/Cole-Thomson Learning, USA, 2004.

- 1. I.M. Kolthoff and V.A. Stenger, Volumetric Analysis, 2nd Edition, Interscience Publishers, New York, 1947.
- 2. Mounir A. Malati, Experimental Inorganic/Physical Chemistry An Investigative, Integrated Approach to Practical Project Work, Woodhead Publishing Limited, Reprint, 2010.
- 3. W. G. Palmer, Experimental Inorganic Chemistry, Cambridge University Press, Reprint, 1970.
- 4. George Brauer, Handbook of Preparative Inorganic Chemistry, 2nd Edition, Academic Press, 1963.
- 5. Geoffrey Pass and Haydn Sutcliffe, Practical Inorganic Chemistry Preparations, reactions and instrumental methods, Springer, 1974.



PHYSICAL CHEMISTRY PRACTICAL - II

Objectives:

- To motivate the students to understand the principles of conductometric titrations and Distribution law.
- To understand the Principles and applications of Thermometry.

I. Conductometric experiments

- (a) Estimation of K_2SO_4 using B_aCl_2
- (b) Estimation of CH₃COOH and CH₃COOONa in a Buffer solution.

(c) Neutralization and Displacement reactions

- Standard: CH₃COONa, Link: HCl Estimation: NaOH + CH₃COONa
- (d) Determination of Dissociation constant of a weak acid.

II. Distribution law

(a) Distribution of Iodine between two immiscible solvents & Study of the equilibrium constant of the reaction $KI + I2 \rightarrow KI3$

(b) Distribution of benzoic acid between two immiscible solvents.

III. Thermometry Determination of Solution enthalpy of

- (i) Benzoic acid water
- (ii) Potassium dichromate water
- (iii) Potassium nitrate water

PRESCRIBED BOOKS

- 1. J. B.Yadav, Advanced Practical Physical chemistry, 20th Edn., GOEL publishing House, Krishna Pakashan Media Ltd., 2001.
- 2. B.C. Kosla, Senior Practical Physical Chemistry, Simla Printers, New Delhi, 1987.
- 3. Saroj Kumar and Naba Kumar, Physical Chemistry Practical, New Central Book Agency, 2012.

- 1. Findlay's Practical Physical Chemistry, Revised and edited by B.P. Levitt 9th Edn., Longman, London, 1985.
- 2. W.J. Popiel, Laboratory Manual of Physical Chemistry, ELBS, London, 1970.
- 3. G.W. Garland, J.W. Nibler and D.P. Shoemaker, Experiments in Physical Chemistry, 8th Edn. McGraw Hill, 2009.