Course No: CH24301CR
Title: Inorganic Chemistry- Selected topics (04 Credits)

Max. Marks: 100 | **Duration: 64 Contact hours**
Continuous Assessment: 20 marks | **End Term Exam: 80 Marks**

Course outcomes: After studying this course, the students will be able to

- To develop a comprehensive understanding of advanced bonding models in inorganic chemistry, with a focus on main group compounds, metal clusters, and metal hydride complexes.
- Correlate magnetic data to characterize the transition metal complexes for their unique properties.
- Understand working, requirements and scope of Mössbauer and NQR as characterization techniques
- To understand fundamental aspects of bonding in inorganic systems.
- To introduce students to the fundamental principles of inorganic photochemistry, focusing on the nature and behavior of excited states, photophysical and photochemical processes

Unit-I Bonding models in Inorganic Compounds (16 Contact hours)

Bonding in main group compounds: Classification and topology of Boron clusters, types of bonds, isolobal analogy, empirical rules for bonding in boron clusters, Selected examples of bonding in higher boranes; Carboranes and Metallacarboranes. Bonding in Boron–Nitrogen, Phosphorous–Nitrogen andSulphur-Nitrogen compounds ((Borazine, Cyclophosphazenes, phosphonitrillic halides, polythiazyls and Sulphur Nitrides) Bent's rule applications.

Bonding in Metal clusters and Polymetallates: Factors favoring metal–metal bond, bonding in di- andtrinuclear metal clusters, cotton rationale and quadruple bonding, selected examples of bondingindinuclear metal clusters and hetero-polymetallates.

Bonding in Metal Hydride Complexes: Hydride as ligand, Characterization & Chemical reactions, Classical and Non classical Hydrides: Bonding and significance of Kuba's type Dihydrogen complexes

Unit-II Magnetic and Electronic Properties of Transition Metal Complexes (16 Contact hours)

Magnetic interaction in dinuclear and polynuclear clusters (examples) magnetic susceptibility: determination, temperature dependence. Magnetic moment; spin-only formula; correlation of μs and μeff values; orbital contribution , magnetic properties with A, E and T ground terms, applications of magnetic moment data in evaluation of nature and complexation parameters. High spin-low spin crossover. Introduction to single molecule magnets (SMMs) and related applications, Magnetic properties of inner transition compounds. Importance of computational approaches in predicting the magnetic behavior of metal complexes. Hands-on training to data analysis: magneto-structural correlations and PHI software).

Types of electronic transitions in metal complexes, selection rules and their relaxation mechanisms; spectral terms of d^1 - d^{10} metal ions. Selected examples of d-d spectra. Orgel diagrams, Charge transfer spectra (Factors affecting energies of LMCT and MLCT transitions)

Unit-III Mossbauer and NQR Spectroscopy (16 Contact hours)

NQR Spectroscopy: NQR isotopes, nuclear quadruple moment; Electric field gradient; nuclear quadruple coupling constant; Axial Symmetry, Asymmetric EFG, Effect of applied magnetic field, Application of NQR.

Mossbauer Spectroscopy: Basic principles, Source considerations and requirements - Nuclear Recoil and Mossbauer Effect, sample considerations and requirements – f-fraction, rigid matrix and low temperature. Spectral parameters - as isomer shift, quadrupole splitting and magnetic splitting, spectrum display. Partial Isomer shift.

Applications of Mossbauer Spectroscopy: Determination of spin crossover temperatures and magnetic transition temperature. Study of - bonding and structure of Fe^{2+} and Fe^{3+} compounds, Sn^{2+} and Sn^{4+} compounds, nature of M—L bond, coordination number and structure, and detection of oxidation state and inequivalent MB atoms.

Unit-IV Inorganic Photochemistry-I (16 Contact hours)

Excited states: Excitation: d-d transition, charge transfer & intra-ligand transitions and selection rules. Excited states; term symbols, splitting of terms in ligand field, Orgel diagram; electrostatic description of spin allowed d-d transitions & energy level diagrams depicting excited states. Fate of excited states; energy dissipation by radiative and non-radiative processes. Jablonoski diagram. Photochemical laws & quantum yield. Kinetics & quantum yield of photophysical (radiative) and photo-chemical processes. Quantum Yields of a unimolecular and bimolecular photo-chemical reaction; Quenching and Stern-Volmer plots.
Chemical Actinometry, Time correlated Single photon counting technique, Flash Photolysis

Books Recommended:

1. Elements of Magnetochemistry; R. L. Dutta, A. Syamal; Affiliated East-West;1993.
2. Electronic Spectra of Transition Metal Complexes; D. Sutton; McGraw-Hill; 1968.
3. NMR, NQR, EPR, and Mossbauer Spectroscopy in Inorganic Chemistry; R. V. Parish; EllisHorwood; 1990.
4. Spectroscopy in Inorganic Chemistry; Vol I & II; Rao, Ferraro; Academic Press; 1970.
5. Physical Methods for Chemistry; 2nd edn.; R .S. Drago; Saunders; 1992.
6. Principles and Applications of Photochemistry, B. Wardle, John Wiley, 2009
7. Ligand Field Theory and Its Applications; B. A. Figgis and M. A. Hitchman; Wiley India,2000.
8. Reaction Mechanisms of Inorganic and Organometallic Systems; 2nd edn.;Jordon; Oxford; 1998.
9. Inorganic Chemistry; G. Wulfsberg; Viva Books, 2000.
10. Mechanism of Inorganic Reactions; Katakis, Gordon; Wiley; 1987.
11. Inorganic Chemistry, Principles of structure and reactivity; 4th edn; J. E. Huheey,E. A. Keiter and R. L.Keiter. Pearson Education Inc.2003
12. Mechanism of Inorganic Reactions, 2nd edn, Basalo, Pearson; WileyEastern, 1997.
13. Fundamentals of Photochemistry; C Rohatgi, Mukhergi; Wiley Eastern.; 1992.

14. G. J. Ferraudi, Elements of Inorganic photochemistry, John Willey and Sons (1988).
15. O. Horvath and K. L. Stevenson, Charge Transfer Photochemistry of Coordination compounds, VCH publishers Inc. (1993).
16. D. M. Roundhill, Photochemistry and photophysics of metal complexes, Plenum Press, New York and London (1994).
17. V. Balazani and V. Carassiti, Photochemistry of coordination compounds, Academic Press, London (1970).
18. Photochemistry and Photophysics of Metal Complexes D. M. Roundhill, 1st edition 1994, Springer Science ISBN 978-1-4899-1497-2 ISBN 978-1-4899-1495-8 (eBook)
19. Biomedical Applications of Inorganic Photochemistry, Peter C. Ford, Rudi van Eldik 1st Edition, Volume 80 – 2022 , Academic Press Hardback ISBN: 9780323991711

Course No: CH24302CR
Title: Organic Chemistry (04 Credits)

Max. Marks: 100 **Duration: 64 Contact hours**
Continuous Assessment: 20 marks **End Term Exam: 80 Marks**

Course outcomes: On completion of the course, the student should be able to:

- Understand the fundamental principles and practical applications of spectroscopic techniques such as FTIR, Mass Spectrometry, UV-Vis and NMR for the structural elucidation of organic compounds.
- Interpret spectral data to identify and characterize organic molecules.
- Elucidate the structure of organic compounds using combined (UV, IR, Mass and NMR) spectroscopic methods.
- To understand the usefulness of metal catalyzed reactions and stereochemical control for the synthesis of complex organic molecules.

Unit-I: Ultraviolet Spectroscopy, Infrared Spectroscopy & Mass Spectrometry (16 Contact hours)

Ultra-Violet Spectroscopy: Electronic transitions in organic molecules, Woodward Fieser rules for calculation of λ_{max} of organic compounds.
Infrared spectroscopy: The Infrared spectrum, The functional group and fingerprint regions, Characteristic IR absorption bands, Intensity and position of absorption bands. Structural features that affect vibrational frequency. Application of IR spectroscopy in structural elucidation of organic compounds.
Mass spectrometry: Instrumentation, Determination of molecular formula, Role of Isotopes, Nitrogen Rule. Fragmentation pattern like Stevenson rule, initial ionization event, α-cleavage, inductive cleavage, two bond cleavage, Retro-Diels Alder cleavage, Mc-Laffertey Rearrangements. Fragmentation pattern of alkanes, alkenes, alcohols, phenols, aldehydes, ketones, Carboxylic acids, Amines.

Unit-II: Proton NMR Spectroscopy (16 Contact hours)

Basic concepts, Mechanism of Measurements, Chemical shift values for various classes of compounds. Fourier Transform (FT): techniques and advantages. One bond coupling, two bond coupling, three bond coupling, second order spectra and Popple notations (A_2, AB, AX, AB_2, ABX, AX_2, A_2B_2). Proton exchange, deuterium exchange, Peak broadening exchange. Nuclear Overhauser Effect (NOE). Applications of 1H NMR in structural elucidation of simple and complex compounds.

Unit-III: Carbon-13 NMR spectroscopy (16 Contact hours)

Carbon 13-chemical shifts, proton coupled and decoupled spectra. Off-Resonance De-coupling. DEPT-45, DEPT-90, DEPT-135. NOE signal enhancement. Applications of ^{13}C-NMR in structural elucidation of simple and complex compounds.

Structure elucidation of organic compounds using combined spectroscopic methods (UV, IR, Mass and NMR).

Unit-IV: Methods in Organic Synthesis-I **(16 Contact hours)**

Stereoselectivity: Stereochemical control in six-membered rings, Stereoselectivity in bicyclic compounds (Norbornane, Camphor, Norbornene derivatives). Stereoselective reactions of acyclic alkenes. Stereochemical reactions near a stereocenter.

Methods of multiple bond formations: Carbon-Carbon and carbon heteroatom (N and O) bond formations with special emphasis on Metal catalysed bond formations (Ullmann, Buchwald-Hartwig, Sonogashira, Heck, Suzuki and Stille reactions).

Books Recommended:

1. March's Advanced Organic Chemistry Reactions, Mechanism and Structure, 6th Ed., Smith, M.B. (Wiley-2014)
2. Organic Chemistry 8th Ed. - F. A. Carey and Robert M. Giuliano (McGraw Hill-2012).
3. Reaction Mechanism in Organic Chemistry RevisedEd., S.M. Mukherjee and S.P. Singh. (Macmillan- 2017).
4. Organic Chemistry - 2nd Ed., J. Hornback. (Brooks/Cole- 2006).
5. Organic Chemistry, 5th Ed., John McMurry. (Brooks/Cole-2000).
6. Advanced Organic Chemistry, 5th Ed., F.A Carey & R.J Sundberg (Springer-2007).
7. Organic Chemistry, 2nd Ed., Jonathan Clayden (OUP-2016).
8. Organic Chemistry, 11th Ed., Solomons, T.W.G., (Wiley-2015).
9. Organic chemistry, Morrison, Boyd and Bhattacharya. 7th Ed. Pearson-2013.
10. Stereochemistry of Organic Compounds 2nd Ed., D. Nasipuri. (New Age Inter.- 2008)
11. Stereochemistry of Carbon Compounds - E.L.Eliel. (TMH -2007)
12. Stereochemistry of Organic Compounds 7th Ed. - P.S. Kalsi. (New Age Inter.- 2012).

Course No: CH24303CR
Title: Physical Chemistry (04 Credits)

Max. Marks: 100 | **Duration: 64 Contact hours**
Continuous Assessment: 20 marks | **End Term Exam: 80 Marks**

Course outcomes: After learning the contents of this course, the students shall:

- learn quantum mechanical reason of the aromaticity and hybridization process in molecules.
- get acquainted with the multielectron wavefunction and evaluation of energy by using approximation methods in the multielectron systems.
- be familiar with the types of surfactants, their aggregation behavior and structure of aggregates.
- be familiar with the applications of the surfactant systems in industries, catalysis, environment and pharmaceuticals.
- learn how solvents influence the thermodynamic and transport properties of electrolyte solutions
- learn how different theories can be used for the quantification of thermodynamic and transport properties of electrolyte solutions
- have a know-how of the structural/electrical aspects of electrode/electrolyte interfaces and their impact over the thermodynamics and kinetics of charge transfer reactions across these interface
- learn about the basic mechanism underlying corrosion, factors affecting the rate of corrosion and different approaches for monitoring and control of corrosion of metals

Unit-I Quantum Chemistry (16 Contact hours)

Chemical Bonding: Hybridization of orbitals (sp, sp^2&sp^3). Huckel's Pi-MO theory: Application to linear and cyclic polyenes. Pi-electron charge and bond-order. Alternant hydrocarbons, Naphthalene, heteroatomic conjugated systems. Limitations of Huckel theory. Extended Huckel Method.

Self-consistent field method: Hamiltonian operator and wave function for multi-electron systems. Electronic Hamiltonian, antisymmetrized wave function, Slater determinant. Hartree and Hartree-Fockself consistent field method. Application of HatreeFock SCF method to He- atom.

Unit-II Self-Assembly of Surfactants and its applications (16 Contact hours)

Classification of Surfactants, Solubility of Surfactants: Kraft temperature and cloud point, Micellization of surfactants: critical micelle concentration (cmc), aggregation number, counterion binding, factors affecting cmc in aqueous media. Thermodynamics of micellization: pseudophase model and mass action models. Structure and shape of micelles: geometrical consideration of chain packing, variation of micellar size and shape transitions with surfactant concentration and temperature.

Micellar solubilization: Solubilization of hydrophobic molecules in micelles, factors affecting micellar solubilization: nature of solubilizate and surfactant, effect of additive and temperature. Its applications in environmental remediation, drug delivery and oil recovery processes.

Unit-III Ionics **(16 Contact hours)**

Ion solvent Interactions: Nonstructural (Born) treatment and an introduction to structural (Ion-dipole, Ion-quadruple) treatments of ion-solvent interactions.

Ion-Ion Interactions: Activity and activity co-efficient. Debye-Huckel theory of activity coefficients of electrolyte solutions; derivation of Debye-Huckel limiting law, validity and extension to high concentrations; ion-pair formation-Bjerrum model.

Conductance of electrolyte solutions: Mobility of ions and conductivity, Einstein relations, dependence of molar conductance on concentration, estimation of K and Λ_0 for weak electrolytes, Theories of Conductance: Debye-Huckel-Onsager conductance equation and brief idea of its extension.

Unit-IV Electrodics **(16 Contact hours)**

Electrified Interface: Metal-electrolyte electrified interface, concept of surface excess, thermodynamics of electrified interface, Lippman equation, electrocapillary curves. Methods for determination of surface excess.

Structural models of metal-electrolyte interface: Helmholtz-Perrin, Gouy-Chapman and Stern models, Structure of semiconductor/electrolyte interface.

Theories of Heterogeneous Electron Transfer: Electron transfer at electrified interface at and away from equilibrium. Butler-Volmer equation, low and high field approximations, significance of transfer coefficient, Marcus theory of charge transfer; basics and predictions.

Electrodics of Corrosion: Corrosion, types and mechanism of corrosion, corrosion current, corrosion potential, Electrodics of corrosion in absence of Oxide films, Corrosion and Evans diagrams, Monitoring and inhibition of corrosion; Cathodic and anodic protection, Passivation

Books Recommended:

1. Physical Chemistry –P. W. Atkins, 9th Edition, ELBS , Oxford, 2009.
2. Physical Chemistry- A Molecular Approach - D. A. McQuarie& J. D. Simon, University Science Books, 1997.
3. Introduction to Quantum chemistry - A. K. Chandra, TataMcGraw Hill, 1997.
4. Quantum Chemistry - Ira. N. Levine, 7th Edition, Pearson, 2009.
5. Quantum Chemistry, R. K. Prasad, 2nd Edition, New Age Publishers, 2001.
6. Molecular Thermodynamics of Electrolyte Solutions, Lioyd L Lee, World Scientific, 2008.
7. An Introduction to Aqueous Electrolyte Solutions, Margaret Robson Wright, Wiley, 2007.
8. Modern Electrochemistry 1, 2A, 2B 2nd Edition, J. O`M. Bokris and A. K. Reddy, Kluwer Academic/Plenum Publishers, New York.
9. Electrochemical methods, Fundamentals and Methods, A.J. Bard, L.R. Faulkner, Wiley,1980.
10. Physical Electrochemistry- Fundamentals, Techniques and Applications, Eliezer Gileadi, Wiley-VCH 2011.
11. Electrochemistry, 2nd Edition, Carl H. Hamann, Andrew Hammett, Wolf Vielstich, WileyVCH.

Course No: CH24304CR
Title: Non-Equilibrium Thermodynamics (02 Credits)

Max. Marks: 50 | **Duration: 32 Contact hours**
Continuous Assessment: 10 marks | **End Term Exam: 40 Marks**

Course outcomes: After studying this course, the students will be able

- understand the concept of entropy production and learn how the extent of entropy production associated with different processes can be estimated
- learn about Onsager' formalism of irreversible processes and how it can be used to account how it can be used to explain various empirical relations observed in electrokinetic phenomena, Thermal diffusion, Thermomechanical effects and thermoelectric phenomena.
- learn how solvents influence the thermodynamic and transport properties of electrolyte solutions
- learn about some unique specialties of far-from-equilibrium systems like possible generation of order and symmetry breaking

Unit-I Fundamentals of Irreversible Thermodynamics (16 Contact hours)

Basic principles of non-equilibrium thermodynamics: Second law of thermodynamics for open system, law of conservation of mass, charge and energy. Irreversible processes and uncompensated heat, degree of advancement, reaction rate & affinity, Relation of uncompensated heat to other thermodynamic functions.

Gibb's equation, entropy production, entropy production due to matter flow, heat flow, chemical reactions, and charge flow. Concept of forces & fluxes, Onsager's theory of irreversible processes, phenomenological laws, their domain of validity. Principle of microscopic reversibility and Onsager relations, Chemical reactions near equilibrium. Curie–Prigogine principle.

Unit-II Applied Irreversible Thermodynamics (16 Contact hours)

Stationary non-equilibrium states, thermodynamic significance. Theorem of minimum entropy production. States of minimum entropy production, stability of stationary states, entropy flow in stationary systems. Stationary state coupling in irreversible processes. Variation of entropy production in stationery states, Glansdroff-Prigogine inequality. Electrokinetic phenomena and expressions for streaming potential, electro-osmotic pressure difference, streaming potential using the linear phenomenological equations. Thermal Osmosis, and thermoelectric phenomena. Self-Organization in physico-chemical systems, Dissipative structures, Symmetry breaking in biological systems.

Books Recommended

1. Thermodynamics of Irreversible Processes; DeGroot,Mazur;Dover;1986.
2. Non-Equilibrium Thermodynamics; C. Kalidas, M. V. Sangaranarayanan, Macmillan India Limited, 2002.
3. Thermodynamics for students of Chemsitry, Kuriacose, Rajaram, (S. Chandand Co., 1996).
4. Exploring Complexity, I. Prigogine, G. Nicolis, (Freeman, 1998).
5. Molecular Thermodynamics, D. A. McQuarrie, J. D. Simon, USB, 1998.

6. Understanding non-equilibrium thermodynamics. G. Lebon, D. Jon, J. Casas Vasques.
7. Springer, 2008.
8. Non-equlibrium thermodynamics, 2nd ed. Yasar Demirel. Elsevier, 2007

Course No: CH24305DCE
Title: Laboratory Course in Chemistry-III (04 Credits)

Max. Marks: 100 | **Duration: 128 Contact hours**
Continuous Assessment: 20 marks | **End Term Exam: 80 Marks**

Course outcomes: The main outcomes of the course are:

- to engage students with a series of well-planned experiments wherein they are expected to learn how to plan and conduct experiments in a physical chemistry lab.
- to carry out hands-on experiments to know how the data generated depicts the variation of various physical properties with the dependable parameters.
- to interpret the generated data through various theories to understand applications and relevance of physical methods to understand and explore the chemical systems.

A. Synthesis and Characterization of the Coordination Compounds of Transition metals

Selected preparations of the following coordination compounds with the specific objectives:

Stabilization of unusual Oxidation states:

a. Tristhioureacopper(I)sulphate monohydrate: and Purification by recrystallization and Observation of crystal morphology under microscope

Multi stage Inorganic Preparations (Any Two)

1. Preparation of Trans-dicholorobis(ethylenediamine) cobalt (III) chloride and its conversion to cis-isomer.
2. Preparation of tris(ethylenediamine) nickel (II) chloride dehydrate and analysis of stepwise complexation process
3. Preparation of Potassiumtrisoxalatoferrate(III)trihydrate and its component analysis.
4. Synthesizing of silver nanoparticles (Ag NP) via chemical reduction: Understanding the Impact of Size on Silver's Optical Properties.

B. Separation and estimation of following Binary metal ion systems using Gravimetry & Titrimetry simultaneously: *(Any Two)*

1. Silver (Ag^{+}) as AgCl and Nickel (Ni^{2+}) as $[NiEDTA]^{2-}$ complex.
2. Nickel (Ni^{2+}) as Ni(DMG) complex and Magnesium (Mg^{2+}) as $[Mg EDTA]^{2-}$ complex.
3. Copper (Cu^{2+}) as CuSCN and Magnesium (Mg^{2+}) as $[MgEDTA]^{2-}$ complex.

C. Chromatography (Paper and Column)

(i) Separation of binary and ternary mixture of inorganic cations through ascending and radial paper chromatography in two different types of mobile phases.

D. Separation by Column Chromatography and Estimations:

Separation of permanganate and dichromate ions on Alumina column and followed by Permanganometric and Spectrofluorometric estimation.

E. Spectrophotometry: *(Any Three)*

1. Determination of stoichiometry of Iron Thiocyanate complex using Job's Continuous variation method.
2. Determination of stoichiometry of Iron (II)—2,2-bipyridyl complex by Mole ratio method.
3. Comparative spectrophotometric analysis of iron complexes using Beer Lambert law. Evaluation of molar extinction coefficient of $[Fe(Phen)_3]^{2+}$ and $[Fe(CN)_6]^{3-}$
4. d-d band analysis and complexation effect on d-d bands in case of d8 octahedral complexes. A comperative study of $[Ni(Phen)_3]^{2+}$ and $[Ni(OH_2)_6]^{2+}$.
5. Formula verification of pottassium trisoxalato ferrate(ii) trihydrate.

F. Potentiometric Titrations: *(Any Two)*

1. Fun with Nernst equation: Standardization of an Iron (ii) solution with a standard dichromate solution and calculation of formal and transition potential values.
2. Complexation effect on redox potential of iron redox couple: Simultaneous potentiometric estimation of iron binary and ternary complex mixtures.
3. Argentometry: Estimation of Iodide with Standard AgNO3 over Pt & Calomel assembly using $I^-\backslash I_2$ redox couple involving pseudo indicator action.

G. pH-metricTitrations

1. Quantitative analysis of Chromate Dichromate mixture by pH Titration.
2. Study of pH influence on a pH dependent redox reaction.

H. ConductometricTitrations:

1. Conductometric investigation of Silver(I) ethylene diamine complexation reaction.

I. Kinetic analysis:

1. To study the rate of dissociation of tris-1,10-phenanthroline nickel (II) complex in acid medium.

Books Recommended:

1. Vogel's quantitative analysis 6 Edn. Mendham, Denny; Pearson Education2002
2. Modern Analytical Chemistry, David HarveyMc Graw Hill.US
3. Analytical Chemistry. 7th edition , Gary D. Christian, Purnendu K. (Sandy) Dasgupta, Kevin A. Schug, Wiley
4. Principles and Practice of Analytical Chemistry; 5th Edition; F. W. Fifield, D. Kealey; Blackwell Sciences Ltd.; 2000.

Course No: CH24306DCE
Title: Chromatographic Techniques (02 Credits)

Max. Marks: 50 | **Duration: 32 Contact hours**

Continuous Assessment: 10 marks | **End Term Exam: 40 Marks**

Course outcomes:

- Explain the principles and mechanisms of chromatographic separation.
- Demonstrate knowledge of instrumentation, stationary/mobile phases, and column materials
- Apply chromatographic methods for qualitative and quantitative analysis

Unit-I Chromatographic Techniques I (16 Contact hours)

Introduction, Types and Classification, principles, differential migration, nature of partition forces, partition, Mobile phases, stationary phases, resolution, plate theory (concept), separation time, zone migration, column packing materials, development techniques, differential migration, partition coefficient, retention time and elution volume.
Column Chromatography: Principle, Mechanism of Separation, Choice of stationary and mobile phases. Types of adsorbents. Plate Theory.
Thin layer chromatography: Theory, principle, adsorbents, preparation of plates, solvents, preparative TLC.

Unit-II Chromatographic Techniques II (16 contact hours)

Gas-Liquid chromatography: Principle, columns and stationary phase, resolution and instrumentation. Detectors
HPLC: Theory, column efficiency, extra column and band broadening, temperature effects and diffusion. Chiral chromatography, chiral stationary phases. Applications and versatility of HPLC. Ion exchange chromatography: Principle, mechanism of separation and applications.

Books Recommended

1. Principles and Practice of Analytical Chemistry; 5th Edition; F. W. Fifield, D. Kealey; Blackwell Sciences Ltd.; 2000.
2. Modern Analytical Chemistry; David Harvey; McGraw-Hill; 2000.
3. Chromatographic Methods; 5th edn. ; A. Braithwaite and F. J. Smith; Kluwer Academic Publishers.
4. Fundamentals of Analytical Chemistry; 6th Indian Reprint; D. A. Skoog and D.M. West; Cenage Learning; 2012.
5. Thin layer Chromatography; E. Stahl and George Allen; Unwin Ltd. London.

Course No: CH24307DCE
Title: Solid State Chemistry (02 Credits)

Max. Marks: 50 | **Duration: 32 Contact hours**
Continuous Assessment: 10 marks | **End Term Exam: 40 Marks**

Course outcomes: After learning the contents of this course, the students shall:

- get familiar with X-ray diffraction technique and its use in determining the internal structure of the solid state alongwith the electron density maps.
- learn about the types of defects and their importance in explaining the properties of solids.
- understand the development of theories of solid state starting from free electron approximation to the finite variable potential field approximation of the electrons for classifying the solids as insulators, conductors and semiconductors.
- get familiarized to the semiconducting, superconducting, magnetic and dielectric properties of solids along with their day-to-day applications

Unit-I Structure and Theories of Solids (16 Contact hours)

Structure of solids: Lattice Planes and Miller indices; Bragg equation, Debye-Scherrer method of X-ray structural analysis of crystals, identification of cubic unit cells from systematic absences in diffraction pattern. Structure factor and its relation to intensity and electron density.
Theories of solids: Free electron theory of metals: The Drude-Lorentz Model, Sommerfeld Model; Fermi Dirac distribution function, Density of state and electronic heat capacity.
Electron Energy Bands: Energy bands in general periodic potential-Kronig-Penney model. Qualitative band schemes for insulators, semiconductors and metals.

Unit-II Electric and magnetic properties of Solids (16 Contact hours)

Semiconductors: Intrinsic & extrinsic semiconductor (n-type & p-type), temperature dependence of charge carriers, p-n junction- devices based on p-n junction (tunnel diode, injection laser).
Super conductors: Characteristic properties- Zero resistance, Meissner effect, Heat capacity, Thermal conductivity, absorption of em radiations and Josephson effect. BCS theory of superconductivity (Qualitative), applications of superconductors.
Magnetic properties of solids: origin of magnetism in solids, Diamagnetism, paramagnetism (Langevin's and quantum mechanical formulations), ferromagnetism (Heisenber's model and Wiess theory), antiferromagnetism and ferrimagnetism. Temperature dependence of magnetization.

Books Recommended

1. Physical Chemistry; P. W. Atkins; Julio De Paula, Ed. 10th, Oxford University Press;2014.
2. Physical Chemistry- A Molecular Approach - D. A. McQuarie& J. D. Simon, University Science Books, 1997.
3. Introduction to Solids, Azaroff, Tata McGraw,1993.
4. Solid State Chemistry and its Applications, West, Wiley, 2014.
5. The Physical Chemistry of Solids, Borg, Biens, Academic press, 1992.
6. Solid State Physics, N.W.Ashcroft and N.D.Mermin, Saunders college, 2001.
7. Elements of Solid state Physics, J.P. Srivastava, Prentice Hall of India, 2003
8. Elementary Solid state Physics, Principals, and applications, M. A. Omar, Peason, 1999.

Course No: CH24003GE
Title: Bio-Organic Chemistry (02 Credits)

Max. Marks: 50 **Duration: 32 Contact hours**
Continuous Assessment: 10 marks **End Term Exam: 40 Marks**

Course outcomes: After learning the contents of this course, the students shall:

- recognize the importance of bio-organic chemistry and Pre-Biotic Chemistry.
- understand formation and synthesis of carbohydrates and amino acids under pre-biotic conditions.
- understand the mechanism of the function of enzymes, specificity and inhibition.

Unit-I (16 contact hours)

(a) Chemical Origins of Biology
Bio organic chemistry: Introduction, Basic consideration, Proximity effects in Organic Chemistry, Molecular rearrangements.

Pre-Biotic Chemistry: Role of HCN and HCHO in biosynthesis, Nucleophiles and Electrophiles in solution of HCN, Formation of Purines and Pyrimidines from HCN under prebiotic conditions. Carbohydrates from Aldol reaction with HCHO, Formation of Amino acids under prebiotic conditions.
(b) Enzymes: Nomenclature and Classification of enzymes. ***Specificity of enzyme action:*** Types of specificity, the active sites; The Fischer "lock and key" hypothesis, The Koshland 'induced fit' hypothesis, Hypothesis involving strain or transition state stabilization.
Enzyme Inhibition: Competitive inhibition, Uncompetitive inhibition, Non-competitive, Allosteric inhibition, irreversible inhibition.

Unit-II (16 Contact hours)

(a) Coenzymes: Introduction, Types of coenzymes, Involvement of coenzymes in enzyme catalyzed reactions: Introduction, Nicotinamide Nucleotides (NAD+ and NADP+), Flavin Nucleotides (FMN and FAD), Adenosine phosphate (ATP, ADP, AMP). Coenzyme A (CoA -SH), Thiamine pyrophosphate, Biotin, Tetrahydrofolate, Coenzyme B_{12}.

(b) Biosynthesis of Natural Molecules: Biosynthesis of Fatty Acids and Triglycerides, Biosynthetic Pathway of Terpenoids and Steroids, Inhibitors of Terpene biosynthesis, Biosynthesis of Flavonoids

Books Recommended

1. Introduction to bioorganic chemistry and chemical biology. D. V. Vranket and Gregary Weiss; Taylor and francis. 2013.
2. Bio-organicchemistry : Harman Dugas 3rd ed.Springer (2010) .
3. Bio-organic chemistry J.Rohr ,Springer (2000).
4. Enzymes 2nd ed. T. Palmer and P. Bonner (2008).
5. Biochemistry :Donald Voet, Judith.G. Voet 2nd ed.Willey (1995)

Course No: CH24003OE
Title: Medicinal Inorganic Chemistry (02 Credits)

Max. Marks: 50 | **Duration: 32 Contact hours**
Continuous Assessment: 10 marks | **End Term Exam: 40 Marks**

Course outcomes: On completion of the course, the students will acquire knowledge of:

- sources and mechanisms of metal ion toxicity and detoxification strategies.
- principles of chelation therapy and therapeutic applications of metal complexes.
- medicinal roles of essential trace elements, metal-based drugs, and diagnostic agents.

UNIT-I: Medicinal Inorganic Chemistry-I (16 contact hours)

Metal toxicity and Homeostasis: sources of metal ion poisoning. Mechanism of metal ion induced toxicity (Pb, Cd, Hg, As, and Se) Toxicity of cyanide and nitrite ions. Metal ion promoted carcinogenesis and probable mechanism of action.

Metal based Therapeutic Compounds: Conditional stability constant, Stereochemistry, Lipophilicity. HSAB theory and Plasma mobilizing index (PMI). Therapeutic index of different chelating drugs in metal ion detoxification. Limitations and hazards of Chelation therapy

Unit-II: Medicinal Inorganic Chemistry-II (16 contact hours)

Treatment of essential trace and ultra-trace element deficiencies: Manganese, Iron, Copper, Cobalt, Zinc, Molybdenum, Silicon, Nitrogen and Phosphorus. Metal salts as anti-acids, antiseptics and diuretics.

Metal complexes as drugs: Vanadium based anti-diabetic drugs, Platinum based anticancer agents(cisplatin and its derivatives), non platinum based anticancer agents and Gold based anti-arthritic compounds and their mechanisms of action. Metal Complexes as anti-virals, anti-bacterials and anti-fungals;

Metal based Diagnostic agents: Tecnetium based radiopharmaceuticals. Gadolinium based MRI imaging agents. Radio protective chelating drugs

Books Recommended

1. Bio inorganic Chemistry -An introduction; Ochai, Allyn and Bacon;1977.
2. Inorganic Aspects of Biological and Organic Chemistry; Hanzilik; Academic;1976.
3. The Inorganic Chemistry of Biological processes; 2nd edn.; Hughes ; Wiley;1973.
4. A Text book of Medicinal aspects of Bio inorganic Chemistry; Das; CBS;1990.
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