

M Sc Semester III Physical & Polymer Chemistry

CHE2301CPC (Molecular Spectroscopy and Statistical Thermodynamics)

Unit I : *Nuclear Magnetic Resonance:* Recapitulation. Simplification of complex spectra: Spin decoupling, Lanthanide shift reagents. ^{13}C NMR, Instrumentation pulse techniques), line widths and rate processes. Chemical exchange: Symmetrical two-site exchange; unsymmetrical two-site exchange, spin relaxation, exchange process, Relaxation time, Measurement of relaxation time. NOE. FT NMR, coupling with nuclei with $I > 1/2$, Two-dimensional NMR, Use of NMR in medical diagnostics.

Unit II: *Nuclear Quadrupole Resonance:* Prolate and oblate nuclear quadrupole, the NQR isotopes, nuclear quadrupole coupling constants, applications.

Mossbauer spectroscopy: The resonant absorption and fluorescence. Doppler effect, Mossbauer effect. The chemical isomer shift. Quadrupole effect, the effect of magnetic field. Mossbauer spectrometer, relative line intensities, elucidation of structure of ^{57}Fe & ^{119}Sn systems ; Mossbauer spectroscopy in biological science.

Unit III: *Statistical Thermodynamics*

Bose-Einstein and Fermi-Dirac statistics, Phase space, ensembles, transformation of the phase space, Liouville's theorem, Fluctuations, Canonical and Grand ensembles partition function. Calculation of equilibrium constant: Dissociation and association of diatomic molecule and isotopic exchange. Heat Capacity of Solids: Debye and Einstein Model.

Reference Books

1. Spectroscopy Vol I & II , B.P. Straughan & S. Walker, Chapman & Hall (1976)
2. Fundamentals of Molecular Spectroscopy , C.N. Banwell & E. M. McCash, Tata McGraw Hill (1995)
3. Principles of Mossbauer Spectroscopy , T.C. Gibb, Chapman & Hall (1976)
4. Interpretation of Carbon -13 NMR Spectra, F.W. Wehrli, A.P. Marchand & S. Wehrli, John Wiley (1983)
5. Molecular Spectra & Molecular Structure , G. Herzberg, Van Nostrand, NY (1950)
6. Statistical Mechanics, Thermodynamics & Kinetics, O.K. Rice, Eurasia Pub (1970)
7. Elements of Statistical Thermodynamics , L.K. Nash, Addison Wesley (1966)
8. Physical Chemistry - A molecular approach , Donald A. McQuarrie, John D Simon, Viva Publishers (1998)
9. Physical Chemistry , P.W. Atkins, Oxford Univ. Press (2006)
10. Fundamentals of Classical & Statistical Thermodynamics, B. N. Roy, John Wiley (2003)
11. Statistical Thermodynamics, M. C. Gupta, New Age (1990)

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M Sc Semester III

Physical & Polymer Chemistry

CHE2302PC
(Polymer Science)

Unit I : Polymerization I

Chain growth polymerization, step growth polymerization. Kinetics and mechanism of polymerization. (Free radical, cationic, anionic, condensation and coordination polymerization). Random, Block and graft copolymers, copolymer equation, reactivity ratios.

Unit II: Polymerization II

Techniques of polymerization: Bulk solution, suspension, emulsion, interfacial and ring opening polymerization, metathesis polymerization, atom transfer polymerization and group transfer polymerization (ATRP, RAFT, etc.).

Unit III : Solution Properties and Glass transition of polymer

Solution properties of polymer : Solubility, solubility parameter, thermodynamics of polymer solutions. Theories of dilute polymer solutions, short and long range interactions. Excluded volume effect. Conformation of polymer chain in solution. Phase equilibria in polymer solution. Glass transition: Introduction, importance and its determination. Factors affecting glass transition temperature, molecular weight, size and shape, flexibility, crystallinity, orientation, intermolecular forces.

Reference Books

1. Textbook of Polymer Chemistry , F.W. Billmeyer Jr., John Wiley (1994)
 2. Principles of Polymer Chemistry , P.J. Flory, Cornell Univ Press (1957)
 3. Introduction to Polymer Chemistry , R.B. Seymour, McGraw Hill (1971)
 4. Physical chemistry of Polymer , A Tager, Mir Pub (1978)
 5. Polymer Science , V.R.GowarikarN.V. Viswanathan & J. Sreedhar, New Age (1986)
 6. Polymeric Multicomponent Materials, L.H. Sperling, John Wiley (1997)
 7. Macromolecular Solution : Solvent Property Relationship in Polymers , R. Saymour , Pergamon Press (1982)
 8. Macromolecules Vol .I & II , H.G. Elias, Plenum Press (1984)
 9. Macromolecules, An introduction to Polymer Science, F.A. Bovey, Academic Press (1979)
 10. Plastic Materials , J.A. Brydson, Butterworth Heineman (1982)
 11. Principles of Polymer Systems , F. Rodriquez, Taylor & Francis (1996)
 12. Principles of Polymerization , G. Odian,
 13. State of Art: Polymer Chemistry, J.Chem. Edu. Special Issue (1981)
 14. Polymer Science & Technology, J.R.Fried, Prentice Hall (2005)
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M Sc Semester III

Physical & Polymer Chemistry

CHE2303PC

(Electrochemistry and Non-equilibrium Thermodynamics)

Unit I : *Electrochemistry I*

Ion-solvent interactions: Non structural treatment, Born-model, modification of Born model, thermodynamics of Ion-solvent interaction.

Structural treatment: Structure of water, structure of water near an ion. Ion-dipole model of ion solvent interaction, ion-quadrupole model of ion-solvent interaction. Solvation number: Static and dynamic picture of ion-solvent molecules interaction.

Unit II: *Electrodics*

Surface excess, electrocapillary phenomena, Lippmann theory, electrochemical kinetics, Butler-Volmer treatment, rate of electrode processes (stoichiometric numbers). Different electrochemical reactions; rapid Electrochemical reactions, organic electrode processes, Bio- chemical reactions, Electrocatalysis.

Unit III: *Irreversible Thermodynamics*

Introduction, importance of entropy in irreversible thermodynamics, postulates of irreversible thermodynamics, Flux and forces,. Caretheodory principle, general conservation equation for matter and Energy at the local equilibrium,. Curie-Prigogine principle, Diffusion in binary solution: Diffusion in free solution under concentration, pressure and electrostatic potential gradient, sedimentation and centrifugation. Electrochemical systems: Chemical reaction, Peltier and Seebeck effects. Uses of irreversible thermodynamics in membrane and soil science.

Reference Books

1. Modern Electrochemistry Vol. I & II , J.O.M Bockris & A. K. N. Reddy, Plenum Press (1998)
2. Electrochemical Methods: Fundamentals and Applications, A.J.Bard & L.R. Faulkner, John Wiley (2001)
3. Physical Chemistry of Electrolytic Solution , H.S. Harned & B.B. Owen, Reinhold (1950)
4. Advances in Electrochemical Engineering & Electrochemistry , P. Delahay & W. Tobias, Interscience (1966)
5. Theoretical Electrochemistry , L. Antropov, Mir Pub (1977)
6. Polarographic Techniques, L. Meites, Interscience (1955)

M Sc Semester III Physical & Polymer Chemistry

Practical Courses

CHE2304PC

Advanced Physical chemistry practicals-1(4 Credits)

CHE2305PC

Advanced Physical chemistry practicals-2 (4 Credits)

1. To determine Partition Coefficient (K_D) of iodine (I_2) between two immiscible liquids (Carbon tetra chloride and water)
2. To determine the interfacial tension between two immiscible liquids (Water and Toluene) at room temperature
3. To study the effect of acid concentration (Hydrochloric acid) and addition of non-ionic surfactant (Brij-35) on rate constant of hydrolysis of sucrose.
4. To determine effect of varying ionic strength of electrolyte on rate constant of saponification of ethyl acetate
5. To construct phase diagram for three component system using chloroform, water and glacial acetic acid
6. To determine Critical Micelle concentration of given surfactant using surface tension measurement
7. To determine equilibrium constant of tri-iodide (I_3^-) formation in aqueous solution
8. To construct phase diagram for three component system using toluene, water and glacial acetic acid
9. To determine Partition Coefficient (K_D) of iodine (I_2) between two immiscible liquids (toluene and water)
10. To study the influence of ionic strength on reaction between potassium persulphate and potassium iodide solution using titration method
11. To determine the viscosity average molecular weight of given polymer(polystyrene) by viscosity method
12. To determine isoelectric point of given amino acid
13. Investigation of the reaction between acetone and iodine
14. To determine the diffusion coefficient 'D' of Sodium Chloride using conductivity measurement
15. To determine the diffusion coefficient 'D' of Potassium chloride using conductivity measurement
16. To determine rate constant of reaction between Potassium Chloride and Potassium persulphate spectrophotometrically
17. To determine the Isosbestic point of given indicator (bromocresol green) spectrophotometrically

M Sc Semester III

Physical & Polymer Chemistry

CHE2301PC

Elective Course I

(Quantum Chemistry)

Unit I : *Quantum Chemistry I*

Recapitulation, Angular momentum and its commutation laws. Step up and step down operators for angular momenta, Legendre, associated Legendre, Hermite and Laguerre polynomials. Quantum mechanics of some simple systems: electron in a ring, rigid rotor, harmonic oscillator.

Unit II: *Quantum Chemistry II*

Approximate methods, perturbation theory (First and second order), time dependent perturbation theory, variation methods, KB approximation with examples. Many electron atoms and angular momenta, He atom, Hartree-Fock self consistent methods, spin-orbit interaction, Hellmann Feynman theorem and its applications.

Reference Books

1. Quantum Chemistry, I. N. Levine, Tata Mc Graw Hill (2002).
2. Quantum Chemistry: An introduction, W. Kauzmann, Academic Press NY (1957).
3. Quantum Chemistry, H. Eyring, J. Walter & G.E. Kimball, John Wiley (1948).
4. Introductory Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill (1995).
5. Elements of Quantum Chemistry, F.L. Pilar, Mc Graw Hill (1968).
6. Molecular Quantum Mechanics: An Introduction to Quantum Chemistry, P.W. Atkins, Clarendon (1970).
7. Quantum Chemistry, D. A. McQuarrie, University Science Book (2007).

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M Sc Semester III

Physical & Polymer Chemistry

Elective Course II

CHE2302EPC (Solid-state Chemistry)

Unit I:

Crystallography: Recapitulation, Diffraction properties of crystals. symmetry elements, space groups. Ionic crystals. Determination of crystal structure. Imperfection in crystals- point defects (Thermodynamic treatment) and line defects. Crystal growth, Crystal engineering and polymorphism.

Metals : Quantum mechanical approach, Electrical, magnetic and thermal properties.

Unit II: *Solid State Chemistry II*

Semiconductors : Extrinsic and intrinsic semiconductors. Band theory, optical and junction properties. Photoconductors.

Super conductors : Theory, preparation and properties. Insulators: Electrical, optical and magnetic properties.

Molecular structure and liquid crystallinity, Theories of liquid crystalline state, phases of liquid crystalline state. Physical, electro-optical and magnetic properties of liquid crystals.

Reference Books

- 1) Solid State Chemistry and its Applications, A.R.West, John Wiley (1975)
- 2) Solid State Chemistry, D.K.Chakrabarty, New Age Int. Pub., New Delhi, (2009)
- 3) Atomic Structure & Chemical Bond, Manas Chandra, Tata Mc Graw Hill (1995)
- 4) Treatise on Solid State Chemistry Vol I, VII, B.N. Hannay, Plenum Press (1975).
- 5) Introduction to Solids, L. V. Azaroff, Mc Graw Hill (1960).
- 6) The Crystal as A Supramolecular Entity: Perspectives in Supramolecular Chemistry, G.R. Desiraju, Wiley-VCH (1996)

M Sc Semester III Physical & Polymer Chemistry

CHE2303EPC Elective Course III (Biophysical Chemistry)

Unit I

Biological Cell and its Constituents

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems, Helix coil transition.

Bioenergetics: Standard free energy change in Biochemical reactions, exergonic, endergonic, hydrolysis of ATP.

Statistical mechanics in Biopolymers: Chain configuration of macromolecules, statistical distribution, end to end dimensions, calculation of average dimension for various chain structures, polypeptide and protein structures, introduction to protein folding problem.

Biopolymer Interactions: Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curve.

Unit II

Thermodynamics of Biopolymer solutions

Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

Cell Membrane and Transport of Ions: Structure and functions of cell membrane, ion transport through cell membrane, Nerve conduction

Biopolymers and their molecular weights : Evaluation of size, shape, molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.

Diffraction Methods: Light Scattering, low angle X-ray scattering, X-ray diffraction and photo correlation spectroscopy.

Reference Books

1. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W. H. Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E. E. Conn and P. K. Stumpf, John Wiley.
6. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
7. Macromolecules: Structure and Function, F. Wold, Prentice Hall.

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M Sc Semester III Physical & Polymer Chemistry

CHE2304EPC Elective Course IV (Advanced Polymer Chemistry)

Unit I : Polymer Synthesis and Characterization

Methods of Polymer synthesis- Free Radical, cationic, anionic, coordination, condensation Polymerization, metathesis, Atom and Group transfer method (ATRP, RAFT), heterocyclic polymerization.

Polydispersion, Average Molecular weight concept-Number, weight, viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights- End group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study, microscopy. Thermal Analysis and physical testing tensile strength.

Unit II: Properties and Applications

Morphology and order in crystalline polymers-configurations of polymer chains. Polymer structure and physical properties-crystalline melting point T_m -melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The Glass transition temperature (T_G) , T_G – relationship between T_G and T_m , effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking, property requirement and polymer utilization.

Fire retarding polymers, electrically and conducting polymers. Biomedical polymers.

Reference Books :

1. Textbook of Polymer Chemistry , F.W. Billmeyer Jr., John Wiley (1994)
2. Principles of Polymer Chemistry , P.J. Flory, Cornell Univ Press (1957)
3. Introduction to Polymer Chemistry , R.B. Seymour, McGraw Hill (1971)
4. Physical chemistry of Polymer , A Tager, Mir Pub (1978)
5. Polymer Science , V.R.GowarikarN.V. Viswanathan & J. Sreedhar, New Age (1986)
6. Polymeric Multicomponent Materials, L.H. Sperling, John Wiley (1997)
7. Macromolecular Solution : Solvent Property Relationship in Polymers , R. Saymour , Pergamon Press (1982)
8. Macromolecules Vol .I & II , H.G. Elias, Plenum Press (1984)
9. Macromolecules, An introduction to Polymer Science, F.A. Bovey, Academic Press (1979)
- 10 Plastic Materials, J. A. Brydson, Butterworth Heineman (1982)
- 11 Principles of Polymer Systems, F. Rodriquez, Taylor & Francis (1996)
- 12 Principles of Polymerization , G. Odian, Pearson Publication
- 13 State of Art: Polymer Chemistry, J. Chem. Edu. Special Issue (1981)
- 14 Polymer Science & Technology, J. R. Fried, Prentice Hall (2005)

M Sc Semester IV
Physical & Polymer Chemistry
CHE2401PC

(Chemical Kinetics and Catalysis)

Unit I:

Chain reactions (formation and decomposition of HBr, HI, phosgene, thermal decomposition of N_2O_5 and C_2H_{10} , oxidation of methane). Comparison between gas phase and solution reactions, factors determining rates in solution. Reaction between ions, reactions involving dipoles, reactions in solution (hydration of acetaldehyde, halogenation of acetone, the aldol condensation) Electron transfer reactions. Oscillatory reactions, Experimental studies of fast reactions: Temperature Jump, molecular beam and NMR methods. Theories of unimolecular (RRK and RRKM).

Unit II : Catalysis I

Heterogeneous catalysis: Kinetics and Mechanism of surface reactions. surface heterogeneity, activity and selectivity, deactivation and regeneration. Theories of promotion and poisoning of catalysts. Catalyst Synthesis: supports and supported catalysts. Zeolites and zeolite-like materials, precipitation and impregnation methods.

Characterization of catalysts: Surface area, pore size distribution (mercury porosimetry) Thermal methods (DTA, TG, TPD and TPR), Surface acidity, Photoelectron spectroscopy (XPS, AES, XRF), LEED, Mossbauer spectroscopy, IR, SIMS, Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM).

Unit III : Catalysis II

Theories of catalysis by metals, semiconductors and supported catalysts. Geometric and electronic factors. Important applications of heterogeneous catalysis in petroleum, petrochemicals and fine chemicals, catalysis in pollution control.

Homogeneous catalysis: Reactions involving carbocations, transition metal complexes as catalysts, Olefin hydrogenation with Wilkinson's catalyst and methanol carbonylation. Important industrial applications.

Reference Books

- Chemical Kinetics , K.J. Laidler, Pearson Edu, Singapore (2004)
Kinetics and Mechanism , J.W. Moore & R.G. Pearson, John Wiley (1981)
Basic Chemical Kinetics , G.L. Agrawal, Tata McGraw Hill (1990)
Chemical Kinetic Methods: Principles of Fast reaction, Techniques and Applications, C. Kalidas, New Age (2005)
Catalytic Chemistry , B.C. Gates, John Wiley (1992)
Principles and Practice of Heterogeneous Catalysis , J.M. Thomas & W.J. Thomas, Weinheim NY (1997)
Spectroscopic Characterization of Heterogeneous Catalysis , J.L.G. Fierro, Elsevier (1990)
Adsorption and Catalysis, D.K.Chakrabarty, New Age International Pvt. Ltd.
Tailored Metal Complexes , Y. Iwasawa, D.Reidel Co. (1986)

M Sc Semester IV Physical & Polymer Chemistry

CHE2402PC

(Properties, Characterization and Specialty Polymer)

Unit I : Polymer Additives and Techniques of processing polymers

Fillers, plasticizers, lubricants, antioxidants, flame retarders, colourants, blowing agents, cross-linking agents, UV absorbers. Effect of additives on polymer properties

Techniques of processing: Extrusion, injection moulding calendaring, compression moulding, spinning, powder coating.

Unit II: Rheological, Mechanical and Thermal Properties and Characterization

Rheology of polymers : Viscous flow and its measurements, molecular weight and shear dependence of viscosity, Spectroscopy.

Mechanical properties of polymers: Stress, Strain, moduli and Poisson's ratio. Viscoelastic behaviour: Models of viscoelastic materials. Dynamic mechanical properties, time-temperature equivalence, rubber elasticity.

Thermal and mechanical characterization: Thermogravimetric analysis (TGA). Differential scanning calorimetry (DSC). Thermomechanical Analysis (TMA), Dynamic Mechanical Analysis. (DMA). Analysis and identification of polymers.

Unit III : Specialty Polymers

Conducting polymers, Polymers in non-linear optics, High temperature polymers, Liquid crystalline polymers, Star burst polymers, Tubular polymers, Heterocyclic polymers, Polymers for medical applications, Biopolymers and Biodegradable polymers, Polymer adhesives.

Reference Books

1. Textbook of Polymer Chemistry , F.W. Billmeyer Jr., John Wiley (1994)
 2. Principles of Polymer Chemistry , P.J. Flory, Cornell Univ Press (1957)
 3. Introduction to Polymer Chemistry , R.B. Seymour, McGraw Hill (1971)
 4. Physical chemistry of Polymer , A Tager, Mir Pub (1978)
 5. Polymer Science , V.R.Gowarikar N.V. Viswanathan & J. Sreedhar, New Age (1986)
 6. Polymeric Multicomponent Materials, L.H. Sperling, John Wiley (1997)
 7. Macromolecular Solution : Solvent Property Relationship in Polymers , R. Saymour , Pergamon Press (1982)
 8. Macromolecules Vol .I & II , H.G. Elias, Plenum Press (1984)
 9. Macromolecules, An introduction to Polymer Science, F.A. Bovey, Academic Press (1979)
 10. Plastic Materials , J.A. Brydson, Butterworth Heineman (1982)
 11. Principles of Polymer Systems , F. Rodriquez, Taylor & Francis (1996)
 12. Principles of Polymerization , G. Odian,
 13. State of Art: Polymer Chemistry, J.Chem. Edu. Special Issue (1981)
 14. Polymer Science & Technology, J.R.Fried, Prentice Hall (2005)
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M Sc Semester IV

Physical & Polymer Chemistry

CHE2403PC
(Surface Science and Surfactants)

Unit I : *Surface Chemistry I*

Surface tension and its determination, thermodynamics of liquid interface, surface energy and free energy of liquids, Adhesion and cohesion, surface tension of solution. Binary systems: Gibbs equation.

Monomolecular films: Gibbs monolayer, Traube's rule. Langmuir Blodgett films. Spreading.

Unit II : *Surface Chemistry II*

Insoluble spread monolayer. Surface pressure, potential and viscosity. Uses of monolayer. Forces : long and short range, contact angle, Young's equation, wetting,. Adsorption of nonelectrolytes. Langmuir (statistical Thermodynamical) and BET equation. Adsorption of electrolytes. Lubrication and foams. Emulsions. HLB number. The ageing and inversion of emulsions. Ellipsometry.

Unit III: *Solution Behaviour of Surfactants*

Recapitulations, morphologies, aggregation number and its determination(SANS and DLS), Kinetics in Micellar media, reverse micellar solutions and their applications, Physico-chemical characterization of micro-emulsions, interfacial compositions.

Block co-polymers: Pluronics, Clouding phenomenon and effect of additives. Clouding in ionic surfactant solutions: Cloud point extraction methodologies, mechanism and variation. Bio-surfactants and drug delivery systems. Surfactant polymer interactions, phase behaviour, PIT and HLB.

Reference Books

1. Non-ionic surfactants by M. J. Schick, Surfactant Science Series, (1985)
2. Colloids and Interface Science by P. Ghosh, PHI learning Pvt. Ltd. New Delhi (2009).
3. Surfactants and Interfacial Phenomena by M. J. Rosen, John Wiley, New Jersey (2004).
4. Handbook of surfactants, M. R. Porter, Chapman and Hall, London (1994).
5. The Hydrophobic Effect by C. Tanford, John Wiley, New York (1980).
6. Physical Chemistry of Surface, A.W. Adamson, John Wiley (1976).
7. Physics and Chemistry of Surfaces , J. Oudar, Blackie & Sons (1975)

M Sc Semester IV
Physical & Polymer Chemistry
CHE2404PC
(Theoretical and Material Chemistry)

Unit I: Quantum Chemistry

Recapitulation, Angular momentum and its commutation laws, Step up and step down operators for angular momenta, Legendre, associated Legendre, Hermite and Laguerre polynomials. Quantum mechanics of some simple systems: electron in a ring, rigid rotor, harmonic oscillator. Approximation methods, perturbation theory (First and second order), time dependent perturbation theory, variation methods, KB approximation with examples. Many electron atoms and angular momenta, He atom, Hartree-Fock self consistent methods, spin-orbit interaction, Hellmann Feynman theorem and its applications.

Unit II: Solid State

Recapitulation, Diffraction properties of crystals, symmetry elements, space groups. Ionic crystals. Determination of crystal structure. Imperfection in crystals-point defects (Thermodynamic treatment) and line defects. Crystal growth, Crystal engineering and polymorphism. Metals: Quantum mechanical approach, electrical, magnetic and thermal properties. Semiconductors: Extrinsic and intrinsic semiconductors. Band theory, optical and junction properties. Photoconductors. Superconductors: Theory, preparation and properties. Insulators: Electrical, optical and magnetic properties.

Unit III: Surface Chemistry

Surface tension and its determination, thermodynamics of liquid interface, surface energy and free energy of liquids. Adhesion and cohesion, surface tension of solution. Binary systems: Gibbs equation. Monomolecular films: Gibbs monolayer, Uses of monolayer. Contact angle, Young's equation, wetting, Traube's rule. Langmuir Blodgett films, Spreading.

References Books:

- 1) Quantum Chemistry, I. N. Levine, Tata Mc Graw Hill (2002)
- 2) Molecular Quantum Mechanics: An introduction to Quantum Chemistry, P. W. Atkins, Clarendon (1970)
- 3) Solid State Chemistry and its Applications, A. R. West, John Wiley (1975).
- 4) Colloids and Interface Science, P. Ghosh, PHI learning Pvt. Ltd. New Delhi (2009).
- 5) Physical Chemistry of Surface, A. W. Adamson, John Wiley (1976).

M Sc Semester IV

Physical & Polymer Chemistry

Practical Courses

CHE2405PC

Advanced Physical chemistry practicals-3 (3 Credit)

CHE2406PC

Advanced Physical chemistry practicals-4 (2 Credit)

1. Separation of caproic acid and acetic acid by ion-exchange method.
2. Separation of mixture of cations by ion exchange method.
3. Phase diagram of partially miscible two component liquid mixtures
H₂O and Nicotine
4. To determine the rate constant of saponification of ethyl acetate at two different temperature and calculate the energy of activation.
5. To determine the catalytic activity of Cu²⁺ in decomposition of H₂O₂ with and without support (alumina)
6. To determine the molecular weight of given substance (NaCl, Sucrose) by cryoscopy.
7. To find out the nature of complex formed by HgI₂ and I⁻ by cryoscopy.
8. To determine the transport number by (a) e.m.f. and (b) Hittorf's method.
9. To determine the nature of silver - ammonia complex and also to find out its stability constant by e.m.f. method
10. To determine molecular weight, end-to-end distance, radius of gyration, expansion factor and stiffness parameter for given polymer using viscometry (polystyrenes).
11. To determine the cross link density of the rubber.
12. To determine the number of hydrogen bonds in gelatin.
13. To determine the solvation number of an electrolyte by compressibility method (KCl/ LiCl in water)
14. To prepare galvanic series for a given series of metals Fe, Al, Mg, Cu, Zn.
15. To evaluate corrosion resistance of a metal Fe in presence of inhibitors.
16. To study the structural transition in surfactant solutions.
17. Construction of Cloud curve for a non-ionic surfactant.
18. Determination of thermodynamic constants ΔG , ΔS and ΔH for the reaction by e.m.f method
$$\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$$
19. To verify Gibbs equation for various surfactant solution using surface tension–concentration relationship

M Sc Semester IV
Physical and Polymer Chemistry

Comprehensive Viva Voce Examination CHE2407PC
(2 Credits)

Comprehensive Viva voce Examination by Internal and External Examiners at the end of the IV semester.

M Sc Semester IV
Physical and Polymer Chemistry
Dissertation CHE2408PC (3 Credits)

Dissertation work: Research work carried out under the supervision of faculty from the department. To be evaluated by a panel of internal examiners at the end of the IV semester.

M Sc Semester IV
Physical & Polymer Chemistry

Special Practical CHE2409PC (3 Credits)

1. Synthesis various polymers using different polymerization techniques such as suspension, emulsion, free radical polymerization and condensation polymerization
2. Characterization of polymers for their average molecular weights, polydispersity.