

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-I (Physical)

SECTION – I

UNIT-I : STATISTICAL MECHANICS: (20 Periods)

Probability theorems in statistical thermodynamics. Phase space system- assembly and ensembles. Ensembles probability, discrete variables, ensemble averages, micro-canonical ensemble and canonical ensemble. Statistical derivation of entropy, enthalpy, free energy, heat capacity in terms of position functions. Treatment of diatomic and polyatomic molecules. Comparison of third law and statistical entropies. Grand canonical ensemble, Systems with more than one component. Quantum effects. Thermodynamic functions of mixing, free energy, entropy, heat, volume, viscosity and compressibility of mixing of ideal and non-ideal binary solutions. Excess functions

UNIT-II : BIOPHYSICAL CHEMISTRY (20 Periods)

Bioenergetics: Standard free energy change in biochemical reactions (exergonic and endergonic). Formation and hydrolysis of energy rich bonds in energy rich molecule.

Enzyme Kinetics: Michaelis-Menten and Lineweaver-Burke plots. Enzyme inhibition reversible and irreversible inhibition, **Biotechnological Applications of Enzymes:** Immobilized enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes.

Biopolymer interactions: Forces involved in biopolymer interaction, electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions, multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.

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, Liposomes, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport.

UNIT-III : SURFACTANTS (20 Periods)

Characteristic features of surfactants- General structural features and behaviour of surfactants: Examples with structures of some common anionic, cationic, nonionic and zwitterionic surfactants, Gemini surfactants, Polymeric surfactants, Bolaform surfactants, Silicone surfactants, Fluorocarbon surfactants

Solubility of surfactants, Kraft point, Cloud point, HLB number, Adsorption and micellization, Hydrophobic effect, Critical micelle concentration and its determination, micellar structure and shape, Aggregation number. Factors affecting CMC and agg no: Effect of electrolytes, pH and organic material, Size and shape of micelles. Thermodynamics of micellization: mass action model and phase separation model, elementary idea on kinetics of micellization

Solubilization and sites of solubilization. Factors affecting solubilization – Temperatures, Nonelectrolytes and electrolytes, Brief description of micellar catalysis

Formation of emulsions and their different types and determination, Emulsifying agents and emulsion stability, inversion of emulsion, Microemulsions: Formation, type, stability and applications

SECTION – II

UNIT-IV : CHEMICAL KINETICS:

(20 Periods)

Rate theories based on thermodynamics, rate theories based on statistical mechanics, conventional transition-state theory, statistical mechanics and chemical equilibrium, Derivation of the rate equation, Thermodynamic formulation of conventional transition-state theory, assumptions and limitation of conventional transition-state theory, Theoretical calculations of specific rate constants for bimolecular reactions.

Elementary reaction in solution; solvent effects on reaction rates, factors determining reaction rates in solution, reaction between ions, ion dipole and dipole-dipole reactions. Effect of ionic strength. Substituent and correlation effects – Hammett equation. Linear free energy relationship.

Homogeneous and heterogeneous catalysis: general catalytic mechanisms, equilibrium treatment, steady state treatment and activation energies for catalysed reaction. Acid-base catalysis – general acid base catalysis, mechanism of acid base catalysis, Bronsted catalysis law. Hammett-Pronsted equation, acidity functions.

UNIT-V : SPECTROSCOPY:

(20 Periods)

(a) IR SPECTRPSCOPY

Review of the theory of IR spectroscopy , Instrument for IR spectroscopy – Sources, Detectors, monochromators – Cells and Sampling techniques – Interpretation of IR spectra using correlation charts – Quantitative analysis – FT-IR spectroscopy , Instrument, Advantages.

(b) NMR SPECTROSCOPY:

Theory of NMR – Relaxation – Chemical Shifts – References and solvents – Spin-Spin splitting – Magnetic Anisotropy – Instrumentation – Shift Reagents – Interpretation of Simple NMR Spectra – ¹³C NMR spectra – Signal averaging, FT-NMR, pulse FT-NMR spectroscopy. Problems to elucidate structure from NMR spectra (minimum 10), ABX, AMX, ABC, A₂B₂ systems – NMR in medical diagnostics.

UNIT-VI : NUCLEAR CHEMISTRY AND GREEN CHEMISTRY:

(20 Periods)

(a) Nuclear Chemistry:

Nuclear models, Shell model – periodicity in nuclear properties, magic numbers characteristics of the shell model, square well potential, energy levels in nuclear potential well, sequence of filling the orbits, merits of shell models. Liquid drop model-similarities between a nucleus and a liquid drop, merits of liquid drop, calculation of nuclear binding energies, the semi-empirical mass equation, limitation of liquid drop model. Nuclear radiations, Radiation dosimetry, units of radiation dosimetry, chemical dosimetry chemical effects resulting from radiation of matter, radiolysis of water and aqueous solutions, free radicals in water radiolysis.

(b) Green Chemistry

Green chemistry and brief description of its 12 principles, Some common examples of green chemical approaches in practice,

Introduction to supercritical fluids: Definition, characteristics and properties, solubility in supercritical fluids, Applications

Introduction of ionic liquids: Definition, Physical and Chemical properties, Synthesis of ionic liquids, Uses of ionic liquids: Solvents, Reaction media, Solvent for catalyst

Recommended Books:

1. Thermodynamics for chemist by S.

2. Glasstone Statistical Thermodynamics by M. C. Gupta
3. Nuclear Chemistry by A. H. Arnikar.
4. Chemical Kinetics by Laidler K. J. Harper and Row,
5. Nuclear Chemistry by Dash U. N., Sultan Chand and Sons
6. Fundamental of molecular spectroscopy, C. N. Banwell, Tata McGraw Hill Pub. Camp.
7. Modern Methods of Chemical Analysis, R. I. Resso, L. Shields, T. Cairns and I. C. McWilliam, John Wiley & Sons
8. Surfactant Science and Technology, Drew Myers, VCH
9. Surfactant Systems Florence Chapman and Hall London
10. Principles of Biochemistry Lehnings World Publishers
11. Hamley, I. W. Introduction to Soft Matter: Polymers, Colloids, Amphiphiles and Liquid Crystals John Wiley & Sons (2000).
12. Green Chemistry: Theory and Practice Paul T. Anastas, John C. Warner
13. Introduction to Green Chemistry y Albert Matlack

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-II (Physical Chemistry)

Max. Marks: 70

Total Periods: 120

SECTION – I

UNIT-I :

(a) POLAROGRAPHY:

(20 Periods)

Instrumentation factors influencing diffusion current, quantitative analysis. Derivation of Ilkovic equation for instantaneous current (with the use of Ficks laws) and also for mean diffusion current. Criterion for diffusion current. Relation between instantaneous current and mean current. Reversible polarographic wave equation – cathodic wave, anodic, wave cathodic-anodic wave. Analysis of Reversible polarographic waves. Polarographic maxima of first and second kind, their suppression. Interpretation of maxima of the first kind and of the second kind, polarity of maxima of the first kind influence of cations and anions on positive and negative maxima. Evaluation of the instability constant of the complexation.

Oscillographic polarography with controlled potential, single, sweep method – summit potential – Randles-Sevcik equation and its limitations, Multi-Sweep method. Advantages and disadvantages of oscillographic polarography. Sinusoidal A.C. polarography, Ssquare-wave polarography, Pulse polarography (Basic principles).

(b) AMPEROMETRY:

Review of principle of Amperometry at one polarized electrode, Various amperometric titration curves, Amperometric indicators, Amperometric titrations with D.M.E. and rotating platinum microelectrode. Amperometry at dual polarized electrode – Principle and method – Dead stop end point.

UNIT – II CHROMATOGRAPHY

(20 Periods)

Theory of Chromatography

Methods of Elution – Ideal and Non-ideal Chromatography – Plate theory – Rate Theory – Reasons for Broadening of Bands – Van Deemter equation and significance of terms involved – Optimum Velocity – Resolution - Methods of Improve Resolution.

Gas Chromatography

Mobile Phase and criteria for its selection – Sample Introduction Techniques – Stationary Phases used in GSC and GLC – Supports for Liquid Stationary Phases – Selection of Columns – Packed, WCOT, SCOT, FSOT – Detectors FID, TCD, FPB, ECD, TID – Their merits and demerits – Temperature Programming in GC – Derivatization in GC – Qualitative analysis from retention parameters – Quantitative analysis

Liquid Chromatography

Principle of HPLC – Instrument and significance of each component – pumps – guard column – Stationary Phases (Solid, Liquid) – Bonded Phase Supports – Detectors UV absorption, Fluorescence Detectors, RI Detectors, Electrochemical Detectors – Normal Phase and Reverse Phase.

UNIT-III : NANOTECHNOLOGY and SURFACE CHARACTERIZATION

(20 Periods)

(a) Introduction to nanotechnology, Terminology like soft (condensed) matter, complex fluids Nanoparticles: Synthesis (top down and bottom up approach, Block copolymer nanoaggregates as templates for nanoparticle fabrication), characterization, properties and applications, Ferrofluids: Fabrication, properties and applications, Supramolecules: host guest chemistry involving crown ethers, cyclodextrins and calixarenes, molecular recognition

(b) Brief idea about methods for determining surface structures and composition- scanning electron microscopy (SEM), low energy electron diffraction (LEED), Auger electron spectroscopy (AES) and photon electron spectroscopy (PES or ESCA), surface chemistry in industrial process.

SECTION – II

UNIT-IV : ION SELECTIVE ELECTRODES: (20 Periods)

Membrane potential, Principles of selectivity, Methods of evaluating selectivities separate and mixed solution method. Solid state electrodes – Glass electrode effect of glass structure on selectivity function of the glass electrode. Acid error, Alkali error, Silver halide, Sulphide, Lanthanum fluoride ion selective electrodes. Liquid ion exchange electrode – Calcium and potassium selective ion electrodes. Gas electrodes, ammonia, sulphur dioxide, oxygen and CO₂ sensing electrode, Micro ion selective electrode, enzyme electrodes. Quantitative determination – known addition method – known subtraction method.

UNIT -V ATOMIC SPECTROSCOPY (20 Periods)

Flame Emission Spectroscopy

Flame as a source of atomic vapour – Flames Atomization – Flame photometer – Applications and limitations comparison with AAS.

Plasma and Electrical Discharge Emission spectroscopy

Emission Spectroscopy with plasma sources –instrument- AES with electrical discharge – Electrodes of AES-DC-arc-spark –Laser microprobe – salient features of the emission spectrograph – Qualitative and Quantitative analysis applications .

Atomic Absorption Spectroscopy (AAS)

Principle of AAS – Instrument – Continuous Source and Line Source – Flames – Flame atomizers – Nonflame atomizers (furnaces) – Monochromators and Detectors – Interference with AAS Quantitative analysis with AAS – Applications – Numerical.

UNIT-VI PHYSICAL CHEMISTRY OF ADVANCED MATERIALS (20 Periods)

Glasses, ceramics, composites and nanomaterials. Glassy state, glass formers and glass modifiers, Applications. Ceramic structures, mechanical properties, clay products. Refractories, characterization, properties and applications, Microscopic composites, dispersion strengthened and particle-reinforced, fibre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.

Thin Films and Langmuir-Blodgett films

Preparation techniques, evaporation/sputtering, chemical processes, , sol-gel, etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

Liquid crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases, smectic-nematic transition and clearing temperature, optical properties of liquid crystals, Lyotropic phases and their description of ordering in liquid crystals.

High T_c materials: Defect perovskites, high T_c superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; applications of high T_c materials.

Books Recommended:

1. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
2. Fundamentals of Analytical Chemistry : Skoog D. R. and West D. M. (Holt, Rinehart & Winston, New York).

3. Chemical Analysis in Industry (in Gujarati) by M. N. Desai.
4. Instrumental Methods of Analysis by G. W. Ewing.
5. (Treatise on Analytical Chemistry, Ed. Kolthoff and Elving).
6. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons..
7. Principles of Polarography by Heynowaski and Kuta, Academic Press.
8. Modern Polarographic Methods, H. Schmidt, M. Van Stackelberg (Academic Press, New York), 1963.
9. Polarography of Metal Complexes, D. R. Crow (Academic Press, New York),
10. Gas chromatography by Littlewood.
11. Gas Chromatography by Bennet, Mogere and Saffarinki.
12. Instrumental Methods of Analysis by G. W. Ewing.
13. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons..
14. Selective Sensitive Electrodes by Moody & Thomas.
15. Ion Selective Electrodes by Durst.
16. Callister, W. D., Jr. Materials Science & Engineering: An Introduction John Wiley & Sons: New York.
17. Principles of Surface and Colloid Chemistry PC Heimenz, Marcel Dekker, New York

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
Physical Chemistry
PAPER-III (Polymer)

Max. Marks: 70

Total Periods: 120

SECTION – I

UNIT-I : REVIEW AND CHEMISTRY OF POLYMERIZATION (20 Periods)

(a) Basics:

Importance of polymers, Historical development of polymer science, Classification, Nomenclature, Isomerism, Configuration and conformation of chains, Intermolecular forces in polymers, Industrial Scenario, Polymer Waste Disposal and Remedies

(b) Chain (addition) Polymerisation and Step (condensation) Polymerization:

Review of distinguishing features of the two techniques, catalysts for free radical, anionic and cationic chain polymerization, Living polymerization and its implications, Ziegler-Natta polymerization: Catalysts and mechanism, Phase techniques in chain polymerization (bulk, solution, suspension, emulsion polymerization), Chain transfer reactions : chain transfer constant and their use, Advanced polymerization techniques (brief description on RAFT and ARTP)

Effect of temperature, inhibitors/retarders and autoacceleration on the rate of polymerisation, thermodynamic aspects of polymerisation.

Step polymerisation, kinetics of catalysed and non-catalysed step polymerisation, extent of conversion and DP, , methods of step polymerisation (dry, wet and interfacial), Criterion of monomer purity, statistics of linear step polymerisation, Non-linear step polymerisation and Carothers equation

(c) Synthesis and Applications of some industrially important common polymers

Addition polymers: (polyolefins and polydienes, vinyl polymers, acrylic polymers)

Condensation polymers: (polyesters, polyamides, polyimides and Polybenzimidazoles, polyethers, epoxies, polyurethanes, formaldehyde (PF,UF and MF) resins, Alkyd resins, polycarbonates, silicones, polysulphones

UNIT-II : COPOLYMERIZATION and COPOLYMERS (20 Periods)

Copolymerization -its technical significance, Types of copolymers, Kinetics of copolymerization, reactivity ratios and their determination, Mayo-Lewis method, Fineman-Ross method, Kelen-Turdos method, prediction of copolymer composition, ideal, alternate & azeotropic copolymerization the Q-e scheme, preparation of graft and block copolymers. Commercially important copolymers: their synthesis and applications.

Block Copolymers and Graft Copolymers : Types, Characterization, Some useful examples, Properties in solid state: Microdomain formation, Properties in solution, Block copolymer micelles, Aggregate shape and transitions, Analogy with surfactant aggregation, Solubilization in block copolymer micelles, Phase behavior of block copolymer–water system, Thermoplastic Elastomers, Polyblends versus block copolymers, Grafting methods, Grafting efficiency, characterization of graft copolymers, properties and applications solutions of block and graft polymers in selective solvents, adsorption of polymers from solution vis-à-vis colloid stability.

Ionomers, Interpenetrating network polymers, Dendritic and hyperbranched polymers

UNIT-III : CHARACTERIZATION OF POLYMERS

(20 Periods)

Average dimensions of a polymer coil, average end-to-end distance, average radius of gyration, the completely unrestricted chain, completely rigid polymer chain.

The concept of mol wt average in polymers, different mol wt averages and their significance, Molecular weight distribution and polydispersity index, methods to determine number mol wt (Vapour phase osmometry, membrane osmometry: theoretical expression for osmotic pressure, significance of second virial coefficient and solvent quality, and end group analysis, Light scattering method for mol wt determination: Zimm plot, Dynamic light scattering. Polymer fractionation methods, Gel permeation chromatography: theory of separation, instrumentation and technique. Intrinsic viscosity versus size of polymer coil and mol wt, Huggins and Kramer equations, Determination of constants of Mark-Houwink equation, Effect of molecular weight on the properties of polymers

Analysis and testing of polymers, Physical testing, spectroscopic methods (IR, NMR), Chromatographic Methods (GC, HPLC), Thermal methods (DTA, TGA, DSC).

SECTION – II

UNIT-IV : POLYMER SOLUTION BEHAVIOUR

(20 Periods)

Criteria for polymer solubility, polymer texture and solubility, dissolution and swelling of polymers and factors affecting swelling, effect of molecular weight and degree of crystallinity on dissolution, size and shape of polymer molecules in solution, thermodynamics aspects of polymer dissolution, solubility parameter and its uses and determination,

Thermodynamics of solutions of small molecules, thermodynamics of polymer solutions, Flory-Huggins theory, Entropy of mixing. Excluded volume effect and Flory interaction parameter and determination. Unperturbed dimensions of polymer coil, good/poor/theta and nonsolvents, viscosity of polymer solutions and the size of polymer coil, effect of mol.wt. on viscosity, determination of intrinsic viscosity in theta conditions,

Concentrated polymer solutions and physical gelation, Newtonian & Non-Newtonian solutions; Bingham plastics, pseudoplastics & dilatant materials under shearing force, power law; Viscoelasticity: creep & relaxation effects, time dependency of flow under constant load & constant strain--understanding in terms of suitable mechanical models.

Phase equilibria and phase separations in polymer solutions and their technological applications

UNIT-V : POLYMER MORPHOLOGY and PROPERTIES

(20 Periods)

Polymer crystallinity

Amorphous and crystalline polymers, fringe micelle model, factors affecting polymer crystallinity, degree of crystallinity in polymers and its determination, X-ray diffraction pattern of polymers, Helical structure, crystallization of polymers, Spherulites and crystallites, structures of polymers crystallised from melt, the fringe micelle concept, structure of spherulites, relation of spherulites to crystallites, polymer single crystals and chain folding during crystal formation, crystallizability and crystallinity, kinetics of crystallization (Avrami equation),

Effect of crystallinity on properties of polymer, Liquid Crystalline Polymers.

Thermal transitions in polymers

Melting versus glass transition

Differential scanning calorimetry (DSC) to characterize the phase transitions in polymers,

Glass transition temperature, its cause and importance, relation between T_g and T_m , factors affecting glass transition temperature, effect of plasticizers, blending and copolymerisation of T_g , , determination of glass transition method by dilatometry, Thermally stable polymers.

Physical Properties:

Characteristic features of fibres, elastomers and plastics, Different types of mechanical behaviour, effect of different factors on mechanical behaviour, Effect of molecular weight and cross-link density, effect of crystallinity, effect of fillers, effect of tacticity and effect of plasticisation, Viscoelastic behaviour, Kelvin and Voigt model, Dependence of viscosity on shear rate and stress dependence, Electrical behaviour of polar and nonpolar polymers, Temperature dependence of conductivity, Conducting polymers, Doping of polymers, Polyacetylene and Polyaniline.

Chemical Transformation:

Polymer degradation: Thermal, mechanochemical, oxidative & photo degradation, Cross-linking and curing reactions, cyclization reactions, Some important polymer reactions: hydrolysis, acedolysis, aminolysis, hydrogenation, addition & substitution reactions.

UNIT-VI : BIOBASED POLYMERS and POLYMER PROCESSING (20 Periods)

(a) Bio-based Polymers

Natural Polymers

Polysaccharides - Starch (structure and function, modification of starch by grafting, starch hydrolysates, Cellulose and its Derivatives, Modification of cellulose, cellulose based plastics, Dextran and its derivatives - synthesis, characterisation and medicinal applications, Food **Polysaccharides** – agar, carrageenans, alginates, pectin, chitin and chitosan, gums :

Polypeptides - Proteins and protein folding, protein classes such as caseins, whey proteins, soy proteins, egg proteins, wheat proteins and muscle proteins, Protein fibers – silk, hair and wool, Merrifield solid phase synthesis

Polynucleotides –Structure of nucleic acids

Polyisoprenes – Extraction and vulcanisation, of natural rubber, isomerism in polyisoprene

Biodegradable polymers: Introduction and overview of biodegradation, degradation of carbon chain polymers, oxo-biodegradation of polyolefins, biodegradable polyesters and their functional polymers, production, properties and modification of microbial polyhydroxyalkanoates, polylactic acid, polycaprolactone, bacterial copolymers,

Biomedical polymers: Hydrogels based on polysachhardies, polymeric hydrogels for drug delivery and tissue engineering, dextran hydrogels for protein release, biodegradable polymeric nanospheres for drug delivery, Implant polymers, Polymer drugs, **Stimuli-sensitive (smart) polymers:** pH- and temperature-sensitive smart polymers and their applications in biotechnology and medicine.

(b) Polymer Processing

Polymer Additives: Antioxidants, thermal stabilizers, UV stabilizers, antistats, colorants (organic dyes and pigments, inorganic pigments), flame retardants, curing agents, blowing agents, impact modifiers, lubricants, plasticizers, preservatives, processing aids, fillers.

Reinforcement: Their function and examples

Processing methods: Extrusion, injection moulding, calandring compression moulding, spinning.

BOOKS RECOMMENDED:

1. Seymour/Carraher's Polymer Chemistry Charles E. Carraher Jr Marcel Dekker
2. Textbook of Polymer Science, J. W. Billmeyer, John Wiley & Sons.
3. Physical Chemistry of Macromolecules, C. Tanford, John Wiley & Sons.
4. Macromolecules in Solution, H. Morowitz, Interscience Publ.
5. Introduction to Polymer, R. J. Young, Chapman & Hall.
6. Principles of Polymer Science : P. Bahadur & N. V. Sastry, Narosa.
7. Polymer Science – Gowarikar et al New Ages International.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
Physical Chemistry
Practicals

MSc Part II Physical Chemistry Laboratory [List of Practicals]

Note:

First few practical classes will be on general instructions about the laboratory practices:

Students should know about the material safety data sheets (MSDS), handling of reagents, safety and measures in the laboratory Information provided on the labels of reagent bottles, Catalogues of chemical and glassware manufacturing companies.

Students must be aware of analytical balances, technique of weighing, cleansing and calibration of glass ware, making solutions in different concentration units and their calibration. Laboratory note book and recording of data, error in data and its treatment. Report writing and presentation.

Students are also expected to know fullest use of a scientific calculator.

Computer should be used in experiments involving extensive calculations and graphs

List of Practicals:

1. To construct the phase diagram for three component system (CHCl_3 – Acetic acid – Water)
2. Determination of the primary salt effect on the kinetics of ionic reactions (Persulphate-iodide reaction).
3. Determination of rate constant, order of reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
4. Simultaneous spectrophotometric determination of -
 - i) Chromium and Manganese
 - ii) Cobalt and Chromium
5. Determinations of pK value of acid-base indicators (Methyl red / Methylene blue / Bromocresol purple) by spectrophotometry.
6. Stability constant of a complex formed by ferric ion and salicylic acid by mole ratio method
7. Photometric titration of iron-EDTA.
8. Determination of dissociation constant of a polybasic acids potentiometrically (Oxalic / Phosphoric)
9. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
10. To determine the degree of hydrolysis and hydrolysis constant for the hydrolysis of aniline hydrochloride by conductance method.
11. Salting effects of structure makers and structure breaker salts on solution
12. Identify and separate the components of a given mixture of amino acid. (Glycine aspartic acid, glutamic acid and tyrosine) by two dimensional paper chromatography.
13. Verification of Langmuir and Freundlich isotherms for adsorption of solutes (oxalic acid, dye) on adsorbents (charcoal, clays)
14. Viscosity of liquids and mixtures of liquids
15. Equivalence conductance of solutions of strong electrolytes and weak electrolytes. Application of Kohlrausch's law. Onsager constant.
16. Effect of substituents on dissociation constants of acids (acetic acid, chloroacetic acids) by conductance method
17. Instability constant of the silver ammonia complex potentiometrically
18. Determination of chloride and iodide ions in a mixture potentiometrically.
19. Study the ratio of complex formation formed by titration of Zn^{2+} with potassium ferrocyanide potentiometrically
20. Electrogravimetric determination of copper from solution

21. Determination of CMC of surfactant by conductance method and calculate thermodynamic parameters for micellization
22. Determine the effect of salts on the cloud point of nonionic surfactant
23. Preparation of simple colloids and determination flocculation value for different salts.
24. Determination of Ca^{2+} and Mg^{2+} in tap water etc. by flame photometrically
25. Determine aggregation of dyes spectrophotometrically
26. Determination of constants of Mark Houwink equation by viscosity method
27. To carryout fractionation of a polydispersed polymer
28. To examine the behaviour of polyelectrolyte in solution
29. Synthesis of some polymers
30. To calculate the surface area of adsorbed molecule in a monolayer, CMC, efficiency, effectiveness from surface tension measurements of aqueous solutions of surfactant
31. Alkaline fading of crystal violet in the presence of surfactants

Books Suggested for Practicals:

- 1] Findley's Practical Physical Chemistry, B.P.Levitt, Longman.
- 2] Practical Physical Chemistry, A.M.James and F.E.Prichanrd, Longman.
- 3] Experimental Physical Chemistry, R.C.Das and B.Behra, Tata McGraw Hill.
- 4] Advanced Physical Chemistry Experiments, Gurtu-Gurtu, Pragati Prakashan.
- 5] Experimental Physical Chemistry, V.D.Athawale and Parul Mathur, NewAge Int
- 6] Advanced Practical Physical Chemistry, J.B.Yadav, Goel Pub.Hosue.
- 7] Experiments in Physical Chemistry, Dr.D.V.Jahagirdar.
- 8] Systematic Experimental Physical Chemistry, Dr.T.K.Chondhekar & S.W.Rajbhoj
- 9] Experiments in Physical Chemistry, D.P.Shoemaker.