

## Applied Chemistry: 2nd Semester

### Detailed Syllabus

#### Paper-VII [Engineering Mathematics -I (Theory)] Full marks - 50

**Unit-I: Linear Algebra:** Algebra of matrices, inverse, rank, system of linear equations, symmetric, skew-symmetric and orthogonal matrices. Hermitian, skew-Hermitian and unitary matrices. Eigenvalues and eigenvectors, diagonalisation of matrices, Cayley-Hamilton Theorem.

**Unit-II: Calculus:** Functions of single variable, limit, continuity and differentiability, Mean value theorems, indeterminate forms and L'Hospital rule, Maxima and minima, Taylor's series, fundamental and mean value theorems of integral calculus. Evaluation of definite and improper integrals, Beta and Gamma functions, Functions of two variables, limit, continuity, partial derivatives, Euler's theorem for homogeneous functions, total derivatives, maxima and minima, Lagrange method of multipliers, double and triple integrals and their applications, sequence and series, test for convergence, power series.

**Unit-III: Complex Variable:** Analytic functions, Cauchy-Riemann equations, Application in solving potential problems, Line integral, Cauchy's integral theorem and integral formula (without proof), Residue theorem (without proof) and its applications.

=====

#### Paper-VIII [Material Science & Engineering -I (Theory)] Full marks - 50

##### Unit-I : Introduction

Brief history of emergence of Material science, Engineering materials, modern day groups - metals & alloys, ceramics, polymers, composites, other approaches of grouping; Property areas of engineering materials; inter relations and inter dependence of Material science, Material Technology and Material Engineering.

##### Unit-II : Structure & Diffusion

*A. Crystallography:* Structure of ionic solids: AB type and AB<sub>2</sub> type. concepts of lattice, lattice energy, symmetry, crystal class, crystal system, unit cell; identifications of crystal planes, directions and positions.

*B. Packing of spheres and packing in crystals:* Close packing and its properties, packing efficiencies and voids, constraints in close packing and chemical bond types.

*C. Imperfections in crystals:* Crystal defects: Perfect and imperfect crystals; point, line and plane defects. Schottky and Frenkel defects. Colour centres in alkali halide crystals.

*D. Non-crystalline structures:* Short and long range order, glass, polymer and others, general property differences with crystalline materials. Linear and three dimensional network structures for non-crystalline materials.

*E. Diffusion:* Fick's laws and application of diffusion in sintering, doping of semiconductors and surface hardening of metals.

### **Unit-III: Brief idea of Metals and Alloys, Ceramics, Polymers and Composites**

*A. Metals & alloys :* Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, iron-iron carbide phase diagram, heat treatment of steels, cold, hot working of metals, recovery, recrystallization and grain growth. Microstructure, properties and applications of ferrous and non-ferrous alloys.

*B. Ceramics:* Structure, properties, processing and applications of traditional and advanced ceramics.

*C. Polymer:* Classification, polymerization, structure and properties, additives for polymer products, processing and applications.

*D. Composites:* Properties and applications of various composites.

---

---

## **Paper -IX [Polymer Science and Technology-I(Theory)] Full marks -50**

### **Unit-I: Chemistry of high Polymer**

Monomer , functionality , degree of polymerization, Carother's equation, classification of polymers, glass transition, melting transition , criteria for rubberiness, Polymerization methods: addition and condensation & their kinetics, cationic and anionic polymerization & their kinetics, stereo-regular polymerization , copolymerization , monomer reactivity ratios and its significance , Kinetics, types of copolymerization, Polymerization techniques: bulk , solution, suspension, emulsion.

## Unit-II: Synthesis, Properties and Applications

*Thermosetting Polymers* : Phenol-formaldehyde resin, Urea-formaldehyde and Melamine-formaldehyde resins , Epoxy resin. Unsaturated polyester, Alkyds.

*Comodity and general purpose thermoplastics*: Polyethylene, Polypropylene, Polystyrene, Polyvinyl Chloride, Polyesters, Acrylic, PU polymers ,

*Engineering Plastics* : Nylon , Polycarbonate, Polybutylene Terephthalate , Polysulfone, Polyphenylene oxide , Acrylonitrile butadiene styrene, Fluoropolymers.

*Natural and synthetic rubbers*: Recovery of NR hydrocarbon from latex , Styrene -Butadiene rubber, Polychloroprene Rubber , Nitrile rubber, Butyl rubber, Ethylene-propylene-DieneTerpolymer, Polysulphide rubber, Polyacrylic rubber, Silicone, Thermoplastic Elastomers.

## Unit-III: Polymer Characterization

Solubility and swelling , concept of average molecular weight , determination of weight average , number average , viscosity average and Z-average molecular weights, Polydispersity and molecular weight distribution in polymers, Gel permeation chromatographic technique, Polymer crystallinity ,Analysis of polymers using IR, XRD, thermal ( DSC,TGA ,DMTA), microscopic (optical and electronic) techniques

---

---

### Paper -X Full marks -50

#### Group-A: Thermodynamics of Materials

Marks 25

Thermodynamic systems and variables; First, second and third laws of thermodynamics; Statistical interpretation of entropy; Free energy functions and criteria for equilibrium; Thermodynamics of solutions; Ideal and non-ideal solutions; Partial and molar quantities; Quasi-chemical model and regular solutions; Polynomial expressions for excess Gibbs energy of mixing for binary and higher order solutions; Multi-component dilute solutions and interaction parameters; Chemical reaction equilibrium, equilibrium constant; applications to

materials and metallurgical systems; Electrochemical systems, cell reactions and EMF, Formation and concentrations cells; Phase rule and binary phase diagrams; Free energy

composition diagrams; Phase equilibrium calculations; Introduction to ternary phase diagrams; Thermodynamics of interfaces; Surface tension and surface energy; Absorption and adsorption; Gibbs Thompson effect

## **Group-B: Quantum mechanics**

**Marks 25**

Black-body radiation, Compton Effect, Wave-particle duality, Uncertainty principle, Acceptable Wave functions, Postulates of Quantum Mechanics, Solutions of the one and three dimensional Schroedinger equation for systems – free particle, particle in a box, particle in a finite well, linear harmonic oscillator (. Reflection and transmission by a potential step and by a rectangular barrier, Solution of Time independent Schrödinger equation at higher dimensions and more complicated systems, Particle in a three dimensional box, linear harmonic oscillator and its solution, density of states, free electron theory of metals. The angular momentum problem. The spin half problem and properties of Pauli spin matrices, Approximate methods, Time independent and time dependent perturbation theory for non-degenerate and degenerate energy levels, the variational method, WKB approximation, adiabatic approximation, sudden approximation, Quantum computation ,Concept of quantum computation, Quantum Q-bits etc.

---

## **Paper-XI Inorganic Chemistry Practical**

**Full Marks: 50**

### **Unit-I :Detection of some important ions/radicals including rare elements,**

$\text{Ag}^+$ ,  $\text{Hg}_2^{++}/\text{Hg}_2^+$ ,  $\text{Pb}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{As}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ti}$ ,  $\text{Zr}$ ,  $\text{Mo}$ ,  $\text{W}$ ,  $\text{V}$ ,  $\text{U}$ .

### **Unit-II : Alloy Analysis**

- i) Cu in Brass.
- ii) Cr and Mn in steel.

### **Unit-III: Ore and Product analysis**

- i)  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  in dolomite/limestone.
- ii)  $\text{Fe}^{3+}$  in basic slag / cement.

### **Unit-IV: Gravimetric method of analysis**

Estimation of  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{Ni}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Zn}^{2+}$ .

### **Unit-V: Preparation of complex compounds and their analysis by**

- i) IR spectrophotometer
- ii) UV/Vis spectrophotometer
- iii) TGA/DTA
- iv) Metal analysis classical method

---

## **Paper-XII**

### **Group-A :Computational Laboratory-I (Practical)**

**Marks-20**

C Programming Laboratory: Problems should cover basic features of the Language

### **Group-B:Fuel testing (Practical)**

**Marks - 30**

- 1) Flash point & Fire point of fuel by Cleveland's open cup apparatus.
- 2) Flash point of fuel by Pensky Martin's 'closed' cup apparatus.
- 3) Kinematic viscosity of lubricating oil by Redwood Viscometer
- 4) Calorific value of fuel by Bomb Calorimeter
- 5) Proximate Analysis of coal