

## ANDHRA PRADESH

### RECRUITMENT OF ASSISTANT PROFESSORS IN THE UNIVERSITY SYLLABUS FOR THE SCREENING TEST

#### POLYMER SCIENCE & TECHNOLOGY

#### SUBJECT CODE - 53

**Genesis of polymers** – Historical development – Definitions – How are polymers made – Polymer chemical structures – classification – Thermoplastics & Thermosets.

Molecular weight & size-average molecular weight – number average and weight average molecular weight – sedimentation and viscosity – average molecular weight – molecular weight and degree of polymerization – poly dispersity and molecular weight distribution in polymers – significance of molecular weight – size of polymer molecules.

**Chemistry of polymerization** – introduction – chain polymerization – step polymerization – miscellaneous – polymerisation reactions – polymerization techniques.

Crystallinity in polymers – crystalline solids and their behaviour – polymers and X-ray diffraction – degree of crystallinity – crystallinity – polymer crystallisation – crystallites – structural regularity and crystallisability – other factors affecting crystallisability – helix structures – spherulites – polymer single crystals – effect of crystallinity on the properties of polymers.

**1. Molecular weight determination:** The existence of molecular weight distributions – definition of weight average, number average and viscosity average. Determination of number average molecular weight ( $M_n$ ) – End group analysis – cryoscopic methods. Ebulliometer methods. Membrane osmometry. Vapor phase osmometry. Comparison of data. Determination of weight average molecular weight  $M_w$ . Light scattering by larger particles – equilibrium – ultracentrifugation method – solution viscosity method.

**2. Glass transition temperature** – Glassy solids and glass transition – transitions and associated properties – factors influencing glass transition temperature – Glass transition temperature and molecular weight – plasticizers – Glass transition temperature of copolymers – Glass transition temperature & melting point – importance of glass transition temperature.

**3. Chemistry of polymerization** – main features of chain growth & step growth polymerizations. Different methods of chain growth polymerization. Free radical polymerization – methods of producing free radicals – mechanism of free radical polymerization – chain transfer – inhibition and retardation. Ionic polymerization – cationic and anionic polymerisation – living polymers. Co-ordination polymerization. Structure of Ziegler Natta catalysts – polymerisation mechanism.

**4. Ring opening polymerisation** – polymerizability of cyclic monomers – Polymerizability of cyclic monomers – Thermodynamic & kinetic considerations – Ring-opening polymerization of cyclic ethers – anionic polymerization of epoxides – cationic polymerization – polymerization of cyclic amides – Hydrolytic polymerization – cyclic polymerization of lactones.

**5. Polymer degradation & stabilization** –types of degradation – Thermal degradation – Thermal degradation – Photo degradation & stabilisation – mechanical degradation – Solvolytic degradation – Hydrolytic degradation – oxidative degradation – Biodegradation.

## **6. Industrial Polymers.**

Polyesters – Polyethylene terephthalate – Polybutylene terephthalate. Polyamides – Nylons – Polyolefines – Polyethylene – Polypropylene – Polystyrene.

**7. Polymer solutions** – The process of polymer dissolution – Nature of polymer molecules in solution – Size and shape of macromolecules in solution – viscosity of dilute polymer solutions – viscometry of concentrated polymer solutions.

## **CHEMISTRY**

**1. Molecular spectroscopy:** Basic principles- Fundamentals of electronic spectra-infrared-microwave- raman-NMR & ESR- Mossbauer spectroscopy.

**2. General Inorganic Chemistry** – redox reactions – modern concepts – oxidation number – balancing of oxidation-reduction reactions – oxidation-reduction potentials.

(b) Acids and bases- modern concepts of acids and bases – pearson theory of hard & soft acids and bases, buffer solutions – Ph, pKa and pKb scales.

**3. (a) Co-ordination Chemistry** - bonding in metal complex – important aspects of crystal field Theory – its applications and limitations.

**(b) Inorganic Polymers:** silicones-metal chelate polymers.

**4. Stereo Chemistry** - optical isomerism- symmetry rules – Absolute configuration-R&S concepts – Asymmetric induction (Cram's rules) stereo-specific addition to carbon – carbon double bond. Cis-Trans isomerism of C=C systems – E, Z configuration-stereo isomerism of aldoximes & ketoximes – Beckmann rearrangement.

**5. Mechanistic Organic chemistry** – Nucleophilic substitution at saturated carbon – SN1 and SN2 mechanism. Structure and solvent effects – Neighbour group participation-solvent effects –Aromatic electrophilic substitution-Friedel Craft's acylation-alkylation-diazocoupling reaction.

## **6. Equilibrium thermodynamics & Electro Chemistry**

**(a) Entropy and its change in reversible and irreversible processes** – Gibbs –Helmoltz equations- Vant Hoff reaction isotherm-third law of thermodynamics test for validity of third law.

Electro chemistry: theory of electrolytic conductance –Debye-Huckle & Onsager equation-wien effect – Falkehagen effect – experimental verification of onsager equation.

**(b) EMF Measurements:** Thermodynamics & kinetic derivation of Nernst eqn.

**7. Chemical Kinetics:** Theories of homogeneous gas phase reaction rates – Unimolecular, bimolecular, termolecular reaction, complexing reaction – opposing, consecutive & Parallel reactions-chain reactions – stationery & non stationery types – exploring limits.

Mechanism and rate expression for hydrogen chloride, hydrogen bromide and hydrogen – oxygen reactions.

## **PHYSICS**

**Atomic spectra :** Quantum number for atom-fine structure of hydrogen lines-stern and gerlach experiment-spectral terms and their rotational energy level diagrams for complex atom, L-S coupling terms-landes 9 factor in L-S and J.J.Coupling, Zeeman, paschen-Back and stark effect.

**Molecular Spectra** : Born-Oppenheimer approximation-Elementary concepts of LCAO Rotational spectra- Vibrational spectra-electronic spectra-vibrational isotope effect-frank condon principle-dissociation energies.

**U V and Visible Spectroscopy** : Beer-Lambert Law single and double beam spectrophotometers of visible & Ultraviolet spectroscopy-Applications of vis spectroscopy-structure of organic and inorganic compounds like lactone & lactam, tyrosine. Geometrical isomerism-Theory of U.V.Spectra - U.V.absorption spectrum of Benzene vapour, Detection of impurities. Structure of chloral.

**I.R & Raman Spectroscopy** : The vibrations of poly atomic molecules-I.R. & double beam spectrophotometers, Analysis of I.R. technique-Thymidine-Thio acetic acid classical theory of Raman effect-vibrotation – Raman CO<sub>2</sub>, N<sub>2</sub>O, SO<sub>2</sub> molecules.

**Semi conducting Materials** : Elemental, intermetallic, III-V, III-VI Compounds and organic semi conductors- Statistics of charge carriers in intrinsic and extrinsic semi conductors characterization of semi conducting materials-conductivity & Hall effect.

**Complex Materials** : Classification and basic properties of amorphous materials-glasses-ceramic materials-liquid crystals polymers composite materials-basic concepts.

**Operational Amplifier Fundamentals** : Block diagram of Op.Amp., Characteristics of the ideal Op-Amp Inverting and non-inverting configurations of Op-Amp., and analysis, Op-Amp. Specification-D.C. off set voltage, D.C.Offset current, common mode rejection ratio and slow rate different Op. Amp configurations-voltage follower, current follower and differential Amplifier. Frequency response of Op.Amp- Amplifier gain and frequency response. Slow rate and output voltage, Noise in the output voltage and external frequency compensation.