

Scientist B - Rubber Technology

Name of the post	Subject	Syllabus
Scientist B - Rubber Technology	Chemistry	Inorganic Chemistry: Atomic structure, periodic trends, chemical bonding (ionic, covalent, VSEPR), p-block, d-block, f-block elements, coordination compounds, lanthanides, actinides. Organic Chemistry: Nomenclature, isomerism (structural, stereoisomerism), reaction mechanisms (electrophilic, nucleophilic), spectroscopy (NMR, IR), functional groups (alkanes, alkenes, alkynes, aromatics), biomolecules (carbohydrates, proteins, nucleic acids). Physical Chemistry: States of Matter (gases, liquids, solids), Thermodynamics, Chemical Kinetics, Electrochemistry, Quantum Chemistry, Solutions, Surface Chemistry.
	Polymer Chemistry	Introduction & Fundamentals Basic Concepts: Definition, history, natural vs. synthetic polymers, plastics, elastomers, fibers. Structure: Monomers, repeating units, polymerization, chain structure (linear, branched, cross-linked), stereochemistry (isotactic, syndiotactic, atactic). Polymerization Mechanisms Addition Polymerization: Free radical, ionic (anionic, cationic), coordination (Ziegler-Natta), emulsion, suspension. Condensation Polymerization: Step-growth, formation of polyesters, polyamides, etc.. Characterization & Analysis Molecular Weight: Number-average weight-average, viscosity-average, distribution, determination methods (osmometry, light scattering, viscometry). Spectroscopy: IR, UV-Vis, NMR, Mass Spec. Thermal Analysis: DSC (Differential Scanning Calorimetry), TGA (Thermogravimetric Analysis), TMA (Thermomechanical Analysis) Physical & Mechanical Properties Phase Behavior: Crystalline vs. amorphous regions,

		crystallinity, spherulites, effect on properties. Transitions: Glass Transition Temperature, Melting Temperature Rheology: Viscosity, viscoelasticity, chain entanglement. Mechanical Properties: Tensile strength, hardness, impact resistance, creep, fatigue. Polymer Processing & Technology Compounding & Additives: Fillers, plasticizers, stabilizers. Processing Techniques: Extrusion, injection molding, blow molding, compression molding, calendering, film casting. Polymers: Polyethylene (PE), Polyvinyl Chloride (PVC), and Polystyrene (PS), Polypropylene (PP). Specialty Polymers: Inorganic polymers (silicones, phosphazenes), biodegradable polymers, conductive polymers.
	Polymer / Rubber Technology	Polymer Science: Monomers, polymers, degree of polymerization, classification (thermoplastics, thermosets, and elastomers), natural vs. synthetic polymers, copolymers. Polymerization: Addition (bulk, suspension, emulsion) and condensation polymerization; techniques and mechanisms. Molecular Structure: Molecular weight & distribution, crystallinity, glass transition temperature, amorphous vs. crystalline states, stereochemistry. Materials & Properties Thermoplastics: PE, PVC, PP, PS properties, identification, uses. Elastomers: Natural rubber (NR), SBR, NBR, EPDM, silicone; properties, monomers, compounding. Properties: Mechanical (tensile, impact, fatigue, creep), thermal, optical (haze, refractive index), viscoelasticity, rheology (viscosity, MFI). Processing & Fabrication Compounding: Additives, fillers, two-roll mills, Banbury mixers, kneaders. Fabrication: Extrusion, injection molding, blow molding, calendering, spinning (fibers). Rubber Processing: Latex processing (concentration, coagulation), sheet rubber production, product manufacturing. Testing & Quality Control Polymer Testing: Melt Flow Index (MFI), impact tests (Charpy, Izod),

		hardness, MFI, density. Product Testing: Testing of specific items like pipes, gloves, tires (tensile, adhesion, endurance). Polymer Science Basics: Polymer Chemistry & Physics. Structure-Property Relationships (Tg, elasticity). Thermodynamics of Polymers. Materials & Compounding: General Purpose Rubbers: Natural Rubber (NR), SBR, BR, IIR. Specialty Rubbers: Nitrile, Neoprene, EPDM, Silicone, FKM, Polyurethanes. Compounding Ingredients: Vulcanizing agents, fillers (carbon black, silica), activators, antioxidants, plasticizers, etc. Processing Technology: Mixing: Two-roll mills, internal mixers (Banbury), continuous mixers. Shaping: Extrusion, calendaring, fabric coating, spreading. Molding: Compression, transfer, injection molding. Latex Technology: Latex compounding, frothing, molding, testing (mechanical stability, hardness). Testing & Quality: Rheometry, physical testing (tensile strength, elongation), aging tests. Standards and specifications for raw rubber (TSR) and finished products. Thermoplastic Elastomers (TPEs). Nanotechnology in rubber. Recycling and Reclaiming Rubber.
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