

# Sri Guru Granth Sahib World University

## Department of Nanotechnology

### Syllabus for PhD Entrance Test:

**Basics of nanotechnology:** Scientific revolutions, Definition of a nano system, Top down and bottom up approaches, 1-, 2- & 3-dimensional nanostructures, Quantum confinement, Evolution of band structures, Dimensionality and size dependent phenomena, Fraction of surface atoms, Misnomers and misconceptions of Nanotechnology.

**Applications of nanomaterials:** Food and Cosmetic applications, Textiles, Paints, Catalysis, Drug delivery and its applications, Biochips- analytical devices, Biosensors.

**Properties of nanomaterials:** Electrical, mechanical, chemical, magnetic etc. properties of various nanomaterials.

**Crystal Imperfections:** Point defects, Line defects, Surface defects, Movement of Dislocation, Dislocation energy

**SEM;** Instrumentation, Source of electron beam, Focusing of electron beam.

**TEM;** Instrumentation, Line diagram, Role of magnetic lenses, Electron diffraction pattern.

**Scanning Probe Microscopy:** Types of probe and their role, tip diameter, Different scanning mode of AFM, Image analysis.

**X-ray diffraction:** Generation of X-rays, Types of X-rays, Characteristics X-rays, Powder diffraction, Crystallite size measurement using Scherrer Formula, Peak broadening.

**Thermal analysis:** DTA and TGA, Calculation of phase reaction.

**Spectroscopy Techniques:** FTIR, Functional group, Location of peaks for different functional group, bonding and stretching mode.

**UV visible spectroscopy:** Basics, Band gap, Direct-indirect band gap.

**Interference of Light,** Principle of Superposition, Theory of Biprism, Interference from parallel thin films, wedge shaped films, Newton rings, Michelson interferometer.

**Diffraction:** Fresnel and Fraunhofer Diffraction, Fraunhofer diffraction due to N slits, Diffraction grating, Dispersive and resolving power of grating.

**Polarization:** Brewster and Malus Laws. Double refraction, Quarter & half wave plate, Nicol prism, and specific rotation.

**Laser & Fibre Optics:** principle of Laser, stimulated and spontaneous emission, He-Ne Laser, Ruby Laser, Application of Lasers. Numerical aperture, step index and graded index fibres, applications of optical fibres.

**Quantum Mechanics & Statistical Physics:** De-Broglie Hypothesis, Davisson Germer experiment, wave function and its properties, expectation value, Wave Packet, Uncertainty principle. Schrodinger Equation for free particle.

**Elements of Electronics:** Semiconductors p-type, n-type, pn junction diodes, pn junction as a circuit element, its characteristics, half wave and full wave and bridge type rectifier circuits basic filter circuits, Zener diode as a voltage regulator. LED its characteristics construction & applications

**Chemical Bonding:** Atomic Bonding in solids, Types of bond: Metallic, Ionic, Covalent and vander Waals bond; Hybridisation; H-bonding Molecular orbital theory for simple molecules such as diatomic molecule etc. Types of Material: Metals, Semiconductors, Composite materials, Ceramics, Alloys, Polymers.

**Overview to Thermodynamics:** The first and second laws of thermodynamics. Thermodynamic functions, heat capacity, enthalpy, and entropy.

**Water & its treatment:** Sources of water, impurities in water, hardness of water and its determination, units of hardness, alkalinity of water and its determination,

**Corrosion:** Corrosion and its prevention - Galvanic & concentration cell, Dry and wet corrosion, Electrochemical theory of corrosion,

**IUPAC Nomenclature:** Systematic IUPAC nomenclature of different classes of compounds including aromatic, bicyclic, and spiro compounds and polyfunctional compounds.

**Diffusion:** Fick's Law, mechanisms of diffusion; self-diffusion; the influence of the pressure and pressure gradient; Kirkendall effect; fast diffusion; influence of isotropic state; experimental methods of investigation of diffusion.