

Syllabus for LPUNEST Ph.D (Nanotechnology)

UNIT 1

Introduction to nanotechnology and nanoscale phenomena; size-dependent properties of nanomaterials; surface area to volume ratio and quantum confinement; classification of nanomaterials (0D, 1D, 2D, 3D); historical development and current trends in nanotechnology; Sustainable development goals (SDGs).

UNIT 2

Quantum mechanics basics; electron confinement and quantum wells; band theory of solids; optical properties of nanomaterials; surface plasmon resonance; electrical and magnetic properties of nanomaterials.

UNIT 3

Chemical bonding and molecular interactions; colloidal chemistry and nanoparticle stability; self-assembly and supramolecular chemistry; surface functionalization and modification; green synthesis of nanoparticles; Top-down approaches, Bottom-up approaches; Renewable energy resources; Water quality parameters (pH, alkalinity, hardness, conductivity).

UNIT 4

X-ray diffraction (XRD); scanning electron microscopy (SEM); transmission electron microscopy (TEM); atomic force microscopy (AFM); dynamic light scattering (DLS); UV-Visible spectroscopy; FTIR spectroscopy; Raman spectroscopy.

UNIT 5

Nanomedicine and drug delivery; nanoelectronics and sensors; environmental remediation; energy applications (fuel cells, hydrogen production, solar cells); nanotechnology in agriculture and food systems. Nanoparticles in biotechnology; biosensors and nano-biosensors; Bioaccumulation and biomagnification; Wastewater treatment processes.