

Course Code	Course Name	Credits
26BY610	BIONANOTECHNOLOGY	04

### Course Objectives

- To introduce the basic concepts, types, and structure of nanomaterials.
- To understand the properties and characterization techniques of nanomaterials.
- To explore the applications of nanomaterials in biological systems and diagnostics.
- To study the role of nanomaterials in drug delivery and their safety aspects.

### Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Explain different types and properties of nanomaterials.
- Understand and interpret basic characterization techniques.
- Describe the interaction of nanomaterials with biological systems and their applications.
- Evaluate the use of nanomaterials in drug delivery and assess their potential toxicity.

### Unit 1 - Basics of Nanomaterials (12 Hrs.)

Introduction to nanoscale and its importance. Definitions and history of nanotechnology. Types and classification of nanomaterial (polymer, carbon, inorganic, organic, biomaterials). Structure and basic properties. Methods of synthesis (top-down and bottom-up).

### Unit 2- Properties and Characterization (12 Hrs.)

Optical properties (UV-Vis, fluorescence). X-ray diffraction (XRD). Imaging techniques (SEM, TEM) and size analysis (DLS, zeta potential). Surface composition. FT-IR and Raman spectroscopy (SERS). Magnetic, electrical and electrochemical properties.

### Unit 3 -Nanomaterials in Biology (12 Hrs.)

Interaction of nanomaterials with proteins, lipids, DNA and RNA. Protein targeting and small molecule interactions. Nanomaterial–cell interactions. Surface modification and basic biocompatibility.

### Unit 4- Nanomaterials in Diagnostics (12 Hrs.)

Use of nanomaterials in imaging (MRI). Surface-modified nanoparticles. MEMS/NEMS applications. DNA/peptide-coupled nanoparticles. Lipid nanoparticles in diagnostics and biosensors.

### Unit 5 - Drug Delivery and Toxicity (12 Hrs.)

Nanoparticles in drug delivery (metal and metal oxide nanoparticles). Antimicrobial applications. Magnetic nanoparticles in therapy (hyperthermia). Toxicity studies: cytotoxicity, genotoxicity and basic safety aspects.

### Reference Books:

1. Poole, C. P., Jr., & Owens, F. J. (2003). Introduction to nanotechnology. Wiley.
2. Bhushan, B. (Ed.). (2017). Springer handbook of nanotechnology (4th ed.). Springer.
3. Cao, G., & Wang, Y. (2011). Nanostructures and nanomaterials: Synthesis, properties and applications (2nd ed.). World Scientific.
4. Ratner, M. A., & Ratner, D. (2003). Nanotechnology: A gentle introduction to the next big idea. Prentice Hall.
5. Niemeyer, C. M., & Mirkin, C. A. (Eds.). (2004). Nanobiotechnology: Concepts, applications and perspectives. Wiley-VCH.
6. Sahoo, S. K., & Labhasetwar, V. (Eds.). (2008). Nanotechnology in drug delivery. CRC Press.
7. Kumar, C. S. S. R. (Ed.). (2006). Nanomaterials for medical diagnosis and therapy. Wiley-VCH.