Course Code	Course Name	Credits
26PH611	NANOSCIENCE AND TECHNOLOGY	04

Course Objectives

- To give a comprehensive training in the theory related to processing, characterization of advance materials and engineering components.

Learning Outcomes

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

- Understand about introduction to an overview over nanotechnology.
- Understand about its various applications and characterization techniques.

Unit 1 – Background To Nanoscience (12 Hrs.)

Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

Unit 2 – Types of Nanostructure and Properties (12 Hrs.)

One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

Unit 3 - Nano and Bio Sensors (12 Hrs.)

Introduction to sensors- Micro and Nano-sensors-Fundamentals of sensors-micro fluids-Packaging and characterization of sensors-Sensors for aerospace and defense-Organic and inorganic nanosensors- Biosensors-Clinical diagnostics-generation of biosensors-Nano material based biosensors-Biosensors based on nucleotides and DNA-Electron transfer of bio-molecules-Nanomaterial based biosensors.

Unit 4 – Characterization Techniques (12 Hrs.)

X-ray diffraction (XRD)- Scanning electron microscope (SEM with EDAX)- Transmission electron microscope (TEM)- Fourier transform infrared spectroscopy (FTIR), UV-Visible -Spectrophotometer- Differential Thermal Analyzer (DTA) and Thermo gravimetric Analysis (TGA).

Unit 5 - Application of Nanomaterial (12 Hrs.)

Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.

Reference Books:

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), Cambridge University Press.
4. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester, 2002.

Websites and eLearning Sources:

1. https://onlinecourses.nptel.ac.in/noc19_mm21/preview
2. https://youtu.be/Ml1bk9wDXVo?si=-tCP3soEk45jYdZp
3. https://youtu.be/huKUJsqik2I?si=4JPziySFZhFGp0rh

COs and Bloom's Taxonomy Mapping – 26PH611		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain the fundamentals of nanoscience including size effects, atomic structure, and surface phenomena.	K1, K2
CO2	Apply concepts of nanostructures to understand properties of one-, two-, and three-dimensional materials.	K3
CO3	Analyze nanosensors and biosensors including their working principles and applications in various fields.	K4
CO4	Analyze characterization techniques such as XRD, SEM, TEM, FTIR, and thermal analysis methods.	K5
CO5	Evaluate and design nanomaterial-based systems for applications in electronics, environment, and biotechnology.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH611													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	1	3	2	1	1	1	1	1.58
CO2	3	3	2	2	1	1	2	3	2	2	2	1	2.00
CO3	3	3	3	2	1	1	2	3	3	2	2	2	2.25
CO4	3	3	3	2	2	1	2	3	3	2	2	2	2.33
CO5	3	3	3	3	2	2	3	3	3	3	2	2	2.58
												Total	2.15

Mean Score: 3- High, 2- Medium/Moderate, 1-Low