Course Code	Course Name	Credits
26PH112	NANO SCIENCE	04

Course Objectives

- To understand the fundamentals and significance of nanoscience
- To study types and properties of nanomaterials
- To learn nanosensors and characterization techniques
- To explore applications of nanomaterials

Learning Outcomes

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

- Explain basic concepts and properties of nanomaterials
- Classify different types of nanostructures
- Understand nanosensors and their applications
- Analyze characterization techniques like XRD, SEM, TEM
- Apply nanomaterials in various technological fields

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 nano sensors- Biosensors-Clinical diagnostics-generation of biosensors-Nano material 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), 11:830-831,Cambridge University Press.
4. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester, 2002.
5. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.

Websites and eLearning Sources:

1. https://nptel.ac.in/courses/113106093
2. https://youtu.be/Gq1bXx1HWfQ?si=dQZLIx2p55MwepYi
3. https://youtu.be/1_M8FdYJJ2c?si=NngGUsVBcP12RiTt

COs and Bloom's Taxonomy Mapping – 26PH112		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall key terms and list important concepts in nanoscience, including nanostructures, properties of nanomaterials, and types of nanostructured materials.	K1
CO2	Explain the principles of nanotechnology and the unique properties of nanomaterials compared to their macro counterparts, including the impact of size and surface area on material properties.	K2
CO3	Apply characterization techniques to analyze various nanostructured materials, demonstrating proficiency in methods such as X-ray diffraction (XRD) and scanning electron microscopy (SEM).	K3
CO4	Analyze experimental data from characterization techniques to identify patterns and correlations related to the properties and performance of nanomaterials in applications such as biosensors and nano electronics.	K4
CO5	Critically evaluate the effectiveness of different types of nanomaterials in specific applications and design an innovative project that proposes new uses for nanotechnology in fields like biomedical engineering or environmental science.	K5, K6

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

Relationship Matrix – 26PH112													
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	1.50
CO2	3	2	2	1	1	1	3	3	2	1	1	1	1.75
CO3	2	3	3	2	1	2	1	2	3	2	1	2	2.00
CO4	2	3	3	1	1	2	1	2	3	2	2	2	2.00
CO5	2	3	2	2	1	3	1	2	2	3	3	3	2.25
												Total	1.90

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

FULLY HUMAN
Fully
Alive