



## VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)

Ibrahimbagh, Hyderabad-500 031, Telangana State

### DEPARTMENT OF PHYSICS

Open elective Course

### FUNDAMENTALS OF NANO MATERIALS AND THEIR APPLICATIONS

L : T : P	Credits	CIE		SEE		Course Code
		Marks	Exam Duration	Marks	Exam Duration	
03 : 0 : 0	03	40	90 min	60	3hours	U19OE610PH

<b>Course objectives</b>	<b>Course outcomes</b>
<b>Students will be able to learn</b>	<b>At the end of the course students will be</b>
<ol style="list-style-type: none"> <li>Learn bulk, thin and nano structures</li> <li>Acquire knowledge on properties of nano materials</li> <li>Appreciate fabrication techniques of nano materials</li> <li>Learn nanomaterial characterization techniques.</li> <li>Appreciate application of nano materials</li> </ol>	<ol style="list-style-type: none"> <li>Distinguish bulk, thin and nano materials from the point of view of size effects</li> <li>List various properties of nano materials</li> <li>Narrate various nanomaterial preparation techniques</li> <li>Describe necessary characterization techniques of nano materials</li> <li>Write various applications of CNTS and nano structures.</li> </ol>

#### UNIT-I: INTRODUCTION TO NANOSCIENCE

Distinction between bulk, thin and nano materials-surface to volume ratio, change of electronic structure, density of states of thin and nano materials, quantum confinement-quantum size effect-Reduction of dimensionality, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional).

#### UNIT-II: PROPERTIES OF NANO MATERIALS

Material behavior at reduced dimensions, Electrical properties: conductivity, surface scattering, ballistic transport Magnetic properties: Soft magnetic Nano-crystalline alloy, Permanent magnetic Nano-crystalline materials, Giant Magnetic Resonance, chemical properties, optical properties and thermal properties.

#### UNIT-III: NANOMATERIALS PREPARATION TECHNIQUES

Bottom-up and Top-down approaches. Preparation techniques Bottom-up methods: Physical Vapor Deposition, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Solgel method ,Self assembly, top-down methods: ball milling, Nano-lithography, Spark plasma sintering.

#### UNIT-IV: NANO MATERIAL CHARACTERIZATION TECHNIQUES

Characterization techniques: X-Ray Diffraction (XRD), working principles of Scanning Electron Microscopy (SEM), working of Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM).

#### UNIT-V: CARBON NANO MATERIALS AND APPLICATIONS

Graphene, Elementary ideas on Carbon nanotubes, CNTs, types of CNTs-single wall (SWCNT) and multiwall carbon nanotubes (MWCNT), properties and characteristics of SWCNTS and MWCNTS. Applications of nano materials in Cosmetic sector, Food, Agricultural, engineering, automotive Industry, environment, medical applications, Textiles, Paints, Energy, space Applications, nanosensors and nanocatalysts.

#### Learning Resources:

- B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, Text Book of Nano Science and Nano Technology –University Press (India) 2013
- K.K. Chattopadhyay and A.N. Benerjee, Introduction to Nanoscience and Nanotechnology , PHI, 2019

+

Prof. G. Prasad  
OU nominee, OU

Prof. Anjan Kumar Giri  
Subject Expert, IIT-H

Prof. S. Srinath  
Subject Expert, UOH

Dr. P.K. Jain  
Subject Expert, ARCI

Prof. A.S. Sai Prasad  
Head and BOS, Dept Phy, VCE

Dr. V. Satyanarayana Murthy  
Subject Expert, BITS PILANI-HYD