NANO TECHNOLOGY

Course Code	20ME4701E	Year	IV	Semester	I
Course Category	Professional Elective- III	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	Level	UNIT
CO1	Understand the basic concepts and applications of Nanotechnology, nano material and nano structures	Understand	L2	1,2,3,4,5
CO2	Describe different classes of nano materials.	Understand	L2	2
CO3	Illustrate the processes for synthesizing and characterizing nano materials	Apply	L3	3,4
CO4	Choose nano materials for different applications	Apply	L3	5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H: High, M: Medium, L: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	1				1			2	2	1
CO2	3	1	2	2	2				1			2	2	1
CO3	3	2	1	2	3				1	3	1	2	2	1
CO4	3	1	1	2	1	2	2		1			2	2	1

Syllabus

UNIT	Contents	Mapped COs
I	**BASICS OF NANOTECHNOLOGY:** Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nano system–Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms– Surface energy and surface stress- surface defects -Properties at nanoscale (optical, mechanical, electronic, and magnetic).	CO1
II	**DIFFERENT CLASSES OF NANOMATERIALS:** Classification based on Dimensionality-Quantum Dots, Wells and Wires, Carbon- based nanomaterial (buckyballs, nanotubes, graphene), Metal based nanomaterials (nanogold, nano-silver and metal oxides), Nanocomposites - properties, advantages and disadvantages over conventional composites.	CO1, CO2
III	**SYNTHESIS OF NANOMATERIALS:** Bottom-up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol gel method, Top down approaches: Mechanical alloying, Nano-lithography, Physical Methods: Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis.	CO1, CO3
IV	**CHARACTERIZATION OF NANOSTRUCTURES:** X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron	CO1,

	Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunnelling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.	**CO3**
V	**APPLICATIONS OF NANOMATERIALS:** Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.	**CO1, CO4**

Learning Resources

Text Books:

1. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.
2. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

References:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Nabok A., "Organic and Inorganic Nanostructures", Artech House, 2005.
3. Dupas C., Houdy P., Lahmani M., "Nanoscience: Nanotechnologies and Nanophysics", Springer- Verlag Berlin Heidelberg, 2007.