		L	T	P	C
15NT101	**ELEMENTS OF NANOSCIENCE AND NANOTECHNOLOGY**	**3**	**0**	**0**	**3**
	Total Contact Hours – 45				
	Prerequisite				
	Nil				

PURPOSE	
Enabling the Students to learn the basics of Nanotechnology.	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the fundamentalsof Nanotechnology
2.	To give a general introduction to different classes of nanomaterials
3.	To impart basic knowledge on various synthesis and characterization techniques involved in Nanotechnology
4.	To make the learner familiarize with nanotechnology potentialities

UNIT I -BASICS AND SCALE OF NANOTECHNOLOGY (9 hours)

Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem –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).

UNIT II - DIFFERENT CLASSES OF NANOMATERIALS (9 hours)

Classification based on dimensionality-Quantum Dots,Wells and Wires-Carbon based nano materials (buckyballs, nanotubes and graphene)– Metal based nano materials (nanogold, nanosilver and metal oxides) - Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics -Biological nanomaterials.

UNIT III - SYNTHESIS OF NANOMATERIALS (9 hours)

Chemical Methods: Metal Nanocrystals by Reduction - Solvothermal Synthesis-Photochemical Synthesis - Sonochemical Routes- Chemical Vapor Deposition (CVD) – Metal Organic Chemical Vapor Deposition (MOCVD) - **Physical Methods:**Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).

UNIT IV – FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES (9 hours)

Nanofabrication: Photolithography and its limitation - Electron beam lithography (EBL) - Nanoimprint – Softlithography patterning. **Characterization:**Field Emission Scanning Electron Microscopy (FESEM) – Environmental Scanning Electron Microscopy (ESEM) - High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)- X-ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy (AES) – Rutherford backscattering spectroscopy (RBS).

UNITV –APPLICATIONS (9 hours)

Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Linear and nonlinear optical and electro-optical properties, applications in displays and other devices - Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology – Nanotoxicology challenges.

TEXT BOOKS

1. T. Pradeep, " *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. Nabok A., "*Organic and Inorganic Nanostructures*", Artech House, 2005.
2. Dupas C., Houdy P., Lahmani M.,"*Nanoscience: Nanotechnologies and Nanophysics*", Springer-Verlag Berlin Heidelberg, 2007.

15NT101 ELEMENTS OF NANOSCIENCE AND NANOTECHNOLOGY												
Course designed by		**Department of Physics and Nanotechnology**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X				X						X
2	Mapping of instructional objectives with student outcome	1,2				4						3
3	Category	General (G)			Basic Sciences (B)			Engineering Sciences &Technical Arts (E)			Professional Subjects (P)	
											X	
4	Broad area (for ‘P’category)	Nanoscience			Nanobio technology			Nanoelectronics			Nano fabrication	
		X									X	
5	Approval											