Course Code	Course Title	L	T	P	C
1152BM113	INTRODUCTION TO NANOTECHNOLOGY	3	0	0	3

a) Course Category Program
Elective

b) Preamble
The course introduces the underlying principles and applications of the emerging field of nanotechnology. It introduces tools and principles relevant at the nanoscale dimensions. Also it discusses current and future nanotechnology applications in biomedical engineeringand electronics.

c) Prerequisite
Basic physics and material science.

d) Related Courses
Nil

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain about theunderlying principles in nanotechnology	K2
CO2	Explain nanomaterials synthesis processes and fabrication techniques	K2
CO3	Explain different nanomaterial characterization techniques	K2
CO4	Describe the application of nanotechnology in biomedical engineering	K2
CO5	Describe the usage of nanotechnology in electronics	K2

f) Correlation of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L											
CO2	L	M	H	H	H								H	
CO3	H	M	L											
CO4	H	M	L											
CO5	L	L	L											

g) Course content

UNIT IINTRODUCTION **9**

History, background scope and interdisciplinary nature of nanotechnology, scientific revolutions, nano sized effects surface to volume ratio, crystal structure, atomic structure, molecules and phases, energy bands- insulators, semiconductors and conductors, Nanoscale-molecular and atomic size, quantum effects.

UNIT IINANOMATERIALS SYNTHESIS **9**

Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples.Chemical Methods - Precipitation Method, Sol-Gel Method, Sonochemical Synthesis, Hydrothermal, Thermal DecompositionProcess.Physical Methods-Ball milling, Physical Vapor deposition (PVD), Chemical Vapor deposition (CVD), Sputter Deposition, Lithography techniques.Biological methods- Synthesis using micro-organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

UNIT IIIMATERIAL CHARACTERIZATION TECHNIQUES **9**

Compositional and Structural Characterization techniques: X-ray, Principles and applications of X-ray diffraction; electron diffraction, Surface characterization Techniques- High resolution microscopy; Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).Spectroscopic techniques: Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy techniques.

UNIT IVNANO IN BIOMEDICAL APPLICATIONS 9

Introduction, Biological building blocks - size of building blocks and nanostructures, Nanomaterials in drug delivery and therapeutics, Nanomedicine, Targeted nanoparticles for imaging and therapeutics

UNIT VNANO IN ELECTRONICS APPLICATIONS 9

Introduction, Electronic structure of Nanocrystals, Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantum dot, Single electron devices, Nanostructured ferromagnetism, Effect of bulk nano-structuring of magnetic properties, Dynamics of nanomagnets, Nanocarbonferro-magnets, Giant and colossal magnetoresistance, Introduction of spintronics, Spintronics devices and applications.

Total 45 Hrs.

h) Learning Resources Text Books

1. T. Pradeep , "NANO The Essential , understanding Nanoscience and Nanotechnology".Tata McGraw-Hill Publishing Company Limited, 2007.
2. Introduction to Nanotechnology, Charles P.poolejr. and frank J.Owens,wileyinterscience.
3. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R.Rao, A. Muller and A.K. Cheetham
4. Fundamentals of Nanoelectronics by George W. Hanson (Pearson Education, New Delhi)

Reference Books

1. Nanotechnology and Nano Electronics – Materials, devices and measurement Techniques by WR.Fahrner – Springer
2. Nanotechnology Principles and Practices by Sulabha K. Kulakarni.