

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME468	Nanotechnology	3-0-0-3	2016
Prerequisite : Nil			
Course Objectives:			
<ul style="list-style-type: none"> • To introduce nanotechnology and nanostructures • To introduce fabrication and characterization techniques used in nanotechnology 			
Syllabus:			
Introduction and scope, nanostructures Effect of Nanoscale dimensions on various properties, Fabrication methods, Characterisation methods, Applications of Nanotechnology (nano materials and devices), Nanomachines, Nanofluids, Nanoswitches, nano computers, nanofilters			
Expected Outcomes:			
The students will be able to			
<ol style="list-style-type: none"> i. Understand properties of materials at nanoscale ii. Know the fabrication and characterization methods used in nanotechnology iii. Acquaint with the various applications of nanotechnology 			
Text books:			
<ol style="list-style-type: none"> 1. A.K. Bandyopdhyay, Nanomaterials, , New age international publishers,2008 2. Bharat Bhushan, Springer Handbook of Nanotechnology, 2010 Charles P Poole, Frank J Owens, Introduction to Nanotechnology, John Wiley and Sons, 2003 3. Jeremy Ramsden,Nanotechnology, William Andrew, Elsevier, 2011 4. T Pradeep, Nano: The essentials, McGraw – Hill education,2 007 5. V.S.Muralidharan, A Subramnya,Nano science and Technology, Ane books Pvt Ltd 			
Reference books:			
<ol style="list-style-type: none"> 1. Gregory Timp, Nanotechnology, Springer-Verlag, 2009 2. John Mongillo, Nano Technology, Greenwood Press, 2007 3. Kelsall Robert. W, Ian Hamley, MarkGeoghegan, Nanoscale Science and Technology, Wiley Eastern,2005 			
COURSE PLAN			
Module	Contents	Hours	End Sem. Exam. Marks
I	Introduction and scope-Classification of nanostructures: Quantum dots, quantum wires, quantum wells, nanoclusters, nanotubes, super lattices, nanocrystalline materials-Effects of nanometer length scale – Changes to the system total energy, changes to the system structures.	7	15%
II	Effect of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.	7	15%
FIRST INTERNAL EXAMINATION			

III	Fabrication methods: Top down and bottom up approaches-Top down processes: Milling, Lithographics, machining process, pulsed laser methods- Bottom up processes: Vapour phase deposition methods, PVD, CVD, electro deposition, plasma assisted deposition process, MBE, chemical methods, colloidal and solgel methods	7	15%
IV	Characterisation methods: General classification of characterization methods, Microscopy techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Diffraction Techniques-Spectroscopy Techniques – Raman Spectroscopy, Surface analysis and depth profiling- Mechanical Properties- Magnetic and Thermal properties.	7	15%
SECOND INTERNAL EXAMINATION			
V	Applications of Nanotechnology (nano materials and devices)- Applications of nanocomposites, nanocrystalline materials, nano layered structures, nanomagnetic materials-magneto resistance- Carbon nanotubes: SW, MW, nanostructured coatings- nano sensors: order from chaos, characterization, perception, nano sensor based on quantum size effect, Electrochemical sensors, Sensors based on physical properties, Nanobiosensors, smart dust	7	20%
VI	Nanomachines: covalent and non covalent approaches, Molecular motors and machines, molecular devices, single molecular devices, practical problems with molecular device- Nanofluids: nanoparticles, preparation of nanofluids, thermophysical properties of nanofluids in comparison with base fluid. Nanoswitches - nano computers- nanofilters	7	20%
END SEMESTER EXAMINATION			

Question Paper Pattern

Maximum marks: 100

Time: 3 hrs

The question paper should consist of three parts

Part A

There should be 2 questions each from module I and II

Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

There should be 2 questions each from module III and IV

Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

There should be 3 questions each from module V and VI

Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.