

Course No.	Course Name	L-T-P-Credits
CY 540	Nano Science and Technology	3-0-0: 03
Prerequisite: NIL		
Course Objectives:	The main objective of the course is to introduce and provide a broad view of the promising field of nanoscience and nanotechnology to the students. Another important objective of the course is to introduce the importance of interdisciplinary interactions among science, engineering, industrial management to solve the various problems in our society.	
Course Outcomes:	After successful completion of the course, students will be able to: <ol style="list-style-type: none"> 1. Learn about the background on nanoscience. 2. Understand the synthesis of nanomaterials and their application as well as the impact of nanomaterials on the environment. 3. Apply their learned knowledge to develop new nanomaterial. 	
SYLLABUS		
Module	Contents	Hours
I	Introduction Definition of a nanosystem, dimensionality and size dependent phenomena, surface to volume ratio, surface energy, surface defects and the properties at nanoscale.	06
II	Different Types of Nanomaterials Classification based on dimensionality – 0D (quantum dots), 1D (wires), 2D (nanodisks), 3D (nanoparticles); carbon based nanomaterials (buckyballs, nanotubes, graphene); metal based nanomaterials (gold, silver) and metal oxides; nanocomposites.	06
III	Synthesis of Nanomaterials Bottom-up approaches: Chemical precipitation and co-precipitation, sol-gel synthesis, microemulsions or reverse micelles techniques, solvothermal synthesis, thermolysis routes, microwave heating synthesis, sonochemical synthesis, photochemical synthesis, synthesis in supercritical fluids. Top-down approach: Ball milling, photolithography, electron-beam lithography (EBL).	08

IV	<p>Introduction to Characterization of Nanomaterials</p> <p>Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Field emission scanning electron microscopy (FESEM), High resolution transmission electron microscopy (HRTEM), Scanning tunneling microscope (STM), Atomic force microscope (AFM), Scanning probe microscopy (SPM), Photoelectron spectroscopy (PES), powder XRD for the study of nanomaterials, structures of nanomaterials by diffraction techniques, electroanalytical techniques, Raman scattering, miscellaneous techniques.</p>	10
V	<p>Applications of Nanomaterials</p> <p>Applications in solar energy conversion and catalysis, Surface Enhanced Raman Scattering (SERS), nanoelectronics, topological insulator, nanomaterials for biological and environmental applications.</p>	06

Essential Readings:

1. M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, "Nanotechnology: Basic Science and Emerging Technologies", Overseas Press India Pvt Ltd, New Delhi, 1st Edition, 2002.
2. T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd, 1st Edition, 2012.

Supplementary Readings:

1. C. N. R. Rao, A. Müller and A. K. Cheetham, "Nanomaterials Chemistry: Recent Developments and New Directions", Wiley VCH, 1st Edition, 2007.