

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCHD502	Nanotechnology	3	0	0	3

Course Objective

To address the fundamental concepts of nanotechnology, synthesis and characterization techniques for nanomaterials.

Learning Outcomes

Students will have an insight into the area of nanotechnology and its application in chemical engineering problems.

Unit No.	Description of Lectures	Lecture Hrs.	Learning Outcomes
1.	Introduction to nanotechnology: History, definitions, particle size, chemistry and physics of nanomaterials, safety issues with nano-scale powders.	6	Student will learn basic of nanotechnology.
2.	Preparation of nanomaterials: Top down and bottom up approach, synthesis of different nanomaterials. theory of nucleation and growth.	10	Student will learn different synthesis techniques of nanomaterials.
3.	Characterization of nanoparticles: Scanning probe microscopes (atomic force microscopy, scanning tunnelling microscopy), transmission electron microscopy, scanning electron microscopy.	10	Student will learn different characterization tools.
4.	Nanocomposites: Nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters.	9	They will familiar of fundamentals of different nanocomposites.
5.	Nanomaterials application: Application of nanoparticles and nanomaterials in different fields of chemical engineering, biotechnology, sensors, etc.	7	They will learn the engineering application of nanomaterials.
	Total	42	

Textbooks:

1. Kulkarni, S. K. (2007). *Nanotechnology Principles and Practices*, Capital Publishing.
2. Rogers, B. Pennathur, S. Adams, J. (2008). *Nanotechnology: Understanding small systems*, Taylor and Francis.
3. Ajayan, P. M. Schadler, L. S. and Braun, P. V. (2004) *Nanocomposite Science and Technology*, Wiley.

Reference Books:

1. Regis, E. (1995) *Nano: The Emerging Science of Nanotechnology*, Back Bay Books.
2. Cao, G. and Wang, Y. (2004) *Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*, World Scientific.