

Basic Sciences, Civil, Electrical & Mechanical Engineering Department

PhD and M.Tech

I	Course Code	PH 225003			
II	Course Title	Advancement of Nanoscience and Nanomaterials			
III	Credit Structure	L	T	P	C
		3	1	0	4
IV	Prerequisite	NIL			
V	Course Coordinator	Dr. Dheeraj Kumar Singh (Physics)			
VI	Course Content	<p>Synthetic Routes for Design of Nanomaterials: Physical Routes (High energy ball milling, Melt mixing, Physical vapor deposition, Laser ablation, Sputter deposition, Electric arc), Chemical Routes (Chemical precipitation and co-precipitation; Sol-gel method, Microemulsions or reverse micelles, L-B films, Solvothermal synthesis) Biological Routes (Using biomembranes, DNA, Enzymes, Plant extract-based synthesis, Herbal molecules, Microorganism-based synthesis), Hybrid Routes (Electrochemical, Chemical vapor deposition, Particle arresting in glass or zeolites or polymers, Micro emulsion-zeolite).</p> <p>Diversified Nanostructures and Nanomaterials: Carbon nanotubes (CNT), Graphene and its derivatives, Fullerenes, Quantum dots, and Semiconductor nanoparticles, Metal nano colloids, Nucleation and growth of Nanoparticles, Metal-based nanostructures, Nanoclusters and nanowires, Polymer-based Nanostructures including dendrimers, metal oxide nanoparticles, Self-assembly of nanostructures, Core-shell nanostructures, Nanocomposites.</p> <p>Characterization Techniques: Measurement of properties-particle size, Crystal structures, Morphological and nano structural features, XRD, XPS, DLS, TEM, SEM, STM, AFM, Spectroscopic techniques such as Raman, UV-Vis and FT-IR.</p> <p>Nano for Energy Devices: Introduction of energy storage/conversion devices, Solar/photovoltaic (PV) cells, Solar cell technologies (Si-wafer based, Thin film, GaAs based, dye-sensitized, PESC, organic solar cells, Quantum Dot Solar cells).</p> <p>Nanotechnology for Drug Delivery System: Nanoparticle surface modification for drug delivery, Multifunction Au-nanoparticle as drug delivery vehicles, Hydrogels for drug delivery, Modified Ag-nanoparticle for Photodynamic Therapy of cancer.</p>			

VII	Assignments/Seminar:	Assignment on advancement of nanotechnology and nanomaterials Seminar on one of the topics of nanoscience and nanotechnology
VIII	Text/References	<ol style="list-style-type: none"> 1. M. Kuno, Introductory Nanoscience, Garland Science 2011. 2. E. L. Wolf, Nanophysics and Nanotechnology, Wiley-VCH 2006. 3. G. Cao, Nanostructures and Nanomaterials, Synthesis, Properties and Applications, Imperial College Press 2004. 4. T. Pradeep, Nano: The Essentials Understanding nanoscience and nanotechnology, Tata McGraw-Hill Publishing Company Limited New Delhi, 2007. 5. H. S. Nalwa (Editor), Encyclopedia of Nanoscience & Nanotechnology, Vol. 10, American Scientific Publishers 2004. 6. A. S. Edelstein and R. C. Cammarata, Nanomaterials Synthesis, Properties and Applications, IOP Publishing Ltd 1996. 7. C. P. Poole Jr. and F. J. Owens, Introduction to Nanotechnology, Wiley 2003. 8. H. S. Nalwa (Editor), Nanostructured Materials & Nanotechnology Concise Edition, Academic 2001. 9. W. A. Goddard, D. W. Brenner, S. E. Lyshevski, Gerald J. Iafrate, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2003. 10. H. F. Tibbals, Medical Nanotechnology and Nanomedicine, CRC Press (Taylor & Francis), 2011.