BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2015-2016
Course Handout (Part II)

Date: 03/08/2015

In addition to part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **CHE G528**
Course Title : **Introduction to Nanoscience and Technology**
Instructor-in-charge : SONAL MAZUMDER

1. Scope & Objective of the Course:

The course deals with introduction to the underlying principles and applications of the emerging field of nanoscience and nanotechnology. Intended for a multidisciplinary audience with a variety of backgrounds. Introduces tools and principles relevant at the nanoscale dimension. It also familiarizes with characterization techniques. Some applications in the area of chemical engineering are discussed. It also discusses current and future nanotechnology applications in engineering, materials, physics, chemistry, biology, electronics and energy.

2. Text Book (TB):

Class lectures will cover most of the topics. However, the following textbook may be referred for the beginners.

Guozhong Cao, Nanostructures and Nanomaterials : Synthesis, Properties and Applications, Imperial College Press 2004.

3. Reference Book (RB):

1. Chattopadhyay K.K. & Banerjee A.N. "Introduction to Nanoscience and Nanotechnology", PHI learning Pvt. Ltd.1st ed., 2009.
2. Mitra P.K. "Characterization of Materials", PHI learning Pvt. Ltd.1st ed., 2014.
3. T. Pradeep, Nano: The Essentials Understanding nanoscience and nanotechnology, Tata McGraw-Hill Publishing Company Limited NEW DELHI, 2007.
4. A S Edelstein and R C Cammarata**."**Nanomaterials Synthesis, Properties and Applications **",** IOP Publishing Ltd 1996.

4. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Ref. (Text Book)
1	Introduction to Nanoscience and Nanotechnology	Course outline, Basic definition of nanoscience and nanotechnology, importance and relevance, scientists and inventors	Class lecture
2	Commercialization aspects of nanotechnology & Project topic discussion	Commercial materials available or in pipeline, commercialization challenges, scenario in India and other developing countries	Class lecture
3-6	Theory of nanoscience and technology	Crystal bonding and structure, energy bands, electrical transport in nanostructure (Quantum wells, wires & dots), Quantu mechanics (Bohr's model, wave-particle duality, wave function, Heisenberg's	RB 1: CH: 2,3,4,5

		uncertainty principle, Schrodinger equation, applications of Schrodinger equation)	
12-20	Synthesis of nanomaterials	Top down approach, bottom up approach, lithographic technique, non-lithographic techniques	RB 1: 6.1, 6.2, 6.3, 6.4
20-25	Classification of nanomaterials	Carbon based materials, metal based materials, self-assembly, composites , core-shell nanostrcutures.	TB, CH: 6
25-31	Properties of nanomaterials	Mechanical, optical, magnetic, dielectric, catalytic	TB, CH:8
32-33	Characterization tools of nanomaterials - I	Principle of X-ray diffraction , applications of X-rays (techniques & method, detection, analysis and calculation)	RB 3: Ch 4, 5
34	Characterization tools of nanomaterials - II	Electron microscopes – TEM, SEM, EMP, FESEM, AFM	RB 3: Ch 7
35-36	Characterization tools of nanomaterials - III	Spectroscopy methods – UV-visible, IR, FTIR, Raman, AES	RB 3: Ch 8
37	Nanomaterials in Chemical Engineering	Nanofluids, nanocomposites, nanofibers etc. in heat transfer, catalysis, membranes etc	Class lecture
38-40	Project	Presentations, report submission.	-

5. Evaluation Scheme:

Components	Duration	Weight age	Marks	Date & Time	Remarks
Mid Semester Test	90 min	30%	40	9/10 4:00 - 5:30 PM	CB
Paper discussion		40%	40	-	CB
Project			60		OB
Comprehensive Examination	3 hours	30%	60	11/12 AN	CB/OB

*This course is based on an emerging field and is highly interdisciplinary. Students are expected to be enthusiastic, creative and innovative in learning the course. This course will involve a lot of learning from books, websites and journal papers besides the stated handout.

6. Make-up Policy:

Make-up will be granted only for genuine cases with valid justification and prior permission of Instructor-in-charge.

7. Chamber Consultation Hour:

To be announced in the class.

8. Notices:

Notices, if any, concerning the course will be displayed on the Chemical Engineering Department Notice Board and Intra Bits Portal.

Instructor-in-charge
CHE G528