



**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**  
**INSTRUCTION DIVISION**  
**SECOND SEMESTER 2015-2016**  
**COURSE HANDOUT (PART-II)**

**Date: 06-01-2015**

In addition to part I (General handout for all courses appended to the timetable) this portion gives further details regarding the course.

**Course No.** : CHEM F336  
**Course Title** : Nanochemistry  
**Instructor-in-charge** : SUROJIT PANDE

**1. Course Description:** Introduction, importance of nanoscience, chemistry behind nano; Instruments to be used for characterizing nanomaterials; Diversity in nanosystems: chemical aspects of metallic, semiconducting nanomaterials, nanocomposites, carbon nanotubes and fullerenes, self-assembled monolayers, monolayer protected metal nanomaterials, core-shell nanomaterials; Applications of nano materials in nanobiology, nanosensors and nanomedicines, hands on experience in laboratory.

**2. Course Objectives:** This is an elective course for chemistry discipline. Throughout the semester we will discuss the properties of nanomaterials and its dependence on shape, size, and functional groups, which enable us to employ nanomaterials for device applications. Applications are limited in the fields of biology, sensors, medicine, and machines. However, in this course we will try to address the most important concepts and applications of Nanochemistry in recent research.

By the end of the semester, you will be able to:

- Learn the importance and properties of nanomaterials
- Gain the idea of synthesis and characterization of nanomaterials
- Study semiconductor nanoparticles and nanocomposite materials
- Investigate different nanosystem, carbon nanotube, fullerenes etc.
- Learn various application of nanomaterials in catalysis, biological, and device application
- Perform laboratory techniques of central importance to explore the idea of nanosystem
  - Liquid magnets
  - Bimetallic nanoparticles
  - Metal nanoparticles in catalysis

**3. Text Book:** T. Pradeep, Nano: The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

**4. Reference Book:** (1) T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2012.





- (2) G. Cao and Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, 2nd edition, World Scientific Series in Nanoscience and Nanotechnology, Vol 2, 2011  
(3) C. P. Poole Jr. and F. J. Owens, Introduction to Nanotechnology, Wiley Int. science 2003.  
(4) Nanomaterials, B. Viswanathan Narosa Publishing House, New Delhi

#### 5. Course plan:

L. No.	Learning Objectives	Topics to be covered	Ref. to Text book
1	Introduction	Nano the beginning, concept, importance	Class note
2-7	Metal nanoparticles: syntheses, characterization, properties, applications	Syntheses, properties of monolayer and polymer capped metal nanoparticles, Mie theory, controlling the size and composition of the metallic cores of nanoparticles, Sensoric and photoelectrochemical applications, catalysis, Anisotropic metal nanoparticle, Nanostructure: 2D array, 3D Superlattice, Bimetallic nanoparticles	
8-10	Instruments for the characterization of nanomaterials	Electron microscopes, Scanning probe microscope, X-ray diffractometer	
11-16	Semiconducting nanoparticles: Syntheses, properties, characterization and applications	Quantum dots, Electronic structure, Semiconductor nanoparticle polymer composite, Optical properties	
17-21	Nanocomposite materials	What are composite materials; Classification of nanocomposites: Nonpolymer based nanocomposites; Polymer based composites; Biocomposites	
22-25	Sell-assembled monolayers	Monolayers on gold, patterning monolayers, Langmuir Blodgett films, Applications of films in LED, Non-linear optical properties	
26-28	Carbon nanotubes	Syntheses, Structures, physical properties, Electronic properties, Mechanical Properties and applications	





29-31	Fullerenes	Syntheses and purification, Properties, Nanostructured fullerene films, Applications in electrocatalytic aspects and photoelectrical conversion of light energy	
32-35	Nanoparticles in catalysis	Introduction of nanoparticles in catalysis, Methods of preparation of supported metal nanoparticles, Applications of nanomaterials in various fields of catalysis	
36-41	Nanoparticles in Biological and biomimetic applications	Colloidal gold bioconjugates, Metal cluster conjugates, DNA and nanoparticles, DNA recognition, Biomimetic applications: Carbohydrate-protein and carbohydrate-carbohydrate interactions, Nanomaterials as delivery systems	

**6. Lab work during the semester:**

- Demonstration of liquid magnet
- Role of gold and silver nanoparticle in catalysis
- Bimetallic nanoparticles

**7. Evaluation Scheme:**

Component	Weightage%	Date /Time/Venue
Mid Semester Test	30 (Closed Book)	17/3 9:00 - 10:30 AM
Tutorial test	15	Continuous
Seminars/Lab/Report	15	-----
Comprehensive Exam	40 (Close/Open Book)	10/5 FN

**Chamber Consultation Hour:** To be announced in the class

**Make-Up:** Make up would be considered only for **regular students having genuine reasons.**

**Notice:** Notices, if any, concerning the course will be displayed on the **in Nalanda website only.**

**SUROJIT PANDE**  
**Instructor-In-Charge**  
**CHEM F336**

