



SECOND SEMESTER 2022-2023

Course Handout Part II

Date: 16/01/2023

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. : **CHEM F336**
Course Title : **Nanochemistry**
Instructor-in-charge : **Balaji Gopalan**
Instructor : -

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.

- 1. Scope & Objectives:** This is an elective course for chemistry discipline. Nanomaterials are ubiquitous in nature. Understanding the properties and its dependence on shape, size, and functional groups enables us to employ these nanomaterials for device applications. We will introduce the various nanosystems, study their properties and applications. Applications are limited in the fields of biology, sensors, medicine, and machines. The course also provides an opportunity to learn the synthetic techniques of nanomaterials, characterizations, familiar with various equipments etc.
- 2. Text Book :** T. Pradeep, Nano: The Essentials, Understanding nanoscience and Nanotechnology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
- 3. Reference Book:** 1) C. P. Poole Jr. and F. J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.
2) S. M. Lindsay, Introduction to Nanoscience, Oxford, 2010
3) G. Cao, Nanostructures and Nanomaterials, Imperial College press, 2004
4) Nanomaterials, B. Viswanathan Narosa Publishing House, New Delhi

4. Course Plan

Lect. No.	Learning Objectives	Topics to be covered	Learning outcomes	Reference to Text book
1	Introduction	Nano the beginning, concept, importance	Origin of size effect, dimensionality surface to volume ratio	Class note
2-5	Instruments for the characterization of	Electron microscopes, Scanning probe	Fundamental physical	T1 2.1 –

	nanomaterials	microscope, X-ray diffractometer, XPS	processes involved in characterization techniques	2.6
6-10	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	Concepts in synthesis, role of ligands, stabilization of colloids, optical properties of metals, self-assembly and structures	T1 8.1 – 8.6 T1 9.1 – 9.5
11-15	Semiconducting nanoparticles: Syntheses, properties, characterization and applications	Quantum dots, Electronic structure, Semiconductor nanoparticle polymer composite, Optical properties	Defect chemistry, Excitons, concepts in synthesis, optical properties	T1 7.1 – 7.6
16-20	Sell-assembled monolayers	Monolayers on gold, patterning monolayers, Langmuir Blodgett films, Applications of films in LED, Non-linear optical properties, Functionalization, superlattices	Preparation of monolayers, characterization techniques, properties	T1 5.1 – 5.7
21-23	Carbon nanotubes	Syntheses, Structures, physical properties, Electronic properties, Mechanical Properties and applications	Graphite structure, Structure-property relationship, property characterization tools	T1 4.1 – 4.9
24-27	Fullerenes	Syntheses and purification, Properties, Nanostructured fullerene films, Applications in electrocatalytic aspects and photoelectrical conversion of light energy, graphene	Structure-property relationship, property characterization tools (Raman spectroscopy)	T1 3.1 3.12
28-32	Nanoparticles in catalysis	Introduction of nanoparticles in catalysis, Methods of preparation of supported metal nanoparticles, Applications of nanomaterials in various	Mechanisms in catalysis, rate law, industrial important reactions	Class notes

		fields of catalysis		
33-36	Nanocomposite materials and Nanoshells	What are composite materials; Classification of nanocomposites: Nonpolymer based nanocomposites; Polymer based composites;	Microstructure-property relationship in materials	Class notes T1 10.1 to 10.5
37-39	Nanosensors	Based on optical properties, electrochemical sensors	Principle in sensor applications, lithography	T1 12.1 – 12.10
40-42	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	Interface chemistry, basic aspects imaging and drug delivery science	T1 11.1 – 11.7 T1 13.1 – 13.7

5. Evaluation Scheme:

EC No.	Evaluation Component.	Duration (min)	Weightage (%)	Date, Time & Venue.	Nature of Component.
1	Midsem	90	25	18/03 9.30 - 11.00AM	Closed book
2	Lab component/assignments		25	Continuous	Open Book
3	Class tests/assignments		15		Surprise Closed book
4	Comprehensive	180	35	19/05 FN	Closed book

6. Chamber Consultation Hours: To be announced through a separate notice.

7. Notices: Notices concerning the course will be displayed in the **CMS**.

8. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

9. Make-up-policy: Make up would be considered only for very **genuine reasons (such as institute deputation outside for sports/cultural fest, hospitalization (with appropriate documentary proof), marriage ceremony of siblings (not cousins))** and genuine grounds of sickness leading to hospitalization (**should be supported by medical documents**) etc.