

Course Title: Nanochemistry II

Course Code: CH-466

Credit Hours: 3-0

Pre-requisite: Nil

1. Course Objectives. The objective the course is to provide students with advanced concepts of nanochemistry and their applications in modern nanotechnology; it also aims to discern future perspectives of nanoscale materials in a chemistry related context.

2. Course Outcomes. The students will be able to develop a basic understanding of core concepts of nanochemistry, the effects that emerge due to nano-dimensions and the subsequent properties of nanomaterials. The course will facilitate the students to develop their knowledge concerning the preparation, characterization and development of nanoscale materials which paves a path to future research/academic achievement in nanotechnology and related interdisciplinary fields.

3. Course Outline

- a. Nano-scale in materials: an overview and history of nanoscience
- b. Effect of nano-dimensions on material properties
- c. Classification of nanomaterials by dimension
- d. Inorganic Nanomaterials
- e. Carbon based nanomaterials
- f. Nano-composites, dendrimers, metal-organic frameworks
- g. Surface effects in nanomaterials, surface energy, Laplace law, grain boundaries and nanocrystalline materials
- h. Surface modification strategies; quantum confinement
- i. Self-assembly in nanomaterials, forces of interaction, hierarchical assemblies
- j. Ostwald ripening, theory of nucleation and growth, La Mer theory
- k. Bottom-up synthesis techniques i.e. Sol-gel, co-precipitation and hydrothermal methods
- l. Nanofabrication techniques i.e. thin-film deposition, layer by layer assemblies, spin coating, dip-coating.
- m. Vapour deposition techniques i.e. PVD, CVD, sputtering
- n. Characterization methods: SEM, TEM, XRD, EDX
- o. Featured applications of nanomaterials in medicine, optics, energy and environment
- p. Nanotechnology: ethics and challenges

4. Text / Reference Books

- a. Ludovico Cademartiri, Geoffrey "Ozin, Concepts of Nanochemistry, Wiley, 2009.
- b. T. Pradeep, et al., A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Ltd (2012).
- c. G. Ozin, A. Arsenault, Andr & C. Cademartiri, Ludovico, Nanochemistry - A Chemical Approach to Nanomaterials, Royal Society of Chemistry (2009).
- d. Handouts