

Title	Advanced Materials Design	Number	CY7xx
Department	Chemistry	L-T-P [C]	3-0-0 [3]
Offered for	M.Sc./PhD (CY) Program	Type	Elective
Prerequisite			

Objectives

The Instructor will:

1. Provide a comprehensive overview of synthesis and characterization of bulk materials, nanoparticles, nanocomposites and hierarchical materials with nanoscale features.
2. cover the fundamental scientific principles controlling assembly of nanostructured materials; synthesis, characterization tools; new properties at the nanoscale, and
3. existing and emerging applications of nanomaterials

Learning Outcomes

The students are expected to:

1. Understand a variety of different methods for synthesizing materials.
2. Evaluate the synthesis methods against each other and be able to make assessments as to what form the final products will be.
3. Should be able to assess appropriate methods for the synthesis of stable nanomaterials

Contents

Introduction to Materials Chemistry: Structure, property and their relationship with materials performance (3 Lectures)

Semiconducting Materials Chemistry: Semiconductor Devices, Phase Change Materials in Memory Technology, Thermoelectric, Superconductors, Topological Insulators, Emerging materials in the device industry such as graphene and 2D materials.(8 Lectures)

Optical/Opto-electronic Materials: Light Emitting Diodes, Photosensors, Photovoltaics (6 Lectures)

Structural & Basic Applied Materials: Structural Materials, Amorphous Materials, Smart & Responsive Materials, Bio-inspired materials (8 Lectures)

Thermal Materials Application: Thermochromics (2 Lectures)

Energy Materials: Batteries and Supercapacitors, Fuel Cells, Hydrogen generation, Hydrogen storage, Carbon capture and sequestration (12 Lectures)

Student Seminars on Selected Topics from above

Textbooks

1. Fahlman, Bradley, (2011), Materials Chemistry, 3rd Edition, Springer
2. P. Yang (2003), The Chemistry of Nanostructured Materials, 1st Edition, World Scientific Publishing Company, Singapore

Reference Books

1. G. Cao, (2004), Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press: Hackensack, NJ
2. Goldstein, J.I. et al. (1992), *Scanning Electron Microscopy and X-Ray Microanalysis: A Textbook for Biologists, Materials Scientists and Geologists*, 2nd Edition, Springer, US.

Preparatory Course Material

1. Qureshi, M. *Chemistry of Materials*, NPTEL Course Material, Indian Institute of Technology Guwahati, <http://nptel.ac.in/courses/104103019/2>