DEPARTMENT OF CHEMICAL ENGINEERING

Syllabus

CHE 59808: Nanomaterials

Designation: elective course

Catalogue Description: Basic concepts and definitions of nanomaterials. Synthesis of nanoparticles and carbon nanotubes. Properties of nanomaterials based on quantum-confinement and surface-to-volume ratio. Scanning and electron probe technology for nanomaterials characterization. Application of nanomaterials. Societal impact of Nanotechnology.

Prerequisites: Junior or Senior Level
Co-requisites: none

Text: Material provided through instructor and review articles from literature.

Course Objectives:

After completing this course, students should

1) Be able to give examples of nanomaterials and rationalize why they are nanomaterials.
2) Be able to explain terms generally used in nanoscience and nanotechnology such as quantum dot, quantum confinement, scanning probe, quantum coral, photonic crystals, nanotubes, organic transitors, molecular electronics, molecular motors, core-shell particles, nanocomposites, and nanocatalysts.
3) Be familiar with synthetic routes to nanomaterials.
4) Be able to qualitatively explain familiar macroscopic phenomena such as phase transitions, diffusion and wetting, in terms of molecular motion and interactions.
5) Be able to explain how the dimensions of a material affect the interaction of light and matter.
6) Be able to predict trends in the mechanical properties of nanomaterials and nanocomposites as a function of the size of the nanomaterial.
7) Be familiar with the operating principles and limitations of scanning and electron probe techniques.
8) Be able to describe existing and potential applications of nanotechnology.
9) Be familiar with ethical, economical, environmental and health related issues associated with nanomaterials and their application.

Topics Covered:

1) Synthesis of Nanomaterials
2) Modeling of Nanomaterials
3) Mechanical Properties and Mechanics of Nanomaterials
4) Optical and Electrical Properties of Nanomaterials
5) Imaging Methods for Nanomaterials
6) Application of Nanomaterials/Nanotechnology Devices
7) Societal impact of Nanotechnology

Course Schedule: This class meets twice a week for a total of three academic hours over a fourteen-week semester. Out-of-class assignments stress problem-solving capability. A close-book mid-term exam will test the students' comprehension of the first four topics covered. A ten-page term paper on a nanomaterial is required instead of a final exam.
Grading: Assignments – 35%, in-class exams – 35%, term paper – 30%.

Contribution of course to meeting the professional component:
This is an elective subject for Biomedical, Chemical, Electrical, and Mechanical Engineering as well as Chemistry and Physics. The primary purpose of the course is to provide the student with a mastery of the fundamental concepts and applications of nanomaterials as related to Nanotechnology.

Relationship of course to program outcomes:
The outcomes for this course contribute to the following departmental educational outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in global and societal context;
i. a recognition for the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Instructor (person who prepared this description) and date of preparation.
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