

Proposed Module for Introduction to Engineering II (25.108)

Module Title: Introduction to Nanoscience and Nanotechnology

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Duration: 3 weeks

Abstract

Understanding the rapidly emerging fields of nanoscience and nanotechnology would be most beneficial to first-year undergraduate engineering students. This module gives a brief introduction to nanoscience and its link to nanotechnology by stressing important development areas, e.g., nanostructured synthesis, top-down and bottom-up assemblies, and hands-on experience in state of the art microscopy tools to evaluate nanoscale materials.

Planned Activities

The Week #1 lecture overviews the historical development of nanoscience highlighting the key landmarks over the last two decades. The main focus will be on materials synthesis and processing with an introduction to emergent nanosystems (bottom-up self-assembly), and hierarchical nanostructured assembly (top-down approaches). Bottom-up nanofabrication builds nanometer scale devices atom-by-atom via either self-assembly, or atomic manipulation using scanning probing microscopy. Top-down nanofabrication builds nanometer scale devices by lithography techniques, e.g., photolithography, e-beam lithography, focused ion beam lithography and nanoimprint etc. Cutting-edge analytical techniques will be introduced, e.g., transmission electron microscopy scanning electron microscopy and atomic force microscopy. The Week #1 lab would involve a tour of the NCOE and CHN laboratory facilities which would involve some directed hands-on experience with the latest microscopy tools. At the end of the tour students will be split into groups of three and each group given an assignment to select a topic in nanotechnology that interests them. Each group would have to work collectively and gather information on this topic and summarize their findings in the form of a professionally written report (template of both good and bad reports provided). This would also serve as homework that is due at the end of Week #2 lecture.

The Week #2 lecture will review the Week #1 lecture with fresh emphasis on gadgets and devices that can be built using nanomaterials. The latest trends in micro/nanoelectronics, data storage and bio-nanotechnology would also be introduced. The challenges, risk and opportunities to society and industry will be discussed. The Week #2 lab would involve each group submitting the previous week's homework and presenting their findings to the class using any available presentation style (handouts, using whiteboard, PowerPoint). These presentations will be evaluated by the instructor, although students would themselves be asked to evaluate each other on feedback sheets provided prior to each presentation (final decision by instructor).

Module Goals

The primary goal of this module is to make sure that all the students have a basic understanding of nanotechnology and nanoscale phenomena, and specifically: (i) to understand the difference between nanoscience and nanotechnology, (ii) to recognize common tools used to interrogate nanoscale phenomena, (iii) have a working knowledge of electronic and energy storage devices built using nanoscale materials, and (iv) be familiar with the risks associated with nanoscale materials.