Department of Materials Science and Engineering
University of Maryland, College Park, Maryland

1. **<u>ENMA 430 – Nanosized Materials</u>**

2. **<u>Credits and contact hours – 3 credits</u>.** The University of Maryland follows the Maryland Higher Education Commission's policies on "contact hours;" specifically, one semester hour of credit will be awarded for a minimum of 15 hours, of 50 minutes each of actual class time, exclusive of registration, study days, and holidays.

   Schedule: meets two 75 minute periods per week

3. **<u>Instructor's or course coordinator's name</u>: Prof. Oded Rabin**

4. **<u>Text book, title, author and year</u>:** None required
   a. Other supplemental materials: (a) Nanochemistry: A Chemical Approach to Nanomaterials by Geoffrey Ozin and Andre Arsenault, RCS Publishing; **Physical Properties of Carbon Nanotubes** by R Saito, G Dresselhaus & M S Dresselhaus, Imperial College Press; **(c)** Reviews from scientific journals

5. **<u>Specific course information</u>**
   a. **<u>Brief description of the content of the course (catalog description:</u>** Practical aspects of nanoscale materials fabrication and utilization will be covered. It presents various approaches for the synthesis of nanoparticles, nanowires, and nanotubes, and discusses the unique properties observed in these structures and devices made with them.
   b. **<u>Pre-requisites or co-requisites</u>:** PHYS431 or ENMA460; and (CHEM231 or CHEM481) and permission of the department.
   c. **<u>Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program</u>:** ENMA 430 is an elective course for Materials Science and Engineering majors.

6. **<u>Specific goals for the course:</u>**
   <u>a. Specific outcomes of instruction</u>: The course objective is to familiarize the student with the scientific concepts behind nanoscience and nanotechnology, and enable them to critically approach the scientific literature in the area and understand it. The focus will be on the relationship between structure, physical properties, and applications.
   (a) Understand the principles behind nanoscale synthesis methodologies.
   (b) Understand the size-dependence of properties of nanostructures.
   (c) Learn to summarize and present information from current scientific papers.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed in this course.

ABET A: Ability to apply mathematics, science and engineering principles to design
ABET C: Ability to design a system, component, or process to meet desired needs
ABET G: Ability to communicate effectively
ABET H: The broad education necessary to understand the impact of engineering solutions in a global and societal context
ABET J: Knowledge of contemporary issues.

7. Brief list of topics to be covered:

1. Introduction
2. Quantum Mechanics
    a. Electronic States and Band Structures in 0D, 1D, 2D, 3D
3. Nanoparticles
    a. Synthetic Approaches, Stability
    b. Nucleation, Growth and Ripening
    c. Quantization Effects
    d. Light Emission, Plasmons, Magnetism, Biomarkers, Heat Transfer
4. Carbon Nanotubes
    a. Synthesis, Related Structures
    b. Nomenclature
    c. Electronic Structure
    d. Fluorescence, Raman
    e. Devices – Merits and Challenges
5. Inorganic Nanowires
    a. Synthetic Approaches
    b. Alignment
    c. Devices – When anisotropy matters!