# *NME 498 – Nanoscience and Molecular Engineering* *(4 credits)* **Autumn 2010**

T/Th (Lectures) 2:30 - 3:50 p.m. (MGH 234) / Fri (Recitation): 2:30-3:20 p.m. (MOR 221)

This course connects fundamental aspects of nanoscale science with device and system applications. In six segments, students will explore nanotechnology and modern product development in molecular engineering, biomimetic engineering, nanothermodynamics and nanoparticle synthesis, electronic transport and nanoelectronic circuits, and finite size device applications involving quantum phenomena.

| ***Date*** | ***Topic*** | ***Instructor*** |
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| Sept. 30<br>Oct. 5<br><br><br>Oct. 8 | **Nanomaterials for Applications in Medicine and Biology**<br>This course segment will discuss functionalized nanomaterials used in biological systems. Topics will include: molecular interactions between natural and synthetic molecules with biological surfaces, design and synthesis of biomaterials that control cell function, and applications of novel biomaterials in drug delivery, immunoengineering, and tissue engineering.<br>*Recitation on Nanomaterials in Medicine and Biology (Woodrow)* | K. Woodrow (BioE)<br>woodrow@uw.edu |
| Oct. 7/12/14<br><br><br>Oct. 15 | **Nanothermodynamics and Nanoparticle Synthesis**<br>Based on the development of a small system description of the chemical potential, formalisms are derived to describe the crystal-melt interfacial energies and solubilites for nanosized systems. Via the Ostwald-Freundlich equation, the size-selective growth process of nanoparticles is discussed.<br>*Recitation on Nanothermodynamics (Overney)* | R. Overney (ChemE)<br>roverney@uw.edu |
| Oct. 19/21/26 | **Molecular Biomimetics – Peptide-Based Nanotechnology and Nanomedicine**<br>Within this course segment are addressed: Biocombinatorial selection, design and implementation of slid-binding peptides, their genetic conjugates, and molecular constructs as building blocks in synthesizing, assembling and fabricating addressable functional nanodevices, nanoprobes and nanobiosensors. | M. Sarikaya (MSE)<br>sarikaya@uw.edu |
| Oct. 28 | **Langmuir Adsorption Kinetics**<br>The basic aspects of Langmuir adsorption is discussed and problems worked.<br>and *Recitation on Molecular Biomimetics* | R. Overney (ChemE)<br>roverney@uw.edu |
| Oct. 29 | **EXAM 1** (CLOSED NOTES) | R. Overney (ChemE)<br>roverney@uw.edu |
| Nov. 2/4<br>Dec. 7<br><br>Dec. 5<br>Dec. 8 | **Basics of Micro- and Nano-Fabrication Applied to MEMS and Microfluidics**<br>Within this course segment techniques will be discussed that are employed in the design, fabrication and characterization of structures and devices at the micro and nanoscale. Particular focus is on the principle of micro-transducers and microfluidic devices.<br>*Recitation on Nano-Fabrication to MEMS (Böhringer)*<br>*Recitation on Nano-Fabrication to Microfluidics (Böhringer)* | K. Böhringer (EE)<br>karlb@uw.edu |
| Nov. 9 | **From Classical to Molecular Tribology**<br>This lecture introduces the students to phenomenological and molecular principles of friction dissipation during sliding. Addressed are contact forces and contact mechanics, dry friction and lubrication. A variety of tribological models are introduced. The lecture culminates in a molecular understanding of friction that entails both initial entropy reduction within the molecular systems followed by mode coupling to vibrational modes, and heat generation. | R. Overney (ChemE)<br>roverney@uw.edu |
| Nov. 16/18 | **Quantum Effects in Materials and Devices**<br>This course segment will address the role of quantum mechanical effects in the behavior of nanoscale materials and devices. For example, quantum-confinement effects and their relationship to the optical properties of | P. Reid (CHEM) |

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| Nov. 19 | materials such as semiconducting nanocrystals will be described.<br>*Recitation on Quantum Effects (Reid)* | preid@chem.washington.edu |
| Nov. 23/30<br>Dec. 2<br><br>Dec. 3 | **Transport and Band Gap Engineering**<br>This course segment will build on the previous seqment to address semiconductor device principles incorporating quantum phenomena. Means to control electron transport with both applied fields and effective fields built in through nanoscale materials engineering will be described.<br>*Recitation on Transport and Band Gap Engineering (Olmstead)* | M. Olmstead (PHYS)<br>olmstd@uw.edu |
| Dec. 10 | **EXAM 2** (CLOSED NOTES) | R. Overney (ChemE)<br>roverney@uw.edu |