MAE 656 – Nanoscale Energy Transport and Conversion

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Description:
As electronic, optoelectronic, photonic and fluidic devices shrink from the microscale down to the nanoscale, the mechanisms for transmitting heat, light and energy become dramatically different. This course aims to provide a detailed look at thermal, electrical and optical energy transport and conversion mechanisms at the nanoscale. Topics to be covered include: a brief review of macroscopic heat transfer with emphasis on limits of macroscopic models, microscopic picture of energy carriers, material waves, energy quantization and energy states in solids, statistical thermodynamics and probability distribution functions as related to thermal energy storage, energy transport by waves and classical particle descriptions of transport processes and energy conversion and exchange processes between carriers. Emphasis will be put on practical applications and nanoengineering principals including heat transfer in nanoelectronics, nanophotonic and nanofluidic devices and nanostructured energy conversion devices.

Date and Time:
Spring 2006, Lecture: TR 2:55-4:10, 4 credits, offered every two years. **Note revised time**

Prerequisite(s): Undergraduate heat transfer recommended (e.g., MAE 323) or permission of instructor.

Textbook(s) and other required material:
Required: Gang Chen "Nanoscale Energy Transport and Conversion: A parallel treatment of Electrons, Molecules, Phonons and Photons" Oxford University Press, 2005.

Additional materials will be taken from the recent literature and relevant texts such as Kittel "Solid State Physics", Wiley, 1995 (solid state) and Tien, Majumdar, Gerner, "Microscale Energy Transport" Taylor and Francis, 1998 (microscale energy transport), Born, Wolf "Principals of Optics" Cambridge, 1999 (EM and optics), Landau and Lifshitz "Quantum Mechanics" Pergamon Press 3rd Ed (Quantum Mechanics).

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