WASHINGTON STATE UNIVERSITY
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School of Mechanical Engineering and Computer Science

Mech 450: Advanced Topics for Nanoscience and Technology

Catalog Data:	**Mech 450 Advanced Topics for Nanoscience and Technology** 3 credits Introduces quantum mechanics, physics in low dimensional structures and materials; hands-on experience with scanning probe microscope. Credit not granted for both Mech 450 and Mech 550.
Class Schedule:	Two 50-minute lecture sessions per week, for one semester.
Laboratory Schedule:	One three hour lab session per week, for one semester.
Prerequisites by Course:	Mech 431 or c//.
Prerequisites by Topic:	Basic physics (mechanics and electromagnetics), introductory chemistry (physical chemistry), basic semiconductor devices
Required Texts:	1. Streetman, Banerjee, "Solid State Electronic Devices" Fifth edition, Prentice (Text of Mech 431) 2. Hall Keith Barnham and Dimitri Vvedensky, Editors, "Low Dimensional Semiconductor Structure", Cambridge University Press
Course Coordinator:	Dr. Daniel Chiang
Course Objectives:	1. Understand charge carrier transport phenomena by applying the principles of quantum mechanics. 2. Learn the principles of low dimensional structures and devices of traditional and polymer semiconductors. 3. Understand various operational modes of scanning probe microscopes (SPM), including STM, STS, SFM, SFS. 4. Advanced topics for nanoscale materials or devices (Field emission nanorod array and carbon nanotubes). 5. Use SPM to characterize nanoscale material or device properties. 6. Use TCAD software to model semiconductor devices and processes
Topics Covered:	1. Review of semiconductor devices 2. Organic semiconductor devices 3. Carrier transport in low dimensional structure: quantum well, quantum wire and quantum dots 4. Quantum effect devices (nanoscale devices) 5. Introduction to scanning probe microscope: STM 6. Vibration 7. Scanning force microscope: non-contact AFM, dynamic EFM and MFM 8. Field emission structure and devices 9. Computer simulation and modeling of semiconductors using TCAD
Course Outcomes:	Students will be able to: A-1. Draw band structure and density of state as a function of energy for 1-D, 2-D, and 3-D single free electron in macroscopic and quantum effect system. A-3. Identify the various scattering mechanisms of electrons in a crystal and describe how they impact electron transport. A-4. Apply quantum principles to multiple-quantum well semiconductor lasers, quantum dot resonant tunneling devices, and high speed hetero-structure devices.

	E-3. Use TCAD to model and simulate semiconductor devices. J-2. Describe economic characteristics of organic solar cells and LED devices as they relate to the production and consumption of energy. K-1. Set up and operate AFM for micro- and nano-scale measurements. K-4. Analyze the relationship between surface material properties and the AFM tip, vibration frequency, phase and amplitude using appropriate software tools.		
Required or Elective Course:	Elective		
Contribution to Professional Component:	Engineering Topics		
Relationship of Course to Program:	Meets: Educational Objectives 1, 2, 3, 4 Program Outcomes A, E, J, K		
Prepared by:	Dr. Daniel Chiang	Date:	November 1, 2006
Approved by CAC:			