WASHINGTON STATE UNIVERSITY
VANCOUVER
World Class. Face to Face.

School of Engineering and Computer Science

ECE 349: Principles of Solid State Devices
Master Syllabus

Catalog Data:	**ECE 349: Principles of Solid State Devices**; 3 credits Semiconductor theory; carrier diffusion and drift, direct and indirect energy materials, homo and hetero-junctions, operations principles of bipolar junctions and MOS field effect transistors, metal-semiconductor contacts. Typically offered in Fall.
Class Schedule:	Three lecture hours per week, for one semester.
Laboratory Schedule:	None
Prerequisites by Course:	CHEM 105, PHYS 202, ECE 325 or c//
Prerequisites by Topic:	Basic understanding of physics, chemistry, and semiconductor devices and their applications, including diodes, bipolar junction transistors and field-effect transistors.
Typical Text:	D. Neamen, *Semiconductor Physics And Devices*, Basic Principles, 4th edition, McGraw-Hill 2011
Course Coordinator:	Dr. Feng Zhao
Course Objectives:	Students will: 1. Describe and apply the semiconductor device equations based on the Shockley model, frequently used assumptions/approximation, and describe their limitations. 2. Recognize semiconductor statistics, excess carrier phenomena and recombination mechanisms. 3. Derive various boundary conditions in non-equilibrium p-n homo- and hetero-junction structures. 4. Analyze detailed characteristics of the bipolar junction transistor in both dc and ac modes of operation including the equivalent circuit models. 5. Describe metal-insulator-semiconductor theory and its application to the metal-oxide-semiconductor field effect transistors. 6. Recognize the non-ideal, performance limiting phenomena encountered as devices are scaled. 7. Understand fundamental principles behind the working of photonic devices such as LED's, solar cells and photodetectors.
Topics Covered:	1. Basics of Semiconductor Theory a. Basic equations b. Standard assumptions c. Mobility and conductivity d. Quasi-Fermi level e. Recombination 2. P-N Junction Theory a. Junction and interface in equilibrium b. Boundary conditions c. Transport problems d. P-N junction diodes

		3. Bipolar Junction Transistors a. Minority carrier profiles b. Current components and current gain c. Secondary effects d. Device models (Ebers-Moll and Gummel-Poon) e. Small signal response f. Heterojunction bipolar transistors 4. Metal Oxide Semiconductor Devices a. MIS theory b. MOSFET structures and models c. Modern and future MOSFET structures d. Metal-Semiconductor Junctions/Heterostructures 5. Photonic devices a. LED’s b. Photodetectors c. Solar Cells		
Lab Experiments and Activities:		None		
Course Outcomes:	Students will be able to:			
	Assessed for Student Outcomes	1-a. Demonstrate knowledge of fundamental semiconductor physics and devices. 1-b. Evaluate engineering approximations to identify operation of semiconductor devices in various operating regimes. 2-a. Define operation and characteristics of diodes and transistors under both steady-state and dynamic operations.		
	Other	1-d. Apply semiconductor statistics to calculate carrier concentrations in semiconductors as a function of temperature, doping and applied bias. 2-d. Produce solutions to satisfy designs for semiconductor devices.		
Relationship of Course to Program:		Meets: Educational Objectives 1, 2 Student Outcomes 1, 2		
Prepared by:		Dr. Feng Zhao	Date:	March 14, 2018; 3/21/18 (mb)