

ESG 333 MATERIALS SCIENCE II: ELECTRONIC PROPERTIES (REQUIRED)

Credit: 3

COURSE CATALOG DESCRIPTION:

After a review of quantum mechanics and atomic physics, the binding energy and electronic energy level in molecules and solids are discussed. The free-electron theory of metals is introduced and applied to the quantitatively via the Kronig-Penney model, and transport properties of metals and semiconductors are discussed in detail. The physical principle of pn junctions, transistors, tunnel diodes, etc. is explained. Fundamentals and applications of photoconductors, lasers, magnetic materials, and superconductors are also discussed.

PRE- OR COREQUISITE(S): ESG 281 or PHY 251; ESG 302 or CME 304

TEXT(S) OR OTHER REQUIRED MATERIAL:

Electronic Properties of Engineering Materials by James Livingston 0-471-31627-X (The older edition of this book with a green jacket is fine)

COURSE LEARNING OUTCOMES	SOS	ASSESSMENT TOOLS
Acquire a basic knowledge of the physics of electrical conductivity in metals and semiconductors	a b e f g i j k	exams, class participation special projects
Learn the application of quantum mechanics and statistical mechanics to the analysis of the PN junction diode	a b e g k	exams, class participation special projects

COURSE TOPICS:

Week 1-2. Metals: The Drude and Sommerfeld Models of Conductivity
Week 3 Hall Effect and Limitations of Free-electron Model
Week 2. Quantum Mechanics of Particles in a Periodic Potential: Bloch's Theorem
Week 3-4. Fourier Analysis of Nearly- Free Electron Model
Week 5. Particle-Wave Picture of Conductivity, Wave Packets, Dispersion
Week 6. Effective Masses, Electrons and Holes
Week 7. Metals, Semiconductors and Insulators in the Band Picture
Week 8. Carrier Statistics in Semiconductors
Week 9-10. Intrinsic and Extrinsic Semiconductors, Donors and Acceptors
Week 11. Inhomogeneous Semiconductors, Chemical Potential
Week 12 PN Junction Theory, I-V Characteristics

CLASS/LABORATORY SCHEDULE:

ESG	333	Materials Sci II: Electr Prop	LEC	1	MWF	12:00	12:53
			REC	R01	F	10:40AM	11:35 AM

			REC	R02	F	12:50PM	1:45 PM
--	--	--	-----	-----	---	---------	---------

CURRICULUM

This course contributes 4 credit hours toward meeting the required 48 hours of engineering topics.

STUDENT OUTCOMES (SCALE 1-3):

A	B	C	D	E	F	G	H	I	J	K
3	3			3	2	2		3	3	3

3 – Strongly supported

2 – Supported

1-Minimally supported

LEAD COORDINATOR(S) WHO PREPARED THIS DESCRIPTION AND DATE OF PREPARATION:

Jonathan Sokolov, 5/25/2010