

Electronic Devices ECE-E302
Fall 2009
(<http://www.ece.drexel.edu/courses/ECE-E302>)

Instructors:

Dr. S. Basavaiah
Office: 410 Bossone; Tel. Ext. – 6922
basu@ece.drexel.edu

Dr. B. Nabet
Office: 502 Bossone
nabet@ece.drexel.edu

Teaching Assistant:

Pouya Dianat Office: 506 Bossone;
psd32@drexel.edu

Prerequisite Course: Materials I

Textbook:

“Semiconductor Physics and Devices: Basic Principles ” 3rd Edition, D.A. Neaman, McGraw-Hill 2003.

Recommended Texts:

1. “Solid State Electronic Devices,” Ben J. Streetman, Prentice Hall, 2000, 5th Edition.
2. “Semiconductor Device Fundamentals,” R. F. Pierret, Addison Wesley, 1996.

Purpose and Content of the Course:

This is a general introductory course on the physics of semiconductor devices. Important topics from solid-state physics are followed by description of operation of a number of semiconductor devices. The student will develop insight into device operation and learns mathematical techniques that allow its precise description which, in turn, will help further understand device behavior. Sample topics include: Definition of a semiconductor; energy band diagram; electrons and holes; Fermi-Dirac distributions; Fermi level; carrier concentration as a function of the temperature; mobility; conductivity; drift; diffusion; recombination and generation; Continuity equation; basic theory of PN junctions; forward and reverse bias; I-V relation; switching behavior; ac operation; capacitance of a PN junction; applications of PN junctions, solar cells, rectifier, tunnel diode; basic operation of a BJT; I-V relation; switching behavior, small signal models. basic operation of JFET and MOSFET. LASER and LEDS.

Laboratory:

Laboratory is an integral part of this course. Each lab will start with a brief description by the TA. The students download and read the labs prior to their session. Lab reports are due one week after the experiment.

Who should take this course?

This course should be taken by pre-juniors. Upon completion of this course the student will have basic understanding of a variety of semiconductor devices, their operation and applications.

Method of assessment: Homework will be assigned for each chapter. The homework will be collected and graded. Labs are performed, collected and graded. Exams and quizzes will be given and graded. Class participation especially during recitation hours will be monitored. Please remember that as of Fall 2006, plus-minus grading system will be in effect.

Grading Policy:

Homework 10%, Labs 15%, Quizzes 15%, Mid-Term 25%, Final 35%.

Copying of homework and labs from others will result in a grade of zero for that homework or lab. If it is done twice, all homework or lab grades will be zero. We may drop the quiz with the lowest grade. Exams cannot be made up unless under emergency conditions.

Tentative Course Schedule

Week 1 Introduction, Crystal lattices (Ch.1)
Bohr model, Energy States, Elements of Quantum mechanics (Ch.2)
Particle-Wave duality, Applications of Schrödinger's Equation

Week 2 Energy bands and charge carriers HW-set 1
Carrier concentrations and Fermi level
Optical absorption and emission (Ch 4) HW-set 2

Week 3 Drift and mobility
Diffusion and continuity equations Quiz 1
Problem solving HW-set 3

Week 4 Diffusion equation (Ch 5)
PN junction: potential, space charge & current flow (Ch.5) Quiz 2,
Problem solving HW-set 4

Week 5 PN junction: Forward and reverse bias (Ch.7)
PN junction: breakdown, transient properties and capacitance (Ch.5)
Problem solving HW-set 5

Week 6 **Mid-Term Exam**
Applications of PN junctions: Photodiodes, solar cells

Problem solving HW-set 6

Week 7 BJT: operation (ch.10)

BJT: regions of operation, biasing (ch.7) Quiz 3,
Problem solving HW-set 7

Week 8 BJT: large signal behavior (Ch 7)

BJT: switching, small signal model (ch.7)
Problem solving HW-set 8

Week 9 Memorial Day, University Holiday

JFETs and MESFETs, Regions of operation
JFETs IV Characteristics

Week 10 MOSFETs (Ch. 11)

MOSFETS Continued (Ch.11) Quiz 4
MOS device HW-set 9

Week 11 Final's week