

# EE 661: Solid-State Electronics

Spring 2008

## Instructor:

Prof. J. Todd Hastings  
office: 352 ASTeCC Building  
phone: 859-218-6544 ext. 292  
e-mail: [hastings@engr.uky.edu](mailto:hastings@engr.uky.edu)  
office hours: Mondays and Thursdays, 2:00pm – 3:00pm, or by appointment.  
web-site: <http://courses.engr.uky.edu/ECE/EE661/>

## T.A.:

Chi Lu  
office: ASTeCC 349  
e-mail: to be announced  
office hours: to be announced

## Class Meeting:

10:00am – 10:50am, MWF, CB 231

## Texts:

Required: *Principles of Semiconductor Devices* by S. Dimitrijevic. Oxford University Press, 2006.

Reference (not required):

*Advanced Semiconductor Fundamentals, Volume VI Modular Series on Solid State Devices*, First or Second Edition, by Robert F. Pierret, publisher: Prentice Hall. 1<sup>st</sup> addition on reserve in library.

*Physics of Semiconductor Devices*, 2<sup>nd</sup> or 3<sup>rd</sup> Edition by Simon M. Sze, publisher: Wiley. 2<sup>nd</sup> addition on reserve in library.

Useful for review (not required): *Semiconductor Device Fundamentals*, by Robert F. Pierret, publisher: Prentice Hall/Addison Wesley

## Grading:

Homework = 10%, Test #1 = 25%, Test #2 = 25%, Final Exam = 40%

## Prerequisites:

EE360 and EE 461G or consent of the instructor is prerequisite to taking EE 661. If you are concerned how the courses that you have taken compare to the prerequisite courses, please consult the instructor.

## Objectives and Outcomes:

The overall objectives of this course are for the student to understand the basic physics of semiconductor materials and to be able to analyze solid-state electronic devices. Specific outcomes include:

1. Understanding of semiconductor crystal structures, basic quantum mechanics, and energy-band theory. Ability to calculate expected values of position, momentum, and energy in one-dimensional quantum systems. Understanding of E-k diagrams and ability to calculate effective mass and density of states.

### **Objectives and Outcomes: (continued)**

2. Understanding of carrier concentration, recombination and generation, and transport in semiconductors. Ability to calculate carrier distributions, concentrations, and currents in semiconductors.
3. Understanding of basic semiconductor devices including: pn-junction diodes, metal-semiconductor heterojunctions, bipolar transistors, and metal-oxide-semiconductor field effect transistors. Ability to derive and calculate:
  - electrostatic parameters,
  - steady state response,
  - dynamic response, and
  - effects of non-idealities.
4. Understanding of the relationship between material parameters, device design, and device performance.
5. Exposure to semiconductor device fabrication processes.
6. Exposure to advanced concepts, i.e. heterojunction semiconductor devices, high-frequency devices, and photonic devices.

### **Class Attendance:**

Students are responsible for all business conducted during scheduled class periods. Announcements concerning homework, exams, and schedules will be made during class.

### **Homework:**

Homework is essential to understand the concepts presented in this course. Students will typically have one week to complete homework assignments. Assignments must be turned into the instructor by 5pm on the day they are due. No late homework will be accepted. Solutions will be available online at <http://courses.engr.uky.edu/ECE/ee661/> after the due date.

Students are allowed and encouraged to work together on the homework, but each student must submit an individual solution set. If a student learns the solution to a problem from another source (human, printed, electronic, etc.), this should be documented in the submitted homework. Directly copying a solution from another student or source is not permitted.

### **Computer Usage:**

Certain homework problems will be most readily solved using a computer. You may use any software package you like to solve these problems, but solutions will be provided in MATLAB format. MATLAB is available in the following computer laboratories: Civil Engineering Lab, Agriculture Lab, Anderson Hall Lab, and Chemistry Physics Lab.

### **Exams:**

There will be two in-class tests and a final exam. Failure to take a test or exam will result in a grade of zero for that test. Permission to take a test at a different time may be granted if the student contacts the instructor **before** the exam date.

### **Academic Offenses:**

Cases of cheating or plagiarism will be handled according to the rules in the University of Kentucky *Student Rights and Responsibilities*. These rules have recently changed and students are encouraged to review them at <http://www.uky.edu/StudentAffairs/Code/part2.html> (section 6.3). If there is any question as to what constitutes cheating or plagiarism please consult the instructor.