SYLLABUS
KENNESAW STATE UNIVERSITY
ELECTRICAL & COMPUTER ENGINEERING
EE 2401: SEMICONDUCTOR DEVICES
FALL 2024

Course Information

Class meeting time: no in-person meetings – all course material is on D2L
Modality and Location: Online
Syllabus is posted in D2L

Instructor Information

Name: Sheila Hill
Email: sdoneho1@kennesaw.edu
Office Location: Q337C
Office phone: (470) 578-2408
Office Hours: Posted on D2L
Preferred method of communication:

- For general questions about course content, assignments, due dates, etc, use the **Ask the Professor a Question** discussion board (you may post anonymously if you wish).
- For specific questions, whether they are personal questions concerning absences, extensions, etc OR if you want me to check your work to see if it's correct before submitting it, email me directly.

Communications will be answered within 24 hours on weekdays and 48 hours on weekends, but in general responses from me are much sooner than that.

Course Description

3 Class Hours, 0 Laboratory Hours, 3 Credit Hours
Prerequisites: PHYS 2212, CHEM 1211, and ENGR 1000
This course effectively applies the knowledge of chemistry and physics to understand the operating principles of various semiconductor devices. The course covers topics starting from the fundamental concepts of atomic and crystal structure, crystal growth, impurity doping and energy bands to the in-depth device operation and quantitative analysis of p-n junction diode, metal-semiconductor contacts and Schottky diode, BJTs and MOSFETs. Also, fundamental operating principles of optoelectronic devices such as, LEDs and photodiodes are discussed. Simple device simulation components reinforce the understanding of various critical aspects of device operation. The course concludes with an experiment-based project on device characterization where students perform analysis on the experimentally acquired data to extract various important device parameters.

Course Materials

Suggested Text (not required):

- Donald A. Neamen, Semiconductor Physics and Devices, 4th Edition, McGraw-Hill Higher Education, 2012, ISBN-13: 978-0073529585.

Reference Texts:

1. Donald A. Neamen, An Introduction to Semiconductor Devices, 1st Edition, McGraw-Hill Higher Education, 2006.
2. S. M. Sze and M. K. Lee, Semiconductor Devices, 3rd Edition, John Wiley & Sons, 2012.
3. Robert F. Pierret, Semiconductor Device Fundamentals, 1st Edition, Addison-Wesley, 1996

Technology Requirements

- You must have access to a computer with reliable internet access, sound and video capabilities. Some of the activities may be completed with a tablet, but that should not be your only way to access course materials since some activities, quizzes especially, don't always work properly.
- The final project involves using Excel or MATLAB to make plots that can be done on your own computer or in the computer lab in Q220. The computers in the EE labs also have all the software you need. The final project also uses MS Word to create the final document.
- You must check your campus email regularly - sometimes important information about the class is dispensed this way.

Assignments that require Dropbox submissions (test calculations, final project, etc) should be submitted **ONLY in pdf format.** If you have images that need to be submitted, put them into a Word document and save as a pdf file. Images by themselves are not acceptable because they can be very difficult to read.

Course Software Skills

- Students are expected to be familiar with Microsoft Word and Microsoft Excel and should be able to create a pdf file.

Learning Outcomes

Upon successful completion of this course, you should be able to perform the following tasks:

1. Identify the electronic properties of semiconductor materials.
2. Calculate carrier concentrations and currents in semiconductor devices.
3. Identify, define and mathematically calculate the parameters of PN junction diodes, transistors, FETs and MOSFETs.
4. Discuss the physics and models of semiconductor devices.
5. Analyze semiconductor device structures and calculate the model parameters.
6. Analyze commonly used diodes.
7. Analyze the characteristics of bipolar transistors.
8. Summarize the basic principle of semiconductor optical devices including solar cells, photodetectors, light-emitting diodes and laser diodes.
9. Apply circuit simulation software to analyze semiconductor devices and circuits.

The course objectives listed above represent the overall learning objectives of this course. You achieve a course objective by achieving the module objectives related to that course objective. The instructional

material and activities found within a module are designed with the intent of assisting you in achieving the module objectives.

Course Requirements and Assignments

Assessment Descriptions:

Tests

- The purpose of the exams is to assess a student's ability to successfully perform tasks associated with the course objectives.
- Four tests will be given during the semester.
- A test will typically cover the content of 3 chapters.
- Tests are on D2L and consist of a conceptual part (30%) and a problem set (70%)
- Format of the tests is multiple choice for conceptual questions and fill-in-the-blank for numerical problems

Final Exam

- Similar to the semester exams, the purpose of the final exam is to assess a student's ability to successfully perform tasks associated with the course objectives.
- The primary difference between a semester exam and the final exam is that the scope of topics assessed in the final exam is comprehensive.
- The final exam is on D2L and consists of a conceptual part (30%) and a problem set (70%)
- Format of the final exam is multiple choice for conceptual questions and fill-in-the-blank for numerical problems.

Participation (Team Missions)

- Participation assignments consist of team problems that assist with the module objectives
- Most are virtual escape room assignments - full credit is given for participating and attempting all problems, even if the answers are not correct
- 10% bonus is added for teams that successfully escape
- Sample solutions will be available the week after the assignments are due
- **Late assignments will not be accepted**

Homework

- The homework assignments are designed primarily to assist in learning the module objectives.
- Homework assignments are available on D2L and must be completed by the due date.
- Answers may be checked with the professor before submitting
- Grading is automatic and grades are available immediately after submitting
- **Late assignments will not be accepted**

Final Project

- The final project gives students a chance to simulate and characterize semiconductor devices using data collected by simulation software
- The project is a Team effort and each Team must turn in a report in D2L
- The format of the report is outlined in a separate module in D2L
- In addition to the written report:
    - Each Team must submit a short video via VoiceThread
    - Each student must comment on another Team's VoiceThread submission
- **Late reports will not be accepted.**

Evaluation and Grading Policies

Midterm Grade:

A midterm grade will be assigned by the midterm grade due date identified on this semester's academic calendar. This midterm grade is for assessing mid-semester performance prior to the last day to withdraw without academic penalty. You may view your midterm grade in Owl Express. Note that only your final grade will be officially recorded on your academic transcript.

Grading Scale:

The grading scale that relates your final grade percentage to the letter grade you will be awarded for this course is presented in the table below:

EE 2401 Grading Scale	
Final Grade Percentage	Letter Grade
90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 59	F

Final grades will be rounded up to the nearest whole number.

EE 2401 Grade Composition	
Assessment Category	Percentage Weighting (%)
Tests (4)	40 (final replaces lowest)
Final Exam	25
Participation Assignments	10
Homework	10
Final Project	15

Course Policies

Attendance Policy:

- Each student is responsible for the lecture content covered on D2L.
- No make-up tests will be administered, unless a credible excuse is given prior to your absence, or in the case of an emergency, on the day of your return to class.
- Students are solely responsible for managing their enrollment status in a class; nonattendance does not constitute a withdrawal.

Appealing a Grade:

- You may appeal any grade received.
- All appeals for re-evaluation of a grade must be made within **one week** of the assessment being returned to you.
- The instructor reserves the right to re-grade the entire exam, homework assignment, or project.

Netiquette Guidelines

- Kennesaw State University's netiquette guidelines can be found here

- Basically, treat people well and everything will be fine.

Feedback in a Timely Manner:

The following table lists the maximum turn-around times on the different types of assessments used in this course.

EE 2401 Feedback Times	
Assessment Category	Max. Turn-around Times
Semester Exams	1 week
Final Exam	1 week
Participation Assignments	Immediate
Homework Assignments	Immediate

Institutional Policies

Federal, BOR, & KSU Required Syllabus Policies

KSU Student Resources

This link contains information on help and resources available to students: KSU Student Syllabus Resources

Course Schedule

EE 2401 Course Schedule Fall 2024			
Week	**Dates**	**Content Covered**	**Due Dates**
1	08/12 – 08/18	Introduction	Syllabus Quiz due Sun 08/18
2	08/19 – 08/25	Crystal Structure of Solids (1.1 - 1.7)	VT Team Intro due Sun 08/25
3	08/26 – 09/01	Quantum Mechanics (2.1 - 2.4)	Team Mission 01 due Sun 09/01
4	09/02 – 09/08	Quantum Theory of Solids (3.1 - 3.5)	Team Mission 02 due Sun 09/08
5	09/09 – 09/15	Homework 01 and Test 01 (Ch 1, 2 & 3)	HW 01 due Wed 09/11 Test 01 due Sun 09/15
6	09/16 – 09/22	Semiconductor in Equilibrium (4.1 - 4.5)	Team Mission 03 due Sun 09/22
7	09/23 – 09/29	Carrier Transport; Excess Carriers (5.1 - 5.3; 6.1)	Team Mission 04 due Sun 09/29
8	09/30 – 10/06	Homework 02 and Test 02 (Ch 4, 5 & 6)	HW 02 due Weds 10/02 Test 02 due Sun 10/06
9	10/07 – 10/13	The PN Junction; PN Junction Diode (7.1 - 7.4; 8.1 - 8.3)	Team Mission 05 due Sun 10/13
10	10/14 – 10/20	Metal-Semiconductor Junctions (9.1 - 9.2)	Team Mission 06 due Sun 10/20
11	10/21 – 10/27	Homework 03 and Test 03 (Ch 7, 8 & 9)	HW 03 due Weds 10/23 Test 03 due Sun 10/27
12	10/28 – 11/03	MOSFETs (10.1 - 10.4)	Semester Project Available (Team Project)
13	11/04 – 11/10	BJTs; Optical Devices (12.1 - 12.7; 14.1 - 14.6)	
14	11/11 – 11/17	Homework 04 and Test 04 (Ch 10, 12 & 14)	HW 04 due Weds 11/13 Test 04 due Sun 11/17

15	11/18 – 11/24	Semiconductor Fabrication (not in textbook) Finish Project and Prepare for Final Exam	Semester Project due Fri 11/22 Project Discussion due Sun 11/24
	11/25 – 12/01	**Thanksgiving Break – no classes**	
Final Exam	12/03 - 12/04	Final Exam Available (due 12/04)	