Volume 2
Issue 2 *Spring 2023 Issue*

Article 2

2-11-2023

Semiconductor Devices

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KENNESAW STATE UNIVERSITY

SYLLABUS

SOUTHERN POLYTECHNIC COLLEGE OF ENGINEERING AND ENGINEERING TECHNOLOGY

ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

EE 2401 SEMICONDUCTOR DEVICES

Course Information

Class meeting time: No synchronous meetings
Modality and Location: D2L

Instructor Information

Name:
Email:
Office Location:
Office phone:
Office Hours:
Preferred method of communication:

Course Description

3 Class Hours, 0 Laboratory Hours, 3 Credit Hours
Prerequisites: CHEM 1211, CHEM 1211L, EE 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 reinforces 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

Required Texts: none
Recommended Texts: Donald A. Neamen, Semiconductor Physics and Devices, 4th Edition, McGraw-Hill Higher Education, 2012, ISBN-13: 978-0073529585.
Technology requirements:

- This class can only be completed by accessing D2L.
- All course resources and assignments are presented online through D2L.
- As a result, students are expected to access the internet outside of the classroom.
- **All tests and the final exam will be presented on D2L and will require the use of a webcam.**
- Students are expected to be familiar with Microsoft Word and Microsoft Excel. The Semester Project includes creating plots in Excel using previously collected data

Learning Outcomes

Upon successful completion of this course, students 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.

Course Requirements and Assignments

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

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

Grade Composition:
The table below lists the categories of assessments that will be used throughout the semester and the percentage weighting that each category will contribute towards your final grade.

EE 2401 Grade Composition	
Assessment Category	**Percentage Weighting (%)**
Tests (4)	40
Final Exam	25
Participation Assignments (6)	10
Homework (4)	10
Final Project	15

Course Policies

Attendance Policy

- There is no official attendance policy since the class is online
- Students are solely responsible for managing their enrollment status in a class; failure to log in to the class on D2L 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.

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

Week	Topic	Due Dates
01	Introduction	Syllabus Quiz due Sun
02	Crystal Structure of Solids (1.1 - 1.7)	VT Team Intro due Sun
03	Quantum Mechanics (2.1 - 2.4)	Team Mission 01 due Sun
04	Quantum Theory of Solids (3.1 - 3.5)	Team Mission 02 due Sun
05	Homework 01 and Test 01 (Ch 1, 2 & 3)	HW 01 due Wed Test 01 due Sun
06	Semiconductor in Equilibrium (4.1 - 4.5)	Team Mission 03 due Sun
07	Carrier Transport; Excess Carriers (5.1 - 5.3; 6.1)	Team Mission 04 due Sun
08	Homework 02 and Test 02 (Ch 4, 5 & 6)	HW 02 due Weds Test 02 due Sun
09	The PN Junction; PN Junction Diode (7.1 - 7.4; 8.1 - 8.3)	Team Mission 05 due Sun
10	Metal-Semiconductor Junctions (9.1 - 9.2)	Team Mission 06 due Sun
11	Homework 03 and Test 03 (Ch 7, 8 & 9)	HW 03 due Weds Test 03 due Sun
12	MOSFETs (10.1 - 10.4)	Semester Project Available (Team Project)
13	BJTs; Optical Devices (12.1 - 12.7; 14.1 - 14.6)	
14	Homework 04 and Test 04 (Ch 10, 12 & 14)	HW 04 due Weds Test 04 due Sun
15	Finish Project and Prepare for Final Exam	Semester Project due Fri Project Discussion due Sun
	Final Exam available (first two days of finals week)	