

Fundamentals of Semiconductor Devices

EE3329, Fall 2021

University of Texas at El Paso

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Office Room: A335 Engineering
Office Hours: M and W: 10:30 - 12:00

Content Delivery:

The course is listed as in-person however if needed all content will be delivered online through synchronous lectures and other online materials. Content will be provided in modules on a chapter-by-chapter basis and will follow a weekly routine. Initially and hopefully for the rest of the semester, there will be mostly face-to-face meetings. Depending on conditions, we will reserve the possibility to meet in low density at a later point in time.

Prerequisites:

PHYS 2421 with grade of "C" or better.

EE 3338 with grade of "C" or better.

Content Description:

This course combines theory of semiconductors with application of engineering analysis and design principles to predict the electrical performance of devices. Students will learn how to analyze and design semiconductor devices.

In order to analyze and design these devices, detailed knowledge of semiconductor physics is needed. Therefore, the course will begin with treatment of semiconductor physics. The second part of the course will focus on applying knowledge of semiconductor physics to model the electronic behavior of devices.

Devices that will be covered include resistors, capacitors, diodes, field-effect transistors and bipolar junction transistors. Device physics will be used to relate internal charged-carrier behavior with external terminal characteristics of the devices.

Semiconductor devices are used in circuits to make useful analog and digital functions such as amplifiers and logic circuits. This course is fundamental to electrical engineering and will benefit persons in all areas of concentration especially solid-state devices and materials, electronics engineering, and computer engineering.

Required Textbook:

Semiconductor Devices: Physics and Technology, 3rd Edition, S. M. Sze and M. K. Lee, Wiley, 2012

Learning Objectives:

After completion of this course, students should be able to:

1. **Analyze:** Apply semiconductor physics to analyze electronic devices including; resistors, capacitors, diodes, field-effect transistors, and bipolar junction transistor.
2. **Design:** Apply the design process to create and evaluate devices to meet specified requirements.
3. **Model:** Apply mathematics to model the behavior of electronic devices under different operating conditions.

Topics Covered in Modules:

- Module 1: Energy bands and carrier concentration in thermal equilibrium
- Module 2: Carrier transport in semiconductors
 - Resistors
- Module 3: p-n Junctions
 - Diodes

- Capacitors
- Module 4: Bipolar junction transistors
- Module 5: Field-effect transistors
 - MOSFETS
 - Survey of semiconductor devices

Online Communications, Activities, Time Commitments, and Resources:

Emphasis is placed on group discussion, group work, individual work, and lectures to clarify points. Reading and homework will be assigned. Knowledge and skill development obtained by working on assignments will be assessed through exercises, discussions and exams. It is through reading, working on assignments and class discussions that most learning will occur. The instructor's role will be to provide content, show how to calculate problems, guide you by discussing relevant topics and assigning problems that will require you to go through the mental steps necessary to obtain knowledge and learn problem-solving skills. The instructor's role will also be to assess your progress and give you feedback.

- **Instructor-to-Student Interactions:**
 - **Lectures:** Lectures will be given at set weekly times.
 - Lectures will discuss theory and present calculation examples
 - Lectures will also invite discussion
 - **Office Hours:** Sessions will be created for open and private discussions at set weekly times.
 - **Announcements:** Course announcements will be given on a weekly and as-needed basis.
 - **Email:** Students can send email with questions to the instructor.
 - **Feedback:** Instructor will provide feedback and suggestions on work.

- **Student-to-Student Interactions:**

- **Group Work:** Groups with 3 students will be created. The groups will be assigned exercises.
- **Online Café:** An open discussion board will be created on Blackboard for students to post and request help from each other. Students can start and reply to discussion threads.
- **Netiquette:** See section below for Netiquette guidelines for postings.
- **Student-to-Resource Interactions:**
 - **Textbook:** Students are required to obtain and read assigned sections of the textbook before each online lecture.
 - **Calculators:** Students will need a calculator to complete the calculation assignments.
 - **Computer and Software:** Students will need a computer and software intended for numerical and symbolic engineering calculations. Licenses for Matlab and MathCAD are available to engineering students at ETC.
 - **Content Modules:**
 - **Handouts:** Electronic copies of the lecture presentations will be provided
 - **Recorded Lectures:** Some lectures are recorded and available to students.
 - **Content Assignments and Assessments**
 - **Calculation Exercises:** Calculation exercises will be assigned to learn how to solve typical problems. The exercises will be assigned through Blackboard. The due date for each exercise will be announced. Students are required to work in groups on calculation exercises.
 - **Exams:** Two exams will be given. The exams will involve calculation of problems with embedded conceptual constraints. The exams will typically be due within a specified length of time. Exam 1 (midterm) will be given after

the 2nd module is completed and will cover modules 1 and 2.
Exam 2 (final) will be given during finals week and will cover
modules 1 to 5.

Online Café Guidelines:

An introductory post given by the instructor will outline the expectations for student posts.

Evaluation: None but moderated.

Netiquette: Appropriate Netiquette must be maintained in all posts. Postings that violate UTEP policy will be investigated and appropriate actions will be taken. For more information on Netiquette refer to online information contained in the following link: [Netiquette guide for online courses](#)

Evaluation:

	Value
Calculation Exercises	50%
Exam 1 (Midterm)	25%
Exam 2 (Final)	25%
Total	100%

Grading Policy:

A: 90% - 100%

B: 80% - <90%

C: 70% - <80%

D: 60% - <70%

F: 0% - <60%

Non-Compliance Policy:

Late Work: Late course work will not be accepted.

Make-up Work: No make-up work will be given.

Posting Netiquette: Postings that violate UTEP policy will be investigated and appropriate actions will be taken.

Attendance: Attendance in activities is mandatory to receive course credit.

Excessive nonattendance will result in loss of credit.

Participation: Participation in assignments and discussions is mandatory to receive credit. Lack of participation will result in loss of credit.

Group Work: Lack of significant contribution to group work will result in zero credit. If lack of contribution persists for any one or more than one exercise, the instructor will take action to ensure equity for group members that are contributing significantly and meaningfully.

Syllabus Changes: Some of the content in the syllabus is subject to change for improvements or other factors. Any changes will be communicated.

Academic Dishonesty:

Incidents of academic dishonesty will be referred to the Director of Electrical Engineering and the Dean of Students. [Link to Dean of Students.](#)

The descriptions and definitions of academic dishonesty can be found at: [Link to Academic Dishonesty Descriptions and Definitions](#) Look under Student Affairs and then Chapter one, section 1.3.1.

Classroom Accommodations:

If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to [Link to CASS email](#), or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at [Link to CASS Website](#)

Summary of Activities and Expected Time Commitments:

Activities	Percent of Grade	Time per Assignment (Hours)	Number of Assignments	Time for all Assignments (Hours)	Due Dates	Attempts Allowed and Post Length	Problem and Parameter Randomization
Textbook Reading Assignments	0	4.0	5	20.0	2 days before start of new module.		
Handout Reading Assignments	0	0.5	5	2.5	1 day before start of new module.		
Live Lectures	0	1.3	30	40.0	Synchronous		
Recorded Lectures	0	1.3	6	8.0	None		
Open Online Café	0	0	0	0	None	Unlimited. No Deleting.	
Calculation Exercises	40	4.0	14	56.0	Will be announced	1	Yes
Exam I (Midterm)	25	2.0	1	1.5	Will be announced	2	Yes
Exam II (Final)	25	3.0	1	3.0	Will be announced	2	Yes
Total Course Commitment (Hrs)				131			
Average Weekly Commitment (Hrs)				9			

UTEP ECE DEPARTMENT

SYLLABUS ADDENDUM

COVID-19 PRECAUTIONS

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that

the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID 19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org