

ECE 3030 (Proposed): Semiconductor Electronic Devices

Course Description

Semiconductor materials and devices. Crystals; bandstructure; charge carrier statistics; excess carriers, transport; PN junction; Schottky barrier; bipolar and field-effect transistors; optoelectronic devices; nanoscale devices.

Prior Course Number: 432 and parts of 331

Transcript Abbreviation: Electronic Devices

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad

Student Ranks: Sophomore, Junior, Senior

Course Offerings: Autumn, Spring

Flex Scheduled Course: Never

Course Frequency: Every Year

Course Length: 14 Week

Credits: 3.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 6.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: Prereq: 2020 or 2021 or 2100, and Physics 1251, 1261, 133, or both 1240 and 1241; and Chem 1220, 1250, or 121; and enrollment in ECE, MSE, or EngPhysics major. Prereq or concur: Math 2415 (415) or 2174.

Exclusions: Not open to students with credit for 331 or 432.

Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: Yes

The course is a GEC: No

The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001

Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Be familiar with the fundamentals of material structure (crystal, amorphous, polycrystalline)
Be familiar with the fundamentals of quantum mechanics
Be competent in analyzing the relationships between the physical and electronic properties of semiconductors

Be familiar with the fundamental principles of operation of semiconductor devices
Master energy band diagram analysis
Be familiar with the physical limits of operation (avalanche and zener breakdown, punch-through, self-heating) of semiconductor devices
Be exposed to a modern engineering simulation tool (2D device simulator)
Be familiar with necessary background to understand the principle of new electronic devices as new technologies develop

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Overview and motivation	1.0							
Microstructure & Crystal structure	2.0							
Electronic material synthesis, defects	2.0							
Principles of quantum mechanics	3.0							
Band structures	3.0							
Semiconductor statistics and charge carrier properties	4.0							
Excess carriers and transport	3.0							
PN junction, metal-semiconductor junctions, Diodes	6.0							
Field effect transistor (regular and HEMT)	6.0							
Bipolar Junction Transistor (regular and hetero)	7.0							
Optoelectronic Devices	2.0							
Overview of new materials, devices, and techniques	1.0							

Representative Assignments

Homework, including semiconductor device design problems
Online web quizzes
Computer aided design simulation of devices (PISCES or ATLAS)

Grades

Aspect	Percent
Homework	15%
Simulation homework	5%
Midterm 1	25%
Midterm 2	25%
Final exam	30%

Representative Textbooks and Other Course Materials

Title	Author
<i>Solid State Electronic Devices</i>	Ben G. Streetman and Sanjay Kumar Bannerjee

ABET-EAC Criterion 3 Outcomes

Course Contribution	College Outcome
***	a An ability to apply knowledge of mathematics, science, and engineering.

Course Contribution		College Outcome
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
*	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
**	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
*	i	A recognition of the need for, and an ability to engage in life-long learning.
*	j	A knowledge of contemporary issues.
*	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Additional Notes or Comments

Change prereq and exclusions to standard form.

Deleted text "Fundamentals of Semiconductor Devices" by Anderson and Anderson and replace it with Neamen. 3/29/12

Add 2020 to prerequisites

Add Chem 1220 to prereqs 8/27/12

Add "or both 1240 and 1241" to physics prereqs 10/19/12

Add 2100 to prereq, modify course goals and topics, change ABET Creitron 3 item g to "no contribution". Result of internal ABET review 4/5/14 BLA

Updated text to 7th edition 10/27/14 CED

update goals assignments and grades 6/16/16 BLA

Edited text info, 5/10/17, CED

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