

# EE2800: SEMICONDUCTOR PHYSICS FOR ENGINEERS

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## Effective Term

Semester B 2025/26

## Part I Course Overview

### Course Title

Semiconductor Physics for Engineers

### Subject Code

EE - Electrical Engineering

### Course Number

2800

### Academic Unit

Electrical Engineering (EE)

### College/School

College of Engineering (EG)

### Course Duration

One Semester

### Credit Units

3

### Level

B1, B2, B3, B4 - Bachelor's Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

EE2005 Electronic Devices and Circuits

AND

MA1200 Calculus and Basic Linear Algebra I or MA1201 Calculus and Basic Linear Algebra II

OR

MA1300 Enhanced Calculus and Linear Algebra I or MA1301 Enhanced Calculus and Linear Algebra II

### Precursors

Nil

### Equivalent Courses

Nil

### Exclusive Courses

Nil

**Additional Information**

Nil

**Part II Course Details****Abstract**

The course aims to give students a fundamental understanding of semiconductor physics and its applications to realize various semiconductor devices. The working mechanism of the selected devices will be studied.

**Course Intended Learning Outcomes (CILOs)**

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1 Describe physical and chemical structures of commonly used semiconductor materials.		x	x	
2 Describe the physical properties of semiconductors with energy band diagrams.		x	x	
3 Describe and solve for the carrier distributions and carrier transport in semiconductors.		x	x	
4 Describe the working mechanisms of selected semiconductor devices.		x	x	

**A1: Attitude**

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

**A2: Ability**

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

**A3: Accomplishments**

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

**Learning and Teaching Activities (LTAs)**

LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1 Lectures	Students will participate in lectures where they will learn various fundamental knowledge and concepts in semiconductor physics, which they will apply in subsequent activities to deepen their understanding and practical skills.	1, 2, 3, 4	3 hrs/wk

2	Laboratories	Students will engage in lab sessions designed to reinforce key concepts covered in lectures and tutorials, enabling them to apply theoretical knowledge through hands-on practice and collaborative problem-solving.	1, 2, 4	3 hrs/wk (3 weeks)
3	Tutorials	Students will work through key concepts by solving practical problems, enhancing their ability to apply theoretical knowledge to real-world scenarios.	1, 2, 3, 4	1 hr/wk

**Assessment Tasks / Activities (ATs)**

	ATs	CILO No.	Weighting (%)	Remarks ("- for nil entry)	Allow Use of GenAI?
1	Tests (min.: 2)	1, 2, 3, 4	30	-	No
2	#Assignments (min.: 3)	1, 2, 3, 4	20	-	Yes
3	Lab Exercises/ Reports (min.: 2)	1, 2, 4	10	-	Yes

**Continuous Assessment (%)**

60

**Examination (%)**

40

**Examination Duration (Hours)**

2

**Minimum Continuous Assessment Passing Requirement (%)**

30

**Minimum Examination Passing Requirement (%)**

30

**Additional Information for ATs**

Remark: To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained. # may include homework, tutorial exercise, project/mini-project, presentation

**Assessment Rubrics (AR)****Assessment Task**

Examination

**Criterion**

Achievements in CILOs

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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**Assessment Task**

Coursework

**Criterion**

Achievements in CILOs

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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## Part III Other Information

### Keyword Syllabus

Introduction to Semiconductors physics

Basic crystal structures of semiconductors. Energy bands and energy gap. Fundamentals of band structure and statistical carrier distribution. The density of states. Fermi-Dirac distribution functions, doping and intrinsic carrier concentration.

Physical Properties of Semiconductors

Physical properties of semiconductors. Carrier-transport phenomena, drift and mobility, resistivity. Drift-diffusion and trap statistics. Current continuity equation.

Basic Devices based on Semiconductors

Basis structure of p-n junctions. Biased and non-biased junction properties. Charge storage and transient behavior: junction capacitors and junction breakdown. Zener diodes. Schottky diodes. Bipolar Junction Transistor (BJT), Metal-oxide-semiconductor field-effect transistors (MOSFETs).

Laboratory Experiment:

Unit 1 Characterization of p-n junction

Unit 2 Characterization of bipolar junction transistor

### Reading List

#### Compulsory Readings

Title	
1	Ben G Streetman: Solid State Electronic Devices (Prentice-Hall), 2016

#### Additional Readings

Title	
1	S. M. Sze: Physics of Semiconductor Devices (John Wiley & Sons, Inc), 4th Edition, 2021
2	Chenming Hu: Modern Semiconductor Devices for Integrated Circuits (Pearson Education) 2021