EE2800: SEMICONDUCTOR PHYSICS FOR ENGINEERS

Effective Term

Semester A 2022/23

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 physic and its applications to realize various semiconductor devices. The working mechanism of the selected devices will be studied. An overview of the fabrication process will also be introduced.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	To describe physical and chemical structures of commonly used semiconductor materials.		x	x	
2	To describe the physical properties of semiconductors with simple mathematic models.		x	x	
3	To describe the working mechanisms of selected semiconductor devices.		x	x	
4	To outline the fabrication process of semiconductor devices and integrated circuits.		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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Key concepts are described and illustrated Key concepts are worked out and based on problems	1, 2, 3, 4	3 hrs/wk
2	Labortories	Key concepts are applied to build simple electronics	1, 2, 4	3 hrs/wk (2 weeks)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	24	
2	#Assignments (min.: 2)	1, 2, 3, 4	8	
3	Lab Exercises/Reports (min.: 2)	1, 2, 4	8	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

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

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

Part III Other Information

Keyword Syllabus

Introduction to Semiconductors physics
Basic 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. Phonon, optical, and thermal properties of semiconductors.

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). Junction field-effect transistor (JFET), Metal-oxide-semiconductor field-effect transistors (MOSFETs).

Basic Introduction to Semiconductor Technology
Overview of the manufacturing process of semiconductor devices and integrated circuits (ICs). Diffusion and ionic implantation processes. Photolithography, Deposition and etching processes. MOSFET fabrication technology. Moore's law.

Laboratory Experiment:
Unit 1 Characterization of p-n junction, Zener diode, Schottky diode
Unit 2 Characterization of bipolar junction transistor

Reading List

Compulsory Readings

	Title
1	S. M. Sze: Physics of Semiconductor Devices (John Wiley & Sons, Inc), 4th Edition, 2021

Additional Readings

	Title
1	Ben G Streetman: Solid State Electronic Devices (Prentice-Hall), 2016
2	Chenming Hu: Modern Semiconductor Devices for Integrated Circuits (Pearson Education) 2021