

EE6427: MODERN POWER ELECTRONICS

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Modern Power Electronics

Subject Code

EE - Electrical Engineering

Course Number

6427

Academic Unit

Electrical Engineering (EE)

College/School

College of Engineering (EG)

Course Duration

One Semester

Credit Units

3

Level

P5, P6 - Postgraduate Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

EE4101 Modern Power Electronics; or equivalent

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course aims to enable students to gain an understanding of the principles and industrial applications of modern power electronics. International regulations concerning all modern electronic equipment and the latest technology to meet these regulations will be presented.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if DEC-A1 app.)		DEC-A2	DEC-A3
1	Identify the practical characteristics of power electronic devices and circuit components.		x		
2	Analyse, design and implement switching methods for AC-DC and DC-AC power converters.		x	x	x
3	Acquire power conversion concepts to power system applications.		x	x	x
4	Describe international regulations related to electromagnetic compatibility and techniques to meet them.			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	Lecture	Students will engage in lectures about key concepts of power electronic converter systems.	1, 2, 3, 4	2 hrs/wk
2	Tutorials	Students will engage in discussion and learning key concepts based on questions and problem solving.	1, 2, 3	1hr/wk
3	Mini-project	Students will be instructed to learn projects on comparing the use of different types of circuit topology for DC-DC or DC-AC converters in electric vehicles and other applications.	1, 2, 3, 4	2 hrs/wk For 6 weeks

Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks ("- for nil entry)	Allow Use of GenAI?
1	At least 3 assignments (may include homework, tutorial exercise, presentation etc.)	1, 2, 3, 4	5	-	No
2	Quiz I or II	1, 2, 3, 4	30	-	No
3	Mini-project	1, 2, 3, 4	15	-	No

Continuous Assessment (%)

50

Examination (%)

50

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.

Assessment Rubrics (AR)**Assessment Task**

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

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 level

Assessment Task

Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

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 level

Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Assessment Task

Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR**Constructive Alignment with Programme Outcomes**

PILO 1, 2 To understand the latest technology and trends in power electronic technology.

PILO 1, 2, 3, 4 To analyze power electronic circuits and systems

Part III Other Information**Keyword Syllabus****Power Electronic Devices**

Review of power electronic devices - power diode, power BJT, power MOSFET, IGBT. Switching characteristics. Device limitations and protection techniques, snubber circuits. Base/gate drive circuits; isolation techniques

DC-DC Conversion

Series-pass supplies, efficiency, performance, applications. The switch-mode supply principle, comparison with series pass, applications. The off-line supply switch-mode system. Step-up and step-down topologies; buck, boost and flyback, transformer coupled circuit arrangements

AC-DC Conversion

Performance parameters, Power factor correction circuit.

DC-AC Inversion

Principle of operation, performance parameters, modulation techniques, harmonic reductions. Inverter types; three-phase, series resonant

Reading List**Compulsory Readings**

Title	
1	Nil

Additional Readings

Title	
1	N Mohan, T M Undeland and W P Robins: Power Electronics: Converters, Applications and Design (2nd Edition, John Wiley & Sons, 1995)