EE2104: INTRODUCTION TO ELECTROMAGNETICS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Introduction to Electromagnetics

Subject Code
EE - Electrical Engineering
Course Number
2104

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
For normative 4 year students:
(MA1201 Calculus and Basic Linear Algebra II or MA1301 Enhanced Calculus and Linear Algebra II)
and
(EE1002 Principles of Electrical Engineering/Principles of Electronic Engineering or PHY1201 General Physics I or PHY1202 General Physics II or PHY1101 Introductory Classical Mechanics or MBE2029 Electrical and Electronic Principles II)

For advanced standings I and II students:
(MA1201 Calculus and Basic Linear Algebra II or MA1301 Enhanced Calculus and Linear Algebra II)

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course aims to introduce the basic principles of electromagnetics for electrical engineering. It emphasizes on solving fundamental problems in electrostatics and magnetostatics, while providing elementary understanding on the Maxwell's equations.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify and calculate the physical quantities of the static electric field.		x		
2	Identify and calculate the physical quantities of the static magnetic field.		x		
3	Apply the Maxwell’ s equations to static and quasi-static electromagnetic problems.			x	
4	Apply the Laplace’ s and Poisson’ s equations on elementary problems.			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.	Lectures on the course materials with theories and examples.	1, 2, 3, 4	3
2	Tutorials	Tutorials for consolidating the lectures and working out some problem sets.	1, 2, 3, 4	1

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	30	
2	#Assignments (min.: 3)	1, 2, 3, 4	20	

Continuous Assessment (%)

50

Examination (%)

50

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.

may include homework, tutorial exercise, project/mini project, presentation

Assessment Rubrics (AR)

Assessment Task

Examination

Criterion

Achievements in CILOs covered by the course (including the abilities to solve fundamental electromagnetics problems).

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Below marginal

Assessment Task

Test(s)

Criterion

Achievements in CILOs covered up to the test(s)
(including the abilities to solve fundamental electromagnetics problems).

Excellent (A+, A, A-)

High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Below marginal

Assessment Task
Assignment(s)

Criterion
Achievements in CILOs covered up to the assignment(s)
(including the abilities to solve fundamental electromagnetics problems).

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Below marginal

Additional Information for AR
Note: In alignment with the departmental practice, the criteria adopted in the rubrics are about achievements in CILOs. Details of the CILOs are listed above (in Part II).

Part III Other Information

Keyword Syllabus

Vector Analysis
Dot and cross products. Cartesian, cylindrical, and spherical coordinates. Differentials and integrals. Gradient, divergence, and curl.

Static Electric Field
Coulomb's law. Electric fields from charges on a spherical shell, a line, and a plane.
Gauss's law and divergence theorem. Electric dipole and permittivity.
Potential and energy. Laplace's and Poisson's equations. Capacitance.
Current density. Continuity equation. Ohm's law and conductivity. Joule heating.

Static Magnetic Field
Biot-Savart law. Magnetic fields from currents in a line, a circular loop, and a solenoid.
Ampere's law and Stokes's theorem. Magnetic dipole and permeability.

Lorentz force.

Quasi-Static Electromagnetic Field
Faraday’ s law. Magnetic energy. Inductance.

Time-Varying Electromagnetic Field
Maxwell’ s equations in integral and differential forms. Displacement current.
Electric and magnetic boundary conditions.
Electromagnetic waves in free-space.

Reading List

Compulsory Readings

	Title
1	Fawwaz T. Ulaby: Fundamentals of Applied Electromagnetics, 5th Edition, (Pearson Prentice Hall) ISBN 0-13-229630-6

Additional Readings

	Title
1	W. H. Hayt and J. A. Buck: Engineering Electromagnetics, 7th Edition, (McGraw Hill) ISBN 007-124449-2