

EE2104: INTRODUCTION TO ELECTROMAGNETICS

Effective Term

Semester A 2023/24

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

(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 MBE2029 Electrical and Electronic Principles 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.

Teaching and Learning Activities (TLAs)

TLAs		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 (%)

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