

Course Title	Electromagnetics
Course Code	EE4300
No. of Credit Hrs (Lecture + Tutorial + Lab)	3 (2+0+1)
No. of Contact Hrs (Lecture + Tutorial + Lab)	4 (2+0+2)
Level-Year	7-4
Prerequisite (if any)	MATH3301, PHYS2411

1) Course Objectives:

To introduce the basic concepts of electromagnetic fields, potentials and the related physical laws and to apply these concepts and laws for solving problems in electromagnetic theory involving simple geometries.

2) Expected Learning Outcomes:

1. **Demonstrate and explain** the fundamental laws of electricity and magnetism. **KLO1 [1]**
2. **Apply** vector algebra, vector calculus, and coordinate systems to formulate and solve basic electromagnetic problems. **KLO1 [1]**
3. **Develop and implement** simulation programs to model and solve electromagnetic field problems. **KLO3 [6]**
4. **Analyze and interpret** the applications of electromagnetic laws and theorems in practical engineering contexts. **KLO3 [6]**
5. **Communicate** technical understanding by preparing structured notes and reports on electromagnetics applications. **KLO8 [3]**

3) Course Contents

1. Vector Algebra – Scalars and Vectors, Unit Vector, Vector Addition, Subtraction, Multiplication, Position and Distance Vectors, Components, Simulations.
2. Coordinate Systems and Transformations – Cartesian, Cylindrical and Spherical Coordinate Systems, Constant Coordinate Surfaces, Simulations.
3. Vector Calculus - Differential Length, Area, and Volume, Line, Surface, and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes's Theorem, Laplacian of a Scalar, Classification of Vector Fields, Simulations.
4. Electrostatic Fields - Coulomb's Law and Field Intensity, Electric Fields Due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law-Maxwell's Equation, Applications of Gauss's Law, Electric Potential, Relationship between E and V-Maxwell's Equation, Electric Dipole and Flux Lines, Energy Density in Electrostatic Fields, Simulations.
5. Electric Fields in Material Space - Properties of Materials, Convection and Conduction Currents, Conductors, Polarization in Dielectrics, Dielectric Constant and Strength, Linear, Isotropic, and Homogeneous Dielectrics, Continuity Equation and Relaxation Time, Boundary Conditions, Simulations
6. Electrostatic Boundary-Values Problems - Poisson's and Laplace's Equations.
7. Magnetostatic Fields - Biot-Savart's Law, Ampere's Circuit Law-Maxwell's Equation, Applications of Ampere's Law, Magnetic Flux Density-Maxwell's Equation, Maxwell's Equations for Static Fields, Magnetic Scalar and Vector Potentials, Simulations.
8. Magnetic Forces, Materials and Devices - Forces Due to Magnetic Fields, Magnetic Torque and Moment, A Magnetic Dipole, Magnetization in Materials, Classification of Materials, Magnetic

Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits, Force on Magnetic Materials, Simulations.

4) Teaching Methods:

- Lectures and Discussion
- Videos
- Self-learning
- Tutorial sheets

5) Mode of Evaluation: Course Assessment Methods

- Quizzes and assignments
- Major Exams
- Final Exam

Evaluation

- **Semester Work**

Major Exams	30%
Quizzes and Homework	10%
Assignments	10%
Tutorial (Homework, Mini-project, Report, Long essay)	10%
- **Final**

Paper work	40%
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6) Textbook(s):

- Elements of Electromagnetics, By Matthew N. O. Sadiku, Oxford University Press. (Latest Edition).

7) References:

1. Engineering Electromagnetics, William H. Hayt, JR, John A. Buck, Seventh Edition, McGraw-Hill International Edition.

