ELE1201 Electricity and Magnetism

Period per Week			Contact Hour per Semester	Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	00	15	60	100	60	40	4

Rationale

Electromagnetic interactions play a central role in determining the structure of the natural world and are the foundation of most current and emergent technology, therefore a basic understanding of electricity and magnetism (E&M) is important. In E&M the student is quickly introduced to a world in which almost all of the quantities are invisible; they are either microscopic such as electrons or abstractions such as field, flux, and potential. Integral calculus becomes a central mathematical tool, and students are asked to apply it in unfamiliar ways, such as calculating the path integral or surface integral of a quantity expressed as a vector dot product. It is necessary for students to think and visualize in three dimensions.

Objectives

- This course aims to give the fundamentals of Electricity and Magnetism by introducing the basic concepts and applications of vector calculus.
- It aims to attach quantitative meaning to the previously qualitatively studied laws in this topic.

Course Content

1. ***Vector Algebra***
   - Definitions: Scalars, Vectors, Unit Vector, and Dimensionality
   - Operations on Vectors: Addition, Subtraction, Multiplication, Dot and Cross Products
   - Position and Distance vectors
2. ***Vector Analysis***
   - Scalar and Vector Fields
   - Classification of vector fields
   - Scalar and Vector Functions
   - Directional Derivatives of Scalar Functions and Derivatives of Vector Functions
   - Gradient, Divergence, Curl and Laplacian of Vector Functions
   - Physical Interpretation of the Divergence and the Curl of a Vector Field
   - Green's theorem, Line Integrals Independent of Path, Exact Differential Forms
   - Differential length, Area and Volume; Line, surface and Volume integrals
   - Coordinate systems and Transformation: Cartesian; Cylindrical; Spherical coordinate
3. ***Electrostatic Fields***

- Coulomb's Law & Field Intensity
- Electric Field due to Continuous Charge Distribution
- Electric flux density
- Gauss' Law-Maxwell Equation
- Electric potential
- Relationship between E and V
- Energy stored in Electric field

Learning Outcomes

The course participant is able to attach quantitative meaning to the basic laws of Electricity and Magnetism, and also able to give daily-life analogies to the concepts studied. The student applies the electricity and magnetism laws studied to explain real situations.

Reference Material

[1] Matthew N.O. Sadiku, *Elements of Electromagnetics*, 3rd ed.,Oxford University Press, 2001

[2] Sears F., Zemansky M., Young H., *Electricity,Magnetism and Optics.*

[3] Murray R Spiegel, *Theory and Problems of Vector Analysis*, SI (Metric) ed., McGraw Hill

[4] William H. Hayt, Jr., *Engineering Electromagnetics*, 5th ed., Tata McGraw-Hill, New Delhi, 1997