**Marwadi University**
**Faculty of Diploma studies**
**Information and Communication Technology**

# Subject Code: 09CT0511
# Subject Name: Engineering Electromagnetics
# Diploma Year – III (Semester V)

**Objective:** The rationale behind this course is to understand the basics of electromagnetic theory.

**Credits Earned:** Credits

**Course Outcomes:** After learning this course, students should be able to,

1. Understand the physical interpretation of coulomb's law, Gauss's law, Biot-Savart law, and Amperes Circuital law.
2. Analyze the fundamental principles and laws of electromagnetism.
3. Apply the four basic Maxwell's equations and be able to apply them to different EM problems.
4. Analyze the effect of electromagnetic wave propagation in free-space, dielectrics, and conductors.

**Pre-requisite of course:** Elementary knowledge of science and mathematics

## Teaching and Examination Scheme

| Teaching Scheme (Hours) | | | Credits | Theory Marks | | | Tutorial/ Practical Marks | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| Theory | Tutorial | Practical | | ESE (E) | IA (M) | CSE (I) | Viva (V) | Term work (TW) | |
| 3 | 2 | 0 | 4 | 50 | 30 | 20 | 25 | 25 | 150 |

**Contents:**

| Sr No | Course content | Total Hrs. |
|---|---|---|
| 1 | **Vector Analysis**<br>Scalars and Vectors, Scalars and Vector Fields, Vector in 2D and 3D space, Unit Vector, Vector in Rectangular Coordinate System, Position Vector, Distance Vector, Vector Addition, and Vector Subtraction, Vector Multiplication. (Dot Product and Cross Product), Circular cylindrical co-ordinates., Spherical co-ordinate system, Del Operator, Gradient, Divergence, and Curl | 07 |

| | | |
|---|---|---|
| **2** | **Coulomb's law and Electric Field Intensity**<br>Coulomb's Law, Electric field Intensity and Electric Field Intensity due to various Charge Distribution., Electric field Intensity due to line charge distribution, Electric field Intensity due to surface charge distribution. | **05** |
| **3** | **Electric Flux Density and Gauss's law.**<br>Electric Flux Density, Faraday Experiment and Relation Between D and E, Gauss's Law, Divergence Theorem and Maxwell First Equation, Application of Gauss's Law. | **05** |
| **4** | **Energy and Electric Potential**<br>Definition of Electric Potential, Maxwell Second Equation, and Relation Between Electric Potential and Electric Field Intensity, Electric Dipole, Energy Density in Electrostatic Field | **06** |
| **5** | **Conductor, Dielectric, and Capacitance**<br>Current and current density, Continuity equation of current, Metallic conductors, and boundary condition for conductor free space interface, Dielectric and Boundary Condition for Dielectric-Dielectric Interface, Capacitance due to several Geometry. | **06** |
| **6** | **The Steady Magnetic Field**<br>The Steady Magnetic Field, Biot-Savarat Law, Magnetic Field due to Infinitely long Current Element, Magnetic Field due to surface current, Ampere Circuital Law and Maxwell 3rd Equation, Application of Ampere Circuital Law, Magnetic Flux Density and Maxwell 4th Equation, Magnetic Potential and Stock Theorem | **06** |
| **7** | **Electromagnetic wave propagation**<br>Electromagnetic wave equation for propagation, phenomena of skin effect, polarization, Standing Wave Ratio, Introduction to waveguides, and radiation from a different antenna. | **04** |
| | **Total** | **39 hrs.** |

**References:**

1. Elements of Electromagnetics by Matthew N.O. Sadiku, Oxford University Press
2. Engineering Electromagnetics by W.H. Hayt and J A Buck, Tata McGraw Hill Publications
3. Electromagnetics with Applications by Kraus and Fleisch, Tata McGraw Hill Publications

**Suggested Theory distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

| Distribution of Theory for course delivery and evaluation | | | | | |
|---|---|---|---|---|---|
| Remember | Understand | Apply | Analyze | Evaluate | Create |
| 40% | 40% | 10% | 10% | 0% | 0% |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

**Suggested List of Tutorial:**

Students are required to complete 10 experiments.

1. Example of Cylindrical and Spherical Coordinate Systems.
2. Example of Gradient, Divergence, and Curl.
3. Example of Columb's Law and
4. Example of Electric Field Intensity.
5. Example of Various Charge Distribution.
6. Example of Electric Field Intensity.
7. Example of Electric Flux Density and Gauss's Law.
8. Example of Electric Potential and Energy density.
9. Example of Conductor, Dielectric, and Capacitance.
10. Example of Steady Magnetic Field.

**Open-Ended Problem:**

1. Matlab Program for Cylindrical and Spherical Coordinate Systems.
2. Matlab Program for Electric Field Intensity and Magnetic Field Intensity.
3. Matlab Program for Electric and Magnetic Potential.