## 3EC01: ELECTROMAGNETICS THEORY
## Credits - 3 (LTP:3,0,0)

**Course Objective:**
To provide a strong knowledge of basic principles, laws, and Theorems of electromagnetism to understand transmission, radiation, and propagation for physical interpretation and applications.

**Teaching and Assessment Scheme:**

| Teaching Scheme (Hours per Week) | | | Credits | Assessment Scheme | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | |
| L | T | P | C | ESE | CE | ESE | CE | 100 |
| 3 | 0 | 0 | 3 | 60 | 40 | 00 | 00 | |

**Course Content :**

| Unit No. | Topics | Teaching Hours |
|---|---|---|
| 1. | **Vector Calculus, Coordinates systems, and Transformation :** Scalar and Vector quantities and its addition, subtraction, and multiplication, Unit vector, Cartesian, Cylindrical and Spherical coordinate systems, Transformation between Coordinate systems. | 05 |
| 2. | **Electrostatics :** Different types of charge distribution(Charge Family), Coulomb's law, Electric field intensity due to different charge distributions, Streamlines, Electric flux density, Gauss's law and its application, Divergence, Divergence theorem, Del operator, Maxwell's first equation. | 07 |
| 3. | **Energy and Potential :** Energy Expended in Moving a Point Charge in an Electric Field, The Line Integral, Definition of Potential Difference and Potential, The Potential Field of a Point Charge, The Potential Field of a System of Charges: Conservative Property, Potential Gradient, The Electric Dipole, Energy Density in the Electrostatic Field. Poisson's and Laplace's Equations, Examples and Solution of Laplace's Equation, Example of the Solution of Poisson's Equation | 07 |
| 4. | **Conductors and Dielectrics :** Current and Current Density, Continuity of Current, Conductor Properties, Nature of Dielectric Materials, Boundary Condition between ideal conductor and perfect dielectric, Boundary Conditions between Perfect Dielectric Materials. Capacitance for parallel plates. | 07 |
| 5. | **Magneto-statics :** Continuity equation, Biot-Savart law, Ampere's circuital law, and its applications, Magnetic Flux and Magnetic Flux Density, Curl, Stokes theorem, Expression for stored energy in the magneto-static field, Scalar and Vector Magnetic Potential, Magnetic boundary condition. | 07 |
| 6 | **Magnetic Forces, Materials, Inductance and Maxwell Equations :** Force on a Moving Charge, Force on a Differential Current Element, Hall Effect, Force between Differential Current Elements, Force and Torque on | 12 |

| Unit No. | Topics | Teaching Hours |
|---|---|---|
| | a Closed Circuit, The Nature of Magnetic Materials, Magnetization and Permeability, Magnetic Boundary Conditions, The Magnetic Circuit, Faraday's Law, Displacement Current, Maxwell's Equations in Point Form, Maxwell's Equations in Integral Form, The Retarded Potentials | |
| | **Total** | **45** |

**List of References :**


1. William H Hayt And John A Buck, "*Engineering Electromagnetics*", McGraw-Hill Publication, Eighth Edition,2014.
2. Matthew N. O. Sadiku,"*Principles of Electromagnetics*", Sixth Edition, Oxford university press, 2015.
3. J.D.Kraus and Daniel Fleisch, "*Electromagnetics applications*", Fifth Edition, McGraw Hill Pub.,2010.
4. Karl Erik Lonngren, Sava VasilevSavov, "*Fundamentals of Electromagnetics with MATLAB*",Second Edition, Sci-Tech Publishing,2007.


**Course Outcomes (COs) :**

1. Understand the coordinate systems for the vector and scalar parameters.
2. Apply the basic principles of the Electric and Magnetic fields.
3. Understand the concept of potential and energy along with conductors and dielectric materials.
4. Analyze the electromagnetic waves using divergence, Curl and stock's theorem.
5. Design and test the properties of the magnetic materials and their parameters.
6. Evaluate EM waves using Maxwell's, Poisson's and Laplace equations.