COURSE CONTENT

ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES								
IV Semester: ECE								
Course Code	**Category**	**H ours/Week**			**Credits**	**Maximum Marks**		
2540406	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:45**		
Prerequisites: knowledge on electromagnetics								

Couse Overview:

This course provides a foundation in electromagnetic field theory, covering electrostatics, magnetostatics, and Maxwell's equations. Students will explore wave propagation in different media, analyze transmission line characteristics, and apply Smith charts for practical problem solving. Emphasis is placed on understanding field behavior, boundary conditions, and propagation parameters. The course bridges theoretical principles with engineering applications in communication systems.

Course Objectives:

The students will try to learn

- Fundamental laws, concepts, and proofs of electrostatic and magneto static fields and apply them to physics and engineering problems.
- Differences between static and time-varying fields and interpret the role of Maxwell's equations in electromagnetic theory.
- Boundary conditions and their applications in solving practical communication engineering problems.
- Characteristics and propagation parameters of Uniform Plane Waves (UPW) in dielectric and dissipative media.
- Wave propagation in transmission lines and solve transmission line problems using analytical methods and the Smith Chart.

Course Outcomes:

After successful completion of the course, students shall be able to

- Acquire knowledge of basic laws and concepts of electrostatics and magnetostatics, and apply them to solve related engineering problems.
- Differentiate between static and time-varying electromagnetic fields, and interpret the role of Maxwell's equations across different boundaries.
- Classify conductors, dielectrics, and other media, and analyze electromagnetic wave propagation in these materials.
- Evaluate propagation characteristics such as impedance, attenuation, and phase velocity in dielectric and dissipative media.
- Apply analytical methods and Smith charts to model, analyze, and solve transmission line problems.

Module – I: Electrostatics **7L**

Review of Coordinate Systems & Vector Calculus, Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and its applications, Electric Potential, Relation between E and V, Maxwell's Equations for Electrostatic Fields, Energy Density, Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitors–Parallel Plate, Coaxial, Spherical.

Module – II: Magnetostatics **6L**

Biot-Savart's Law, Ampere's Circuit Law and its applications, Magnetic Flux Density, Maxwell's equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law.

Module – III: Maxwell's Equations (Time Varying Fields) **7L**

Faraday's Law, Transformer and Motional EMF, Inconsistency in Ampere's Law and Displacement Current Density, Maxwell's Equations in Differential and Integral form. Boundary Conditions (Dielectric — Dielectric, Conductor– Dielectric, Conductor–Free Space interfaces).

Module – IV: EM Wave Characteristics **7L**

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves–Definitions, Relation between E&H, Wave Propagation in Lossless and Conducting Media, Wave Propagation in Good Conductors and Good Dielectrics, Skin Depth, Surface Impedance, Poynting Theorem. Reflection and Refraction of Plane Waves — Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection.

Module – V: Transmission Lines **6L**

Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless Lines, Types of Distortions, condition for Distortion less transmission lines, Minimum Attenuation, Loading — Types of Loading, Input Impedance, SC and OC Lines, Reflection Coefficient, VSWR, Impedance Transformations - λ/4, λ/2, λ/8 Lines, Smith Chart and Applications.

TEXT BOOKS:

1. Engineering Electromagnetics – William H. Hayt Jr. and John A. Buck,8thEd., McGrawHill,2014
2. Principles of Electromagnetics –Matthew N.O. Sadiku and S.V. Kulkarni, 6thEd., Oxford University Press, Asian Edition, 2015.

REFERENCES:

1. Electromagnetic Waves and Radiating Systems–E.C. Jordan and K.G. Balmain,2ndEd., PHI,2000.
2. Engineering Electromagnetics – NathanIda, 2ndEd., Springer (India) Pvt. Ltd., New Delhi,2005.
3. Electromagnetic Field Theory Fundamentals –Bhag Singh Guru and Husey in R. Hiziroglu, Cambridge University Press, 2nd Ed., 2006.

REFERENCE LINK:

1. **https://www.youtube.com/watch?v=vfu_mNbnHGM&list=PLgwJf8NK2e4I_YltJja47CwZJkzNWK89&index=1**
2. **https://www.youtube.com/watch?v=G3RwhsZ4O4I&list=PLgwJf8NK2e4I_YltJja47CwZJkzNWK89&index=2**
3. **https://www.youtube.com/watch?v=8dR_o7LtDkw&list=PLgwJf8NK2e4I_YltJja47CwZJkzNWK89&index=3**

4. **https://www.youtube.com/watch?v=TYOYID9gJxM&list=PLgwJf8NK2e4I_YltJja47CwZJkzNWK89&index=4**
5. **https://www.youtube.com/watch?v=D2eHgZ4kMHU&list=PLgwJf8NK2e4I_YltJja47CwZJkzNWK89&index=6**

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech Talk and Concept Video topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper–I
8. Model question paper–II
9. Lecture notes
10. Drshya Siksha Sangrah Videos(DSSV)