



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ELECTROMAGNETIC WAVES AND TRANSMISSION LINES								
IV Semester: ECE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AECD11	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 48		Tutorial Classes: Nil		Practical Classes: Nil		Total Classes: 48		
Prerequisite: Applied Physics								

I. COURSE OVERVIEW:

Electromagnetic Waves and Transmission Lines gives the necessary information about the formation of magnetic fields when electric current flows and structures to conduct electromagnetic waves. It covers the fundamental concepts of electro-magnetic wave theory and introduces the basic laws of electromagnetic fields, time varying Maxwell's equations, wave propagation and transmission lines. It provides a platform for advanced courses such as antennas and wave propagation, microwave engineering, transmission via wired links and optical fiber networks.

II. COURSES OBJECTIVES:

The students will try to learn

- I. The basic concepts required to understand various engineering applications involving electromagnetic fields.
- II. The wave propagation characteristics of electromagnetic wave in bounded and unbounded media.
- III. The basic theory of transmission lines, appropriate tools (smith chart) to analyze transmission lines.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

- CO1 Describe fundamental laws (Coulomb's and Gauss's) of electrostatic fields to evaluate the field intensity and flux density of continuous charge distributions.
- CO2 Demonstrate Biot-Savart's law and Ampere's circuit law to determine forces due to magnetic fields.
- CO3 Apply Maxwell's equations and their applications to time varying fields and boundary conditions.
- CO4 Construct the wave equations for both conducting and dielectric media to derive the relation between electric and magnetic field intensities.
- CO5 Understand the propagation of electromagnetic waves through different media using the concept of uniform plane waves.
- CO6 Make use of the smith chart as a graphical tool to solve impedance matching issues in transmission lines.

IV. COURSE CONTENT:

MODULE - I: ELECTRO-STATICS (10)

Electrostatics: Coulomb's law, electric field intensity, fields due to different charge distributions; Electric flux density, Gauss law and its applications; Scalar electric potential; Energy density, illustrative problems; Conductors and dielectrics characterization; Convection and conduction currents; Dielectric constant, isotropic and homogeneous dielectrics; Continuity equation and relaxation time, Poisson's and Laplace's equations; Capacitance: Parallel plate, coaxial, spherical capacitors; Illustrative problems.

MODULE –II: MAGNETO-STATICS (09)

Magneto statics: Biot-savart's law; Ampere's circuital law and applications; Magnetic flux density; Magnetic scalar and vector potentials; Forces due to magnetic fields; Ampere's force law; Boundary conditions: Dielectric-dielectric, dielectric conductor interfaces; Inductances and magnetic energy; Illustrative problems; Maxwell's equations (Time varying fields): Faraday's law; Inconsistency of ampere's law for time varying fields and definition for displacement current density; Maxwell's equations in differential form, integral form and word Statements.

MODULE –III: UNIFORM PLANE WAVES (10)

Uniform plane waves: Wave equations for conducting and perfect dielectric media; Relation between E and H; Wave propagation in lossless and conducting media, Loss tangent, Intrinsic impedance; Skin depth; Polarization, Illustrative problems.

Reflection/refraction of plane waves: Reflection and refraction at normal incidence, reflection and refraction at oblique incidence; Standing waves; Brewster angle, critical angle, total internal reflection, surface impedance; Poynting vector and pointing theorem; Illustrative problems.

MODULE –IV: TRANSMISSION LINE CHARACTERISTICS (09)

Transmission line characteristics: Types, transmission line parameters, transmission line equations, characteristic impedance, propagation constant; Phase and group velocities; Infinite line concepts, Lossless/low loss transmission line characterization; condition for distortionless and minimum attenuation in transmission lines; Loading: Types of loading; Illustrative problems.

MODULE –V: UHF TRANSMISSION LINES AND APPLICATIONS (10)

UHF transmission lines and applications: Input impedance relations; SC and OC lines; Reflection coefficient, VSWR; UHF lines as circuit elements, $\lambda/4$, $\lambda/2$ and $\lambda/8$ lines, impedance transformations, significance of Z_{\min} and Z_{\max} ;

Smith chart: Configuration and applications; Single and double stub matching; Illustrative problems.

V. TEXTBOOKS:

1. Matthew N. O. Sadiku, "Elements of Electromagnetics" Oxford University Press, 4th edition, 2009.
2. E. C. Jordan, K.G. Balmain, "Electromagnetic waves and Radiating Systems PHI learning", 2nd edition, 2000.
3. Umesh Sinha, Satya Prakashan, "Transmission lines and Networks", Tech India Publications, 1st edition, 2010.

VI. REFERENCE BOOKS:

1. G.Sashibushana Rao, "Electromagnetic Field theory and Transmission Lines", Wiley India, 2013.
2. John D. Ryder, "Networks, Lines and Fields" PHI learning, 2nd Edition, 1999.

VII. ELECTRONICS RESOURCES:

1. NPTEL: Electrical, Electronics and Communication: Electromagnetic theory.
2. <http://web.stanford.edu/class>
3. <http://www.electronicagroup.com>
4. <http://www.cpri.in/about-us/departmentsunits/library-and-information-centre/digital-library-links.html>

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper-I
7. Model question paper-II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations