ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

IV SEMESTER: ECE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AECB13	Core	L	Т	Р	С	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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. OBJECTIVES:

The course should enable the students to:

- 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:

After successful completion of the course, students should be able to:

- CO 1 **Describe** fundamental laws (Coulomb's and Gauss's) of electrostatic fields to evaluate Understand the field intensity and flux density of continuous chargedistributions.
- CO 2 **Demonstrate** Biot-Savart's law and Ampere's circuit law to determine forces due to Understand magnetic fields.
- CO 3 **Apply** Maxwell's equations and their applications to time varying fields and boundary Apply conditions.
- CO 4 **Construct** the wave equations for both conducting and dielectric mediato derive the Apply relation between electric and magnetic field intensities.
- CO 5 Understand the propagation of electromagnetic waves through different media using the Understand concept of uniform plane waves.
- CO 6 Make use of the smith chart as a graphical tool to solve impedance matching issues Apply in transmission lines.

IV. SYLLABUS:

MODULE -I ELECTROSTATICS

Classes: 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, conductivity, power absorbed in conductor, Poisson's and Laplace's equations; Capacitance: Parallel plate, co axial, spherical capacitors; Method of images; Illustrative problems.

MODULE -II MAGNETOSTATICS

Classes: 10

Magnetostatics: Biot-savart 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

Classes: 08

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 poynting theorem-applications; Power loss in plane conductor; Illustrative problems.

MODULE -IV TRANSMISSION LINE CHARACTERISTICS

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

MODULE -V UHF TRANSMISSION LINES AND APPLICATIONS

Classes: 08

Classes: 09

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.

Text Books:

- 1. Matthew N.O. Sadiku, "Elements of Electromagnetic", 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.

Reference Books:

- 1. Nathan Ida, "Engineering Electromagnetic", Springer (India) Pvt. Ltd, 2nd Edition, 2005
- 2. William H. Hayt Jr., John A. Buck, "Engineering electromagnetic", Tata McGraw Hill, 7th Edition, 2006.
- 3. G. Sashibushana Rao, "Electromagnetic Field theory and Transmission Lines, Wiley India, 2013.
- 4. John D. Ryder, "Networks, Lines and Fields", PHI learning, 2nd Edition, 1999.

Web References:

- 1. http:// web.stanford.edu/class
- 2. http://www.electronicagroup.com
- 3. http://www.cpri.in/about-us/departmentsunits/library-and-information-centre/digital-library-links.html

- 4. http://nptel.ac.in/courses/antennas5. http://www.tutorialspoint.com/discrete_mathematics

E-Text Books:

- http://www.bookboon.com/en/concepts-in-electrostatics-ebook
 http://www.www.jntubook.com
 http://www.allaboutcircuits.com
 http://www.archive.org