ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

IV Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AECC11	**PCC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	0	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		
Prerequisites: There are no prerequisites to take this course.								

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 engi- neering, transmission via wired links and optical fiber networks.

II. COURSE 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 andunbounded media.
III	The basic theory of transmission lines, appropriate tools (smith chart) toanalyze 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 the field intensity and flux density ofcontinuous charge distributions.	Understand
CO 2	**Demonstrate** Biot-Savart's law and Ampere's circuit law todetermine forces due to magnetic fields.	Understand
CO 3	**Apply** Maxwell's equations and their applications to time varyingfields and boundary conditions.	Apply
CO 4	**Construct** the wave equations for both conducting and dielectricmedia to derive the relation between electric and magnetic field intensities.	Apply
CO 5	**Understand** the propagation of electromagnetic waves throughdifferent media using the concept of uniform plane waves.	Understand
CO 6	**Make use of** the smith chart as a graphical tool to solveimpedance matching issues in transmission lines.	Apply

IV. SYLLABUS:

MODULE – I: ELECTROSTATICS (12)

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 (12)

Magneto statics: 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 (12)

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 (12)

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 (12)

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.

IV. 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.

V. 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.

VI. 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/antennas
5. http://www.tutorialspoint.com/discrete_mathematics