ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

IV Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECC11	PCC	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:

This course 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, radio channels and optical fiber networks.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The knowledge 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 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)

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 (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)

Types of Noise: Resistive (Thermal) Noise Source, Shot noise, Extraterrestrial Noise, Arbitrary Noise Sources, White Noise, Narrowband Noise- In phase and quadrature phase components and its Properties, Modeling of Noise Sources, Average Noise Bandwidth, Effective Noise Temperature, Average Noise Figures, Average Noise Figure of cascaded networks. Noise in DSB and SSB System Noise in AM System, Noise in Angle Modulation System, Noise Triangle in Angle Modulation System, Pre-emphasis and de-emphasis.

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, λ/4, λ/2 and λ/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