ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

IV Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB13	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

COURSEOBJECTIVES:

Students will try to learn:

I The basic 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.

COURSE OUTCOMES:

After successful completion of the course, Students will be able to:

CO 1 **Memorize** different coordinate systemsto describe the spatial variations of the physical quantities in electromagnetic field theory.

CO 2 **Describe** fundamental laws (Coulomb's and Gauss's) of static electric fields to evaluate the Field intensity and Flux density of various charge distributions.

CO 3 **Obtain** Continuity Equation, Relaxation time, Laplace's Equation and Dielectric constant for Electric Fields.

CO 4 **Demonstrate** Biot-Savart's law and Ampere's Circuit lawto determine forces due to magnetic fields.

CO 5 **Apply** Maxwell's equations and their application to time varying fields and boundary conditions.

CO 6 **Compute** the energy relations for electric and magnetic fields.

CO 7 **Summarize** the boundary conditions for dielectric, conductor and free space interfaces in time varying fields.

CO 8 **Explore** the phenomena of wave propagation in different media and its interfaces.

CO 9 **Construct** the wave equations for both conducting and dielectric mediato derive the relation between Electric and Magnetic field intensities.

CO 10 **Describe** the transmission lines, its equivalent circuit and explain their characteristics for various wave lengths.

CO 11 **Analyze** transmission lines under Loss less / Distortion less condition to get minimum attenuation.

CO 12 **Make use of** Smith chart to calculate the characteristic parametersof transmission lines.

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**
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**	**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**	**Classes: 09**
Transmission line characteristics: Types; Transmission line parameters; Transmission line equations; Characteristic impedance, propagation constant; Phase and group velocities; Infinite line concepts, Loss less/lowlosstransmissionlinecharacterization;conditionfordistortionlessandminimumattenuationin transmission lines; Loading: Types of loading; Illustrative problems.		
MODULE - V	**UHF TRANSMISSION LINES AND APPLICATIONS**	**Classes: 08**
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", PHIlearning, 2nd Edition, 2000.
3. Umesh Sinha, Satya Prakashan, "Transmission lines and Networks", Tech IndiaPublications, 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