ELECTROMAGNETIC WAVES ANDTRANSMISSION LINES

IV Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEC007	Foundation	3	-	-	3	30	70	100
Contact Classes: 60	Tutorial Classes:Nil	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the 3D vector co-ordinate systems and electromagnetic field concepts.
II. Analyze the importance of Maxwell's equations in electromagnetic theory and wave propagation.
III. Study the propagation characteristics of electromagnetic waves at boundary.
IV. Demonstrate the ability to compute various parameters for transmission lines using smith chart and classical theory.

COURSE OUTCOMES (COs):

CO 1: Understand coulomb's law and gauss's law to different charge distributions, it's applications and applications of Laplace's and Poisson's equations
CO2: Evaluate the physical interpretation of Maxwell's equations and applications for various fields.
CO3: Understand the behavior of electromagnetic waves incident on the interface between two different media.
CO4: Understand the significance of transmission lines and concept of attenuation, loading, and analyze the loading technique to the transmission lines.
CO5: Formulate and analyze the smith chart to estimate impedance, VSWR, reflection coefficient, OC and SC lines.

COURSE LEARNING OUTCOMES (CLOs):

1. Understand the different types of 3D co-ordinate systems, scalars and vectors, physical significance of divergence, curl and gradient.
2. Illustrate the concepts of coulomb's law and gauss's law to different charge distributions like point charge, line charge, surface charge and volume charge. Analyze its applications.
3. Understand the applications of Laplace's and Poisson's equations to solve problems on capacitance of different charge distributions.
4. Illustrate the physical significance of Biot-Savart's law and Ampere's Circuit law for different current distributions and analyze its applications.
5. Evaluate the physical interpretation of Maxwell's equations and applications for various fields like antennas and wave guides.
6. Derive the boundary conditions between different media like dielectric to conductor, conductor to free space.
7. Analyze and apply the Maxwell's equations to derive electromagnetic wave equations for different media.
8. Understand the behavior of electromagnetic waves incident on the interface between two different media.
9. Formulate and analyze problems in different media such as lossy, lossless with boundaries using uniform plane waves.
10. Understand the significance of transmission lines and its types, derive their primary constants and secondary constants.
11. Understand the concept of attenuation, loading, and analyze the loading technique to the transmission

lines.

12. Understand the design of various transmission lines with respect to distortion, loss, impedance matching, and VSWR and reflection coefficient.
13. Summarize the impedance transformation for different lengths such as λ/4,λ/2,λ/8 transmission lines.
14. Understand the design of ultra high frequency transmission lines for different applications by using single and double stub matching techniques.
15. Formulate and analyze the smith chart to estimate impedance, VSWR, reflection coefficient, OC and SC lines.
16. Apply the concept of electromagnetic fields to understand and analyze land mobile communications.
17. Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

Module-I	**ELECTROSTATICS**	**Classes-09**

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; 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; Method of images; Illustrative problems.

Module-II	**MAGNETOSTATICS**	**Classes-09**

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; Magnetic boundary conditions; 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; Conductors and dielectrics-characterization; Loss Tangent

Module-III	**UNIFRORM PLANE WAVES**	**Classes-09**

Uniform Plane Waves: Wave equations for conducting and perfect dielectric media; Relation between E and H; Wave propagation in lossless and conducting media; 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& poynting theorem-applications; Power Loss in plane conductor; Illustrative problems.

Module-IV	**TRANSMISSION LINES CHARACTERISTICS**	**Classes-09**

Transmission lines 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-09**

UHF Transmission Lines& 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 Zmin and Zmax ; Smith chart-configuration and applications; Single and double stub matching; Illustrative problems.

Text Books:

1. Matthew N.O. Sadiku, - Elements of Electromagnetics, Oxford University Press, 4th Edition.
2. E.C. Jordan and K.G. Balmain, – Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2004.2.
3. Umesh Sinha, Satya Prakasan, - Transmission Lines and Networks, , 2nd Edition, 2001.

Reference Books:

1. Nathan Ida - Engineering Electromagnetic, Springer India Pvt. Ltd, 2nd Edition, 2005.
2. William H. Hayt Jr. and John A. Buck, - Engineering Electromagnetic, TMH, 7th Edition, 2016.
3. G.Sashibushana Rao -Electromagnetic Field theory and Transmission Lines, Wiley India, 2013.
4. John D. Ryder,-Networks, Lines and Fields, PHI, 2nd Edition, 1999.

Web References:

1. http:// web.stanford.edu/class
2. http://www.electronicagroup.com
3. http://www.cpri.in/about-us/departmentsUnitss/library-and-information-centre/digital-library-links.html
4. http://nptel.ac.in/courses/antennas
5. http://www.tutorialspoint.com/discrete_mathematics

E-Text Books:

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