ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

Course Code:22EC1111

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Prerequisites: Applied Physics

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the constitutive relationships for fields and understand their importance(L2)
CO2: Demonstrate the characteristics of electromagnetic waves in the medium.(L3)
CO3: Illustrate plane wave propagation at media Interface(L3)
CO4: Determine the basic transmission line parameters, such as the reflection coefficient, standing wave ratio, and impedance.(L3)
CO5: Analyze transmission line systems using Smith charts.(L4)

UNIT-I 12 Lectures

Electromagnetic Fields

Introduction to Electromagnetic fields, Maxwell's Equations in time domain and phasor domain, Scalar and Vector Potentials, Ampere's Force Law, Continuity Equation, Relaxation time, Joule's Law, Poisson's and Laplace's Equations, Boundary Conditions at media interface.

Learning outcomes: At the end of this unit, the student will be able to

1. understand basic laws of static electric and magnetic fields (L2)
2. describe the Maxwell's equations for time varying fields (L2)
3. illustrate the Boundary conditions of the fields at media interface(L3)

UNIT-II 10 Lectures

Plane Wave Propagation

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization.

Learning outcomes: At the end of this unit, the student will be able to

1. understand Wave Equations for Conducting and Perfect Dielectric Media (L2)
2. illustrate the Uniform Plane Wave Propagation in Lossless and Lossy Media (L3)
3. understand the characterization of conductors and dielectrics (L2)

UNIT-III 10 Lectures

Plane Waves at the Media Interface

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector, and Poynting Theorem – Applications, Power Loss in a Plane Conductor.

Learning outcomes: At the end of this unit, the student will be able to

1. demonstrate Reflection and Refraction of Plane Waves (L3)
2. understand Oblique Incidences (L2)
3. illustrate Brewster Angle, Critical Angle and Total Internal Reflection (L3)

UNIT-IV **10 Lectures**

Transmission Lines

Transmission Line parameters and equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR, UHF Lines as Circuit Elements, Transients on Transmission Lines.

Learning outcomes: At the end of this unit, the student will be able to

1. explain transmission line parameters with equations (L2)
2. illustrate the concepts of reflection, impedance transformation and impedance mismatch (L3)
3. calculate VSWR from reflection coefficient (L3)

UNIT-V **8 Lectures**

Smith Chart

Smith Chart-Configuration, Applications, Impedance transformation one- eighth, quarter, half wave transmission lines, Impedance matching- Introduction to Single and Double Stub Matching.

Learning outcomes: At the end of this unit, the student will be able to

1. describe Smith chart graphically to determine transmission line parameters such as reflection coefficients, impedances and standing wave ratio (L2)
2. analyze the applications of the Smith Chart (L4)
3. understand the concept of Impedance matching (L2)

Text Books:

1. E.C. Jordan and K.G. Balmain, *Electromagnetic Waves and Radiating Systems*, 2nd Edition, PHI, 2000.
2. Matthew N.O. Sadiku, *Elements of Electromagnetics*, 3rd Edition, Oxford University Press, 2001.

References:

1. John D. Krauss, Electromagnetics, 4th Edition, McGraw- Hill publications, 1991.
2. Joseph Edminister, Vishnu Priye, Electromagnetics, 2nd Edition, Schaum's outline series, Tata McGraw-Hill publications, 2006.
3. R K Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill Education, 2005.

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