EM WAVES AND TRANSMISSION LINES

Course Code: 13EC1111

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Course Outcomes:

At the end of the course the student will be able to

CO 1 Comprehend the behavior of electric fields due to static charge distributions

CO 2 Comprehend the behavior of magnetic fields due to current distribution.

CO 3 Specify the "constitutive relations" for fields and understand why they are required.

CO 4 Describe the propagation characteristics of electromagnetic waves.

CO 5 Design of transmission lines at high frequencies.

UNIT-I (13 Lectures)

ELECTROSTATICS :

Coulomb's Law, Electric Fields due to Different Charge Distributions, Gauss Law and Applications, Electrostatic Potential and Equipotential surfaces, Energy Density, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Method of Images. Convection and Conduction currents, Continuity Equation, Relaxation Time, Joules Law, Analogy between D and J.

UNIT-II (13 Lectures)

MAGNETOSTATICS:

Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Scalar and Vector Potentials,Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy.

UNIT-III (8 Lectures)

MAXWELL'S EQUATIONS (TIME VARYING FIELDS) :

Faraday's Law and Transformer emf, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in time domain and phasor domain, Boundary Conditions.

UNIT-IV (12 Lectures)

PLANE WAVE PROPAGATION:

Helmhotz Equations- Wave Equations for Conducting and Perfect Dielectric Media. Uniform Plane Waves, Uniform Plane Wave Propagation in Lossless and Lossy Media. Conductors & Dielectrics – Characterization, Polarization, Behavior of plane waves at the interface of two media: 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.

UNIT-V (14 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; ë/4, ë/2, ë/8 Lines – Impedance Transformations. Smith Chart – Configuration and Applications, Single and Double Stub Matching.

TEXT BOOKS:

1. Matthew N.O. Sadiku, *"Elements of Electromagnetics"*, Oxford Univ. Press, 3rd Ed., 2001.
2. G.S.N. Raju, *"Electromagnetic Field Theory and Transmission Lines"*, Pearson Edn., 2005.
3. G. Sasi Bhushana Rao, *"Electromagnetic Field Theory and Transmission Lines"*, Wiley India Pvt. Ltd, 2012.

REFERENCES:

1. E.C. Jordan and K.G. Balmain, *"Electromagnetic Waves and Radiating Systems"*, PHI, 2ndEd., 2000.
2. Nathan Ida, *"Engineering Electromagnetics"*, Springer (India) Pvt. Ltd., New Delhi, 2nd ed., 2005.
3. John D. Ryder, *"Networks, Lines and Fields"*, PHI, 2nd Edition., 1999.
4. William H. Hayt Jr. and John A. Buck, *"Engineering Electromagnetics"*, TMH, 7th Edition, 2006.
5. Umesh Sinha, *"Transmission Lines and Networks"*, Satya Prakashan (Tech. India Publications), New Delhi, 2001.