ELECTROMAGNETIC FIELD THEORY (IEC-302)

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OBJECTIVE OF COURSE:

1. To analyze field and potential due to the static charges.
2. To evaluate static magnetic fields.
3. To understand how material effect from the electric & magnetic field.
4. To study the relation between the electric & magnetic field under time varying condition.
5. To understand the fundamental of propagation of uniform plane wave.

PREREQUISITES OF COURSE:

1. Engineering Mathematics (IMA-101 & IMA-201)
2. Engineering Physics (IPH-101)

UNIT-I

Introduction to Electromagnetic Fields

Vector Calculus, Co-Ordinate systems, Gradient, Divergence and curl, Gauss Theorem, Stoke's Theorem, Electric Field due to Point Charges, electrostatic Potential, Solution of Laplace and Poisson's equation in one dimension, methods of Images applied to plain boundaries, Electric flux Density, Boundary conditions, Electrostatic Energy.

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UNIT-II

Magneto-static Fields

Ampere law of force, Magnetic flux density, Ampere's circuital law, Boundary conditions, Faraday's Law, Energy stored in magnetic fields.

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UNIT-III

Time-Varying Fields

Continuity equation, Displacement current, Maxwell′s equation, boundary conditions, plane wave equation and its solution in conducting and non conducting media. Phasor notation, phase velocity, group velocity, Depth of penetration, conductors and dielectrics, impedance of

conducting medium, Polarization, Reflection and refraction of plane waves at plane boundaries, Poynting vectors, and Poynting theorem.

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UNIT-IV

Transmission Lines

Transmission line equations, Characteristic impedance, Distortion-less lines, Input impedance, lossless lines, Open and short circuited lines, Standing wave and reflection losses, Impedance matching, Application of smith chart, Introduction to guided waves.

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UNIT-V

Waveguides

Rectangular Waveguide, Circular Waveguide Transverse Electric (TE) and Transverse Magnetic (TM) Modes, Wave Propagation in the Guide, Power Transmission & Attenuation, Waveguide Resonators.

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Text Book:

1. M. N. O. Sadiku, “Elements of Electromagnetics”, 4th Edition, Oxford University Press, India. (TBS 621.34 SAD/P)

References:

1. Nathan Ida, “Engineering Electromagnetism”, Second Edition, Springer India Private Limited. (TBS 621.34 IDA/E)
2. Rakesh Singh Kshetrimayum, "Electromagnetic Field Theory", Cengage Learning India Publication, First Edition, 2012.
3. W. H. Hayt and J. A. Buck, “Electromagnetic field theory”, Seventh Edition, McGraw Hill Education.

OUTCOME

On completion of this course the student will understand

1. Different coordinate systems, application of Vector calculus and different theorem involved in the different fields.

2. Calculate the electric field, scalar potential, stored energy, and capacitance associated with simple distributions of charge
3. Calculate the magnetic field, stored energy, and inductance for simple distributions of current density.
4. Identify an electromagnetic wave and determine parameters (frequency, phase constant and velocity, associated intrinsic impedance) and power density.
5. Apply boundary conditions to determine current and charge densities produced on conducting boundaries by applied fields.
6. Identify Maxwell's equations and apply them in both their integral and differential forms to time-varying field problems.
7. Determine the attenuation constant, phase constant, and skin depth for waves in a lossy medium, where the conductivity may range from low to high.
8. Distinguish between linear polarization, circular polarization, and elliptical polarization.
9. Calculate reflection and transmission coefficients and fields for uniform plane waves normally-incident and obliquely-incident on planar interfaces.
10. Determine parameters associated with waves on lossless and lossy transmission lines, including frequency, phase velocity & attenuation.
11. Design transmission line terminations to minimize reflections and maximize received power.
12. Determine frequency-domain parameters associated with a transmission line system, including input impedance, reflection coefficient, and SWR.
13. Analyze transmission line problems in the frequency domain with complex load impedance, to determine input and load voltage/current, power delivered.
14. Introductory detail about the microwave waveguide.