

Course 9. Electromagnetic Fields (Video Course)

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Detailed Syllabus :

Electrostatics 16

- 1 Scalar and Vector fields 2
- 2 Coulomb's Law and concept of Electric Field 2
- 3 Divergence, the Divergence Theorem and Gauss' Law 2
- 4 Concept of Electrostatic Potential, Poisson's Equation 2
- 5 Energy in the Field, Capacitance 2
- 6 capacitance of common two-plate capacitors, including two-wire capacitors 2
- 7 Dielectrics, dielectric boundary conditions 2
- 8 Solution of Laplace's Equation and Poisson's Equation in 1-D. Capacitance calculations with multiple dielectrics 2

Magnetostatics 12

- 9 Force due to a Magnetic field, Force due to combined Electric and Magnetic fields 2
- 10 Biot-Savart Law, calculation of Magnetic Field for simple coil configurations 2

Topic Lectures

- 11 Ampere's Law 1
- 12 Magnetic flux, Stokes theorem 2
- 13 Magnetic materials, magnetic boundary conditions 2
- 14 Inductance calculations from $\phi = L \cdot I$, for common geometries 2
- 15 Force on a dipole 1

Slowly Time-Varying Systems 5

- 16 Frames of reference and motional emf. Faraday's law 2
- 17 Stored energy in the magnetic field. The Inductance equation 2
- 18 Examples from electric machines and transformers 1

Time-Varying Fields 13

- 19 The Displacement current. Maxwell's Equation 2
- 20 The wave equation in 1-Dimension 1
- 21 Solution of the wave equation. Plane waves 2
- 22 Wave propagation in vacuum and lossy dielectrics 2
- 23 Skin depth and frequency dependence of lumped elements 2
- 24 Energy transport by waves. The Poynting vector 2
- 25 Reflection at boundaries. Normal incidence formula. Impedance matching. 2

Total 46

References

1. *Principles and Applications of Electromagnetic Fields* - Plonsey, R. and COLLIN, R.E., McGraw Hill. 1961.
2. *Engineering Electromagnetics* - William H. Hayt, Jr. Fifth Edition. TMH.1999.