ELECTROMAGNETICS
ENEX 254

Lecture : 3 **Year :II**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
The objective of this course is to provide students with a basic mathematical concepts related to electromagnetic time invariant and time variant fields including electromagnetic wave and their transmission on different media

1 Introduction (4 hours)

1.1 Scalar and vector fields
1.2 Operations on scalar and vector fields
1.3 Co-ordinate systems (Cartesian, cylindrical and spherical) and conversions

2 Electric Field (15 hours)

2.1 Coulomb’s law
2.2 Electric field intensity
2.3 Electric flux density
2.4 Gauss’s law and applications
2.5 Physical significance of divergence, divergence theorem
2.6 Electric potential, potential gradient
2.7 Energy density in electrostatic field
2.8 Electric properties of material medium
2.9 Free and bound charges, polarization, relative permittivity, electric dipole electric boundary conditions
2.10 Current, current density, conservation of charge, continuity equation, relaxation time
2.11 Boundary value problems, Laplace and Poisson equations and their solutions, uniqueness theorem

3 Magnetic Field (9 hours)

3.1 Biot-Savart’s law
3.2 Magnetic field intensity
3.3 Ampere’s circuital law and its application
3.4 Magnetic flux density
3.5 Physical significance of curl, Stoke’s theorem
3.6 Scalar and magnetic vector potential
3.7 Magnetic properties of material medium

3.8 Magnetic force, magnetic torque, magnetic moment, magnetic dipole, magnetization
3.9 Magnetic boundary condition

4 Time Varying Fields (4 hours)

4.1 Faraday's law, transformer EMF, motional EMF
4.2 Displacement current
4.3 Maxwell's equations in integral and point forms

5 Plane Waves (9 hours)

5.1 Wave propagation in lossless and lossy dielectric
5.2 Plane waves in free space, lossless dielectric, good conductor
5.3 Power and poynting theorem average power density
5.4 Reflection of plane wave at normal incidence
5.5 Standing wave and SWR
5.6 Input intrinsic impedance

6 Transmission Lines (4 hours)

6.1 Transmission line equations (Taking analogy from wave equations)
6.2 Lossless, lossy and distortionless transmission lines
6.3 Input impedance, reflection coefficient, standing wave ratio

Tutorial (15 hours)

1. Conversion of coordinate systems (Cartesian to cylindrical /spherical and vice versa, cylindrical to spherical and vice versa)
2. Electric field intensity and flux density (Coulomb's law, Gauss law, divergence, electric potential and energy density)
3. Boundary condition, electric dipole, and boundary value problems
4. Magnetic fields (Biot-Savart law, Ampere circuit law, Stoke's theorem, magnetic force and torque)
5. Time varying fields (Transformer/motional EMF, displacement current)
6. Wave propagation equations in lossy and lossless medium (Poynting theorem, standing wave ratio and intrinsic impedance)
7. Transmission line (Lossless, lossy and distortionless)

Practical (22.5 hours)

1. Teledeltos (Electro-conductive) paper mapping of electrostatic fields
2. Determination of dielectric constant, display of a magnetic hysteresis loop
3. Studies of wave propagation on a lumped parameter transmission line
4. Microwave sources, detectors, transmission lines
5. Standing wave patterns on transmission lines, reflections, power patterns on transmission lines, reflections, power measurement
6. Familiarizations of electric and magnetic field measurements using simulation tool

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	4	5
2	15	20
3	9	12
4	4	6
5	9	12
6	4	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Hayt, W. H. (2001). Engineering Electromagnetics. McGraw-Hill Book Company.
2. Kraus, J. D. (1973). Electromagnetics. McGraw-Hill Book Company.
3. Rao, N. N. (1990). Elements of Engineering Electromagnetics. Prentice Hall.
4. Devid K. Cheng, (1989). Field and Wave Electromagnetics. Addison-Wesley.
5. Sadiku, M. N. O. (2010). Elements of Electromagnetics. Oxford University Press.