MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering

Department of Electronics & Communication Engineering
Course Hand-out

Electromagnetic Field and Waves | EC 1404 | 4 Credits | 3 1 04

Session: Jan 15 –May 15 | Faculty: Mr C P Gupta, Mr Tejpal| Class: Core Course

A. Introduction: This course comes in the class of core course for the undergraduates. To provide the basic skills required to understand, develop, and design various engineering applications involving electromagnetic fields. The contents of the course are so thoughtfully designed to lay the foundations of electromagnetism and understanding of the application of electromagnetics in real world problems such as CMOS transistors, hard drives, wireless communications, guided wave principles such as fibre optics and electronic electromagnetic structures.

B. Course Outcomes: At the end of the course, students will be able to

[1404.1]. Apply vector calculus to understand the behavior of static electric fields in different engineering situations;
[1404.2]. Apply vector calculus to understand the behavior of static magnetic fields in standard configurations;
[1404.3]. Acquire the skills to apply boundary conditions to problems of electromagnetics;
[1404.4]. Analyze Maxwell's equation in different forms (differential and integral) and acquire the skills to apply them to diverse engineering problems.
[1404.5]. Analyze the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering

C. SYLLABUS

Review of Vector Calculus: Cartesian coordinates, Circular Cylindrical and Spherical co-ordinates.
Electrostatics: Coulomb's law and its applications; Electric field intensity and Electrostatic potential due to point charges, Field due to continuous charge distribution. Electric flux and electric flux density, Gauss's law, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, energy density in electrostatic fields., **Electric field in material space:** convection and conduction currents, conductors, polarization in dielectrics, continuity equation and relaxation time. **Electrostatic boundary condition:** dielectric-dielectric, dielectric-conductor. Poission's and Laplace's equations. **Magnetostatics:** Magnetic field intensity, Biot-Savart's law; magnetic flux and magnetic flux density; Ampere's law, Maxwell's equation, application of ampere's law. **Maxwell's equation,** Maxwell's equation for static fields, magnetic scalar and vector potential, Magnetic boundary conditions, magnetic energy; **Electromagnetic Waves & Applications:** Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, displacement current, Maxwell's equation in final form. Maxwell's equations in integral and point form for free space and material media, Poynting vector and complex Poynting vector theorem, instantaneous and average energy in plane waves; **Electromagnetic wave propagation:** Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane wave in free space, plane waves in good conductors, power and the pointing vector, reflection of a plane wave in a normal incidence. Introduction to Transmission Lines and waveguides.

D. REFERENCE BOOKS

1) Jr. Hayt and Bucker, Engineering Electromagnetics, 7th Edition , McGraw Hill, 2006.
2) M. A. Plonus, Applied Electromagnetics, McGraw Hill 1978.
3) J. D. Kraus, Electromagnetics, 4th Edition, McGraw Hill 1992.
4) Cheng, Fields, Waves and Electromagnetics, 2nd Edition, Addison Wesley, 2004.
5) S. Ramo, J.R. Whinnery and T. Van Duzer, Fields and Waves in Communication Electronics, Wiley, 3rd edition, 1994. S.M. Wentworth, Fundamentals of Electromagnetics with Engineering Applications, Wiley, 2005.