The University Of Sheffield.

Electronic & Electrical Engineering.

EEE345 ENGINEERING ELECTROMAGNETICS

Credits: 10

Course Description including Aims

1. To develop an understanding of the physical behaviour of electric and magnetic fields.
2. To develop a mathematical basis for calculating fields in engineering applications.
3. To apply these ideas to solve practical problems in electronic and electrical engineering.

Outline Syllabus

Electrostatic fields Gauss's theorem, Laplace's equation, solution in simple geometries, Poisson's equation, numerical and analytical methods for calculating fields, application to pn junction diode and parallel plate capacitor.
Magnetostatic fields Ampère's law, Stokes' theorem, scarlar and vector magnetic potentials, calculation of static fields.
Low frequency time-varying fields Faraday's law, diffusion equation, skin depth, 1-D eddy current in thick and thin plates, AC resistance.
Waves in 1D, reflection, decay, wave equation. Pulse propagation, speed, wavelength, forward and backward solutions.
Transmission lines: distributed impedance and admittance, wave equation in 1D, propagation constant, dispersion, characteristic impedance, lossless line, microstrip, power transmission, coax, reflection, standing waves, input impedance of terminated line.
Electric and magnetic fields in coax, plane waves.
TEM propagation, wavelength, speed, transverse nature, impedance of free space, energy density, resistive and radiative losses, Poynting's vector, radiated power, absorption length, eddy currents and optical fibres. **Electromagnetic waves in 3D,** wavevector, wave equation in 3D, interface conditions, reflection and refraction of waves at dielectric and metallic interfaces, total internal reflection, principles of waveguiding.

Time Allocation

24 lectures and 12 hours of tutorial support in weeks 13 to 24.

Recommended Previous Courses

2nd year courses EEE220 Electric and Magnetic Fields and AMA243 Mathematics IV (Electrical).

Assessment

2 hour examination. All questions may be attempted and full marks can be gained by complete answers to 3 questions.

Recommended Books

Hammond, P.	*Electromagnetism for engineers*	Pergamon Press 1986
Cheng, D.K.	*Field and wave electromagnetics*	Addison-Wesley 1989
Demarest, K.R.	*Engineering Electromagnetics*	Prentice Hall, 1998
Hayt, W.H.	*Engineering Electromagnetics*	McGraw-Hill, 1989

Objectives

On completion of the module successful students will be able to

1. Perform a range of vector operations.
2. Select and apply appropriate techniques for calculating electrostatic or magnetic fields in a range of practical devices.
3. Identify and specify approximate models and boundary conditions for a range of devices.
4. Demonstrate familiarity with the ideas of pulse and wave propagation in 1D and 3D.
5. Appreciate the main features of electrical transmission lines and to be able to perform calculations on them.
6. Appreciate the principles of electromagnetic plane wave propagation and of reflection and refraction at dielectric and metallic interfaces.