MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHH 404: ELECTRODYNAMICS

[52 hrs]

CO1 Have the basics of electro and magnetostatics.

CO2 Have the knowledge Maxwell's equations. Will be able to apply Maxwell's equation to solve problems in electrodynamics.

CO3 Have the knowledge of Poynting theorem,Retarded, potentials. Electric and magnetic dipole radiation.

CO4 Will have a basic understanding of plasma physics and apply theknowledge to study motion of charged particles in various fields.

Unit I **Electrostatics and Magneto statics:**

Gauss's law and applications, Electric Potential, Poisson's equations, Work, energy in electrostatics. Laplace's equations and its solution in one, two and three dimensional problems (Cartesian co ordination). Boundary conditions and uniqueness theorem. Method of images and applications. Multipole expansion. Electric dipole field, redo pot, Field inside a dielectric- special problems involving linear dielectric, Biot –Savart law and applications, Ampere's law and applications,

Magnetic vector potential, Boundary conditions. Multipole expansion of vector potential. Review of magnetisation. Magnetic field inside matter, The field of a magnatized object. [13 hrs]

Unit II **Electromagnetic waves**:

Review of Maxwell's equations, formulating electrodynamics using scalar and vector potentials, Gauge transformations. Coulomb gauge and Lorentz gauge. Energy and momentum of electromagnetic waves. Propagation through linear media, reflection and transmission of electromagnetic waves: plane waves in conducting media, skin depth, dispersion of electromagnetic waves in non conductors, wave guides, transmission of electromagnetic waves in rectangular wave guide.

[13 hrs]

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Unit III **Electromagnetic Radiation**:

Retarded potentials. Electric and magnetic dipole radiation. Lienard-Wiechert potentials. Fields of a point charge in motion, slowly moving, Power radiated by a point charge oscillation, Larmour formula,

Review of Lorentz transformations, Four vectors, Magnetism as a relativistic phenomenon, Lorentz transformation of electric and magnetic fields, The electromagnetic field tensor notation, potential formulation of electrodynamics.

[13 hrs]

Unit IV **Plasma Physics:**

Plasma - definition, Debye shielding distance, hydromagnetic equations. Motion of charged particle in (a) uniform magnetic field (b) electric and magnetic fields at not angled (c) space dependent magnetic field. Adiabatic invariants, the equation of motion of a plasma fluid, magnetic pressure, plasma confinement, Pinch effect, Plasma as a conducting fluid, Drift velocities, Plasma oscillations, Plasma waves, Propagation of electromagnetic waves in plasma. Magnetic mirrors. [13 hrs]

Text Books:

1. D.J. Griffiths, 'Introduction to Electrodynamics', III Edn. (PHI, 2003)
2. B.B. Laud 'Electromagnetics' (New age International PVT. LTD)
3. P. Lorrain and D. Corson, 'Electromagnetic field and waves'(CBS)
4. I.S Grant and W.R. Phillips 'Electromagnetism' (John Wiley and sons Ltd.)
5. Pramanik, 'Electromagnetism' (PHI,2010)
6. J.D. Jackson, 'Classical Electrodynamics' (Wiley eastern,2003)
7. Reitz J R, Milord F J, Christy R W, 'Foundations of Electromagnetic Theory', III Edn. (Narosa Publishing House, 1990)
8. Purcell E M, `Electricity and Magnetism', II Edn. (McGraw Hill, 1985)
9. A.R. Choudhari, 'The Physics of fluids and plasmas' (Cambridge UP 1998)
10. Chen Francis, 'Plasma Physics', II Edn. (Plenum Press, 1984)
11. Bitten Court J A, 'Fundamentals of Plasma Physics' (Pergamon Press, 1988)
12. Paul Bellan, 'Fundamentals of Plasma Physics' (CUP 2006)

Reference Books:

1 Sommerfeld A, 'Mechanics' (Academic Press, 1964)
2 Krauss John D, 'Electromagnetics', II Edn. (Tata McGraw Hill, 1973)
3 Singh R N, 'Electromagnetic Waves and Fields' (Tata McGraw Hill, 1991)