MPHC4202

Classical Electrodynamics and Classical Mechanics II

Group A: Classical Electrodynamics

Vector and scalar potentials, Gauge transformations: Lorentz and Coulomb gauge, Helmholtz theorem (with proof); Inhomogeneous wave equation; Green function for the inhomogeneous wave equation.

[8 lectures]

Simple radiating systems: Fields and radiation of a localized oscillating source, electric dipole fields and radiation, angular distribution of radiation due to an oscillating dipole. Center-fed linear antenna.

[9 lectures]

Radiation by moving charges: Lienard-Wiechert potentials and fields for a point charge, charges moving with uniform velocity, accelerated charges, radiation from accelerated charges moving (i) with low velocities and (ii) with relativistic velocities, bremsstrahlung, synchrotron radiation; Cherenkov radiation. Rayleigh's scattering and the colour of sky.

[13 lectures]

Total power radiated by an accelerated charge – Larmor's formula, angular distribution of radiation, radiation reaction – Abraham Lorentz formula

[6 lectures]

References:

1. Classical Electrodynamics (3rd edition, Wiley) – J.D. Jackson

2. Classical Electricity and Magnetism (2nd edition, Dover Publications) – Panofsky and Phillips

3. Introduction to Electrodynamics (4th edition, Pearson)– D. J. Griffiths

4. Foundations of Electromagnetic Theory (4th edition, Pearson) – Reitz, Milford and Christy

5. Feynman Lectures Vol. II - R. P. Feynman, R. B. Leighton and M. Sands (Addison-Wesley)

Group B: Classical Mechanics–II (Continuum Mechanics)

Canonical formalism for continuous media: Lagrangian and Hamiltonian densities, Noether's theorem, Energy momentum Tensor; applications to sound wave equation and Maxwell equation.

[18 lectures]

Fluid Systems: Stress and Strain Tensors, Lagrangian and Eulerian coordinates, Conservation equations, The Navier-Stokes-Duhem Equations for Fluid Motion. Applications.

[18 lectures]

References:

1. Bachelor, An introduction to fluid Mechanics; CUP
2. Faber, Fluid Dynamics for Physicists; CUP
3. Falkovich, Fluid Mechanics, a short course for Physicists; CUP
4. White, Fluid Mechanics; WCB McGraw Hill
5. Kundu & Cohen, Fluid Mechanics, Academic Press
6. Classical Mechanics, Goldstein
7. Classical Mechanics, K. C. Gupta