PHY 621 - Classical Electrodynamics

Course Code & Number	Course Name	C.H.	Lec.	Lab.	Tut.
PHY 621	Classical Electrodynamics	4	4	0	0

Syllabus

Introduction to Electrostatics: *Coulomb's law, Electric field, Gauss's law, Differential form of Gauss's law, Scalar potential, Surface distributions of charges and dipoles, Poisson's and Laplace's equations, Green's theorem, Uniqueness theorem, Formal solution of boundary-value problem, Green' functions, Electrostatic potential energy.*

Boundary–Value Problems in Electrostatics, I: *Method of images, Point charge and a grounded conducting sphere, Point charge and a charged, insulated, Conducting sphere, Point charge and a conducting sphere at fixed potential, Conducting sphere in a uniform field, Method of inversion, Green's function for a sphere, Conducting sphere with hemispheres at different potentials, Orthogonal functions and expansions, Separation of variables in rectangular coordinates.*

Boundary-Value Problems in Electrostatics, II: *Laplace's equation in spherical coordinates, Legendre polynomials, Boundary-value problems with azimuthal symmetry, Spherical harmonics, Addition theorem for spherical harmonics, Cylindrical coordinates, Bessel functions, Boundary-value problems in cylindrical coordinates, Expansion of Green's functions in spherical coordinates, Use of spherical Green's function expansion, Expansion of Green's functions in cylindrical coordinates.*

Multipoles, Electrostatics of Macroscopic Media, Dielectric: *Multipole expansion, Multipole expansion of the energy of a charge distribution in an external field, Macroscopic electrostatics, Simple dielectrics and boundary conditions, Boundary–value problems with dielectrics, Molecular polarizability and electric susceptibility, Models for molecular polarizabilty, Electrostatic energy in dielectric media.*

Magnetostatics: *Introduction and definitions, Biot and Savart law, Differential equations of Magnetostatics, Ampere's law, Vector potential, Magnetic induction of a circular loop of currents, Localized current distribution, magnetic moment, Force and torque on localized currents in an external field, Macroscopic equations, Boundary conditions, Uniformly magnetized sphere in an external field, Permanent magnets, Magnetic shielding.*

Time-Varying Fields, Maxwell's Equations, Conservations Laws: *Faraday's law of induction, Energy in the magnetic field, Maxwell's displacement current, Maxwell's equations, Vector and scalar potentials, wave equations, Gauge transformations, Green's function for the time-dependent wave equation, Initial-value problem, Kirchhoff's integral representation, Poynting's theorem, Conservation laws, Macroscopic equations.*

References

- J.D. Jackson, Classical electrodynamics, 3rd Edition, John Wiley and Sons, 1998.
- W. Greiner , Classical Electrodynamics, Springer-Verlag New York, Inc., 1998.