Electrodynamics-II
PHYS-308

Brief Introduction
Magnetostatics in free space, Magnetostatics inside matter, Maxwell's equations, Electromagnetic waves in free space, Electromagnetic waves inside matter

Text Book
David J. Griffiths, Introduction to Electrodynamics, 4th Edition, Cambridge University Press, 2017

Pre-requisites
- Electricity and Magnetism-I (PHYS-107)
- Electricity and Magnetism-II (PHYS-201)

Learning Outcomes
On successful completion of this course, students will be able to:
- Use their conceptual understanding of the electromanetic laws in order to qualitatively and quantitatively describe the behaviour of the solutions to the problems
- Use their ability to manage the electromagnetic laws in simple situations
- Use these concepts to set up a model and perform the necessary calculations; select appropriate methods and make appropriate approximations
- Apply this knowledge in practical situations

Evaluation
Sessional: 20%
- Assignments 10%
- Quiz 5%
- Class Participation 5%

Midterm: 30%
Final Term: 50%

Lecture Plan

Lecture No.	Contents	Date	Day/Time
Lecture No. 1	Electric current, Steady current, Time-varying current, Line currents, Surface currents	24-03-2020	Tuesday/13:30
Lecture No. 2	Volume currents, Equation of continuity for dynamic/ static case, Charge conservation, Line charge density vs Line current, Surface charge density vs Surface current density, Volume charge density vs Volume current density, Divergence/flux of volume current density, Example 5.4	27-03-2020	Friday/11:30
Lecture No. 3	Lorentz force law, Work done by magnetic force, Magnetic force on line/surface/volume currents, Magnetic force on a closed current loop in uniform field	30-03-2020	Monday/13:30
Lecture No. 4	Biot-Savart law for magnetic force, Biot-Savart law for magnetic field due to line/surface/volume currents, Magnetic flux, Magnetic monopole doesn't exist	31-03-2020	Tuesday/13:30
Lecture No. 5	Applications of Biot-Savart law: Magnetic field due to infinitely long straight current-carrying wire, Right-hand rule	03-04-2020	Friday/11:30

Lecture No.	Contents	Date	Day/Time
Lecture No. 6	…continued Magnetic field due to a circular current loop (special cases: at centre/large distance), Tiny current loops are magnetic dipoles, Magnetic field lines of a tiny current loop, Magnetic field at the axis of magnetic dipole, Magnetic dipole vs Electric dipole, Magnetic torque vs Electric torque, Magnetic energy vs Electric energy	06-04-2020	Monday/13:30
Lecture No. 7	Ampere's law, Ampere's law vs Gauss's law, Differential/integral forms of AL, Applications of Ampere's law: Magnetic field due to infinitely long straight current-carrying wire, Magnetic field due to coaxial cable	07-04-2020	Tuesday/13:30
Lecture No. 8	…continued Magnetic field due to toroid, Magnetic field due to solenoid, Magnetic field lines of a solenoid	10-04-2020	Friday/11:30
Lecture No. 9	Curl of magnetic field, Curl of magnetic field vs Divergence of electric field	13-04-2020	Monday/13:30
Lecture No. 10	Magnetic vector potential, Magnetic vector potential vs Electric scalar potential, SI unit and physical significance of MVP, Uniqueness theorem, Classification of Fields,Class I/II/III/IV fields with examples	14-04-2020	Tuesday/13:30
Lecture No. 11	Solutions of Laplace's/Poisson's vector equations, Biot-Savart law for MVP due to line/surface/volume currents, Biot-Savart law for MVP isn't valid for infinite current distributions, Alternate way of finding MVP due to infinite current distributions	17-04-2020	Friday/11:30
Lecture No. 12	Multipole expansion of MVP, Magnetic monopole/ dipole/quadrupole, Area enclosed by closed current loop	20-04-2020	Monday/13:30
Lecture No. 13	MVP of a magnetic dipole, Magnetic dipole moment for line/surface/volume currents, Magnetic vector potential vs Electric scalar potential, Magnetic field of a magnetic dipole	21-04-2020	Tuesday/13:30
Lecture No. 14	Coordinate-free form for MVP/Magnetic field of a magnetic dipole, MVP/Magnetic field of a magnetic dipole in spherical coordinates	24-04-2020	Friday/11:30
Lecture No. 15	Magnetostaic boundary conditions, BC on the normal component of magnetic field, BC on the tangential components (parallel/perpendicular to the sheet current) of magnetic field	27-04-2020	Monday/13:30
Lecture No. 16	BC on the normal/tangential components of MVP, Magnetization, SI unit/direction, Free current vs Bound current, Magnetization vs Polarization	28-04-2020	Tuesday/13:30
Lecture No. 17	MVP/Magnetic field due to a magnetized object, Bound surface/volume currents, Bound surface/ volume charge density vs Bound surface/volume current density, Field due to magnetized object vs Field due to polarized object	01-05-2020	Friday/11:30