II Year-I Semester		L	T	P	C
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ELECTROMAGNETIC FIELDS (R1621024)

Prerequisite Course: Linear algebra, vector analysis, matrix analysis and complex calculus

Course Description and Objectives:

Electromagnetic fields is the foremost pre-requisite course for most of the subjects in Electrical Engineering. Either in the enunciation of basics of electrical elements R, L and C that are the building blocks of any electrical device or in the illustration of Energy transfer from mechanical to electrical and vice versa its role is crucial. This course also includes the famous works of Coulomb, Ampere, Faraday, Maxwell etc. to the field of Electrical Engineering.

Course Outcomes:

Upon the course, the student will be able to achieve the following outcomes.

Cos	Course Outcomes	Pos
1	Calculate electric field and potentials using guass's law or solving Laplace's or Possion's equations.	4
2	Learn how to calculate capacitance, energy stored in dielectrics and get's the concept of conduction and convection currents.	3
3	Find magnetic field intensity due to current, the application of ampere's law and the Maxwell's second and third equations.	4
4	Calculate the magnetic forces and torque produced by currents in magnetic field.	5
5	Will the able to calculate self and mutual inductances and the energy stored in the magnetic field.	4
6	Students will gain knowledge on time varying fields and get ability to calculate induced Emf. Concepts of displacement current and Poynting vector and associated problems are solved.	4

Syllabus:

UNIT-I
Electrostatics:
Objective:
To study the production of electric field and potentials due to different configurations of static charges.
Electrostatic Fields – Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge – Work done in moving a point charge in an electrostatic field – Electric Potential – Properties of potential function – Potential gradient – Guass's law — Maxwell's first law, div (D)=ρv Laplace's and Poison's equations and Solution of Laplace's equation in one variable.

UNIT-II
Conductors – Dielectrics and Capacitance:
Objective :
To study the properties of conductors and dielectrics, calculate the capacitance of different configu-various and understand the concept of conduction and convection current densities.
Electric dipole – Dipole moment – potential and EFI due to an electric dipole – Torque on an Electric dipole in an electric field – Behaviour of conductors in an electric field – Conductors and Insulators Polarization – Boundary conditions between conduction to Dielectric and dielectric to dielectrics capacitance – capacitance of parallel plates, spherical

and coaxial cables with composite dielectrics –Energy stored and energy density in a static electric field – Current density – conduction and Convection current densities – Ohm's law in point form – Equation of continuity.

UNIT III
Magneto statics and Ampere's Law:
Objective:
To study the magnetic fields produced by currents in different configurations, application of ampere's law and the Maxwell's second and third equations.
Static magnetic fields – Biot-Savart's law – Oesterd's experiment – Magnetic field intensity (MFI) – MFI due to a straight current carrying filament – MFI due to circular, square and solenoid current – Carrying wire – Relation between magnetic flux, magnetic flux density and MFI – Maxwell's second Equation, div(B)=0 –Ampere's circuital law and its applications viz. MFI due to an infinite sheet of current and a long filament carrying conductor – Point form of Ampere's circuital law –Field due to a circular loop, rectangular and square loops, Maxwell's third equation, Curl (H)=J.

UNIT IV
Force in Magnetic fields:
Objective :
To study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
Magnetic force - Moving charges in a Magnetic field – Lorentz force equation – force on a current element in a magnetic field – Force on a straight and a long current carrying conductor in a magnetic field – Force between two straight long and parallel current carrying conductors – Magnetic dipole and dipole moment – a differential current loop as a magnetic dipole – Torque on a current loop placed in a magnetic field.

UNIT V
Self and Mutual inductance:
Objective :
To develop the concept of self and mutual inductances and the energy stored.
Self and Mutual inductance – determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magnetic field.

UNIT VI
Time Varying Fields:
Objective :
To study time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced Emf.
Time varying fields – Faraday's laws of electromagnetic induction – Its integral and point forms – Maxwell's fourth equation, Curl (E)=$-\partial B/\partial t$ – Statically and Dynamically induced EMFs – Simple problems –Modification of Maxwell's equations for time varying fields – Displacement current – Poynting Theorem and Poynting vector.

TEXT BOOKS:
1. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill Companies, 7th Editon. 2006.

REFERENCE BOOKS
1. "Principles of Electro Magnetics" by Sadiku, Oxford Publications,4^{tyh} edition.
2. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt. Ltd., 2nd edition.
3. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford higher education.
5. Electro magnetism : Problems with solutions by Ashutosh Pramanik, PHI Publications.