ELECTROMAGNETIC FIELDS

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB10	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I Demonstrate the concept of electrostatic field intensity and electric potential.
II Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in an electric field.
III Understand the concept of field intensity and flux density in magnetic fields.
IV Discuss forces in magnetic fields and laws of electromagnetic induction
V Summarize the concept of time varying field and analyze propagation of electro-magnetic waves.

COURSE OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

CO 1 Determine the force and electric field intensity due various types of charge distribution with the help of vector calculus.
CO 2 Estimate the capacitance of various configurations and study behaviour of charges in conductors and dielectrics.
CO 3 Understand Bio-Savart's law and determine magnetic field intensity due different configuration of conductors, their other deductions.
CO 4 Calculate the magnetic force acting on body due to different configurations of conductors and deduce the magnetic potentials.
CO 5 State Faraday's laws of electromagnetic induction in time varying fields and analyze wave propagation in electro-magnetic fields.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

1 Analyze the force and electric field intensity in the electrostatic field with knowledge of vector algebra.
2 Identify the characteristics of electrostatic fields in terms of definitions.
3 State different laws which defines characteristics of electrostatic fields.
4 Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in electric field.
5 Demonstrate the electric dipole and its effect on electric field.
6 Estimate the capacitance of parallel plates, spherical and coaxial capacitors with composite dielectrics.
7 Summarize the concept of magneto static and interrelate the terms of magnetic fields.
8 Interpret the magnetic field intensity due to circular, square and solenoid current carrying wire.
9 Use Ampere circuital law to determine magnetic field intensity due to an infinite sheet of current, a long current carrying filament and its applications.

10	Predict the force due to moving charge in the magnetic field for different configuration of current carrying conductor.
11	Demonstrate the magnetic dipole and its effect on magnetic field.
12	Calculate the self inductance and mutual inductance for different configurations of wires and applications of permanent magnet.
13	State the Faraday's laws of electromagnetic induction and nature of voltage induced in the coil.
14	Derive and explain the differential and integral form of Maxwell's equation in time varying fields and fields varying harmonically with time.
15	Discuss the electromagnetic wave propagation and its analysis.
16	Apply the concept of electromagnetic and electrostatic fields to solve real time world applications.
17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

MODULE-I	**VECTOR CALCULUS AND ELECTROSTATICS**	**Classes: 09**

Introduction to Cartesian, cylindrical and spherical co-ordinates. Conversion of one type of co-ordinates to another; Electrostatic fields: Coulomb's law, electric field intensity due to line and surface charges, work done in moving a point charge in an electrostatic field, electric potential, properties of potential function, potential gradient, Gauss's law, application of Gauss's law, Maxwell's first law, Laplace's and Poisson's equations, solution of Laplace's equation in one variable.

MODULE-II	**CONDUCTORS AND DIELECTRICS**	**Classes: 09**

Dipole moment, potential and electric field intensity due to an electric dipole, torque on an electric dipole in an electric field, behavior of conductors in an electric field, electric field inside a dielectric material, polarization, conductor and dielectric, dielectric boundary conditions, capacitance of parallel plate and spherical and coaxial capacitors 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.

MODULE-III	**MAGNETOSTATICS**	**Classes: 09**

Biot-Savart's law, magnetic field intensity, magnetic field intensity due to a straight current carrying filament, magnetic field intensity due to circular, square and solenoid current carrying wire, relation between magnetic flux, magnetic flux density and magnetic field intensity, Maxwell's second equation, div(B)=0.

Magnetic field intensity due to an infinite sheet of current and a long current carrying filament, point form of Ampere's circuital law, Maxwell's third equation, Curl (H)=Jc, field due to a circular loop, rectangular and square loops.

MODULE-IV	**FORCE IN MAGNETIC FIELD AND MAGNETIC POTENTIAL**	**Classes: 09**

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;

Vector magnetic potential and its properties, vector magnetic potential due to simple configurations, Poisson's equations, self and mutual inductance, Neumann's formula, determination of self-inductance of a solenoid, toroid and determination of mutual inductance between a straight long wire and a square loop of wire in the same plane, energy stored and density in a magnetic field, characteristics and applications of permanent magnets.

MODULE-V	**TIME VARYING FIELDS AND WAVE PROPAGATION**	**Classes: 09**

Faraday's laws of electromagnetic induction, integral and point forms, Maxwell's fourth equation, curl (E)=∂B/∂t, statically and dynamically induced EMFs, modification of Maxwell's equations for time varying fields, displacement current.

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in loss dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text Books:

1 K.B. Madhu Sahu, " Eelectromagnetic Fields", Scitech Ltd., 2nd Edition.

2 David J Griffiths, "Introduction to Electrodynamics" Pearson Education Ltd., 4th Edition, 2014.

3 Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, 1st Edition, 2012.

4 E Kuffel, W S Zaengl, J Kuffel, "High Voltage Engineering Fundamentals", Newnes, 2nd Edition, 2000.

Reference Books:

1 Matthew N O Sadiku, S V Kulkarni, "Principles of Electromagnetics", Oxford University Press, 6th Edition, 2015.

2 AS Mahajan , AA Rangwala "Electricity And Magnetism", McGraw Hill Publications, 1st Edition, 2000.

3 MS Naidu , V Kamaraju "High Voltage Engineering", McGraw Hill Publications, 3rd Edition, 2013.

4 William H Hayt, John A Buck, "Problems and Solutions in Electromagnetics", McGraw Hill Publications, 1st Edition, 2010.

Web References:

1. https://www.calvin.edu/~pribeiro/courses/engr315/EMFT_Book.pdf
2. https://www.web.mit.edu/viz/EM/visualizations/coursenotes/modules/guide02.pdf
3. https://www.nptel.ac.in/courses/108106073/
4. https://www.iare.ac.in

E-Text Books:

1. https://www.bookboon.com/en/electromagnetism-for-electronic-engineers
2. https://www.books.google.co.in/books/.../Fundamentals of Electromagnetic Fields
3. https://www.aliexpress.com/item/EBOOK...Electromagnetic-Fields-2