ELECTROMAGNETIC FIELDS

III Semester: **EEE**

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

OBJECTIVES:

The Students Will Try To Learn:

- I The behavior of charge under rest with static electric field in terms of electric field intensity, electric displacement and electric potential.
- II The charge distribution in conductors, dielectrics and condensers.
- III The sources to develop constant and variable magnetic field to study effect of these fields in terms of magnetic field intensity, magnetic displacement and magnetic potential.
- IV The nature of electromagnetic wave propagation in free space, conductors and dielectric materials.

COURSE OUTCOMES:

After successful completion of the course, Students will be able to:

- CO 1 **Use the vector calculus and other mathematical techniques to describe electromagnetic phenomenon.**
- CO 2 **Make use of coloumb's law for obtaining force and electric filed intensity due to line, surface and volume charge distribution.**
- CO 3 **Recognize the basic nomenclatures of point charge that helps in characterizing the behavior of electro-static fields .**
- CO 4 **Make use of the Gauss law for obtaining electric field intensity, density of uniform and non-uniform regions.**
- CO 5 **Determine the potential and torque due to electric dipole used in structuring the principle of electrical equipments.**
- CO 6 **Demonstrate the behavior of conductors and dielectrics, their by compute the capacitance of different configured plates.**
- CO 7 **Make use of Biot-Savart law and Ampere circuital law for obtaining magnetic field intensity due to circular, square, rectangular and solenoid current carrying wire.**
- CO 8 **Predict the force due to moving charge in the magnetic field of various configured conducting material.**
- CO 9 **Signify the magnetic dipole , dipole moment for obtaining torque due to magnetic dipole helps in structuring electrical devices..**
- CO10 **Calculate the self inductance and mutual inductance for different configurations of wires and energy stored in the coil.**
- CO11 **State the Faraday's laws of electromagnetic induction and note the nature of emf induced in the coil for fixed and variable fields.**
- CO12 **List out the differential and integral forms of Maxwell's equation in time varying fields for obtaining numerical solutions of complex engineering problems.**
- CO13 **Make use of the Maxwell Equations to produce a wave equation for the free- space, insulators and conductors for propagation of electromagnetic waves.**

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 ElectromagneticFields
3. https://www.aliexpress.com/item/EBOOK...Electromagnetic-Fields-2