

## ELECTROMAGNETIC FIELDS

<b>III Semester: EEE</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEEB10	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	
<p><b>OBJECTIVES:</b>  <b>The Students Will Try To Learn:</b></p> <p>I The concepts of electro-statics , magneto-statics and time varying fields that allows required foundations in structure of power generation, transmission and distribution systems.</p> <p>II The nature of wave propagation in free space, conductors and dielectrics to frame multi-disciplinary assignments with real time constraints.</p> <p>III The fundamentals of electromagnetic fields and wave propagation to figure out the complex engineering problems with solutions and also helps in pursuing higher studies.</p> <p><b>COURSE OUTCOMES:</b>  <b>After successful completion of the course, Students will be able to:</b></p> <p>CO 1 Make use of coulomb's law for obtaining force and electric field intensity due to line, surface and volume charge distribution.</p> <p>CO 2 Recognize the basic nomenclatures of point charge that helps in characterizing the behavior of electrostatic fields .</p> <p>CO 3 Make use of the Gauss law for obtaining electric field intensity, density and deduce Poisson's, Laplace equations.</p> <p>CO 4 Determine the potential and torque due to electric dipole used in structuring the principle of electrical equipments.</p> <p>CO 5 Realize the behavior of conductors and dielectrics, their by compute the capacitance of different configured plates.</p> <p>CO 6 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.</p> <p>CO 7 Predict the force due to moving charge in the magnetic field of various configuration for developing principles of electrical machines.</p> <p>CO 8 Signify the magnetic dipole , dipole moment for obtaining torque due to magnetic dipole helps in structuring electrical devices..</p> <p>CO 9 Calculate the self inductance and mutual inductance for different configurations of wires and energy stored in the coil.</p> <p>CO10 State the Faraday's laws of electromagnetic induction and note the nature of emf induced in the coil for fixed and variable fields.</p> <p>CO11 List out the differential and integral forms of Maxwell's equation in time varying fields and fields varying harmonically with time for obtaining numerical solutions of complex engineering problems.</p> <p>CO12 Make use of the Maxwell Equations to produce a wave equation for the free- space, insulators and conductors for propagation of electromagnetic waves.</p>								
<b>MODULE-I</b>	<b>VECTOR CALCULUS AND ELECTROSTATICS</b>						<b>Classes: 09</b>	
<p>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.</p>								

<b>MODULE-II</b>	<b>CONDUCTORS AND DIELECTRICS</b>	<b>Classes: 09</b>
<p>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.</p>		
<b>MODULE-III</b>	<b>MAGNETOSTATICS</b>	<b>Classes: 09</b>
<p>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, <math>\text{div}(\mathbf{B})=0</math>.</p> <p>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, <math>\text{Curl}(\mathbf{H})=\mathbf{J}_c</math>, field due to a circular loop, rectangular and square loops.</p>		
<b>MODULE-IV</b>	<b>FORCE IN MAGNETIC FIELD AND MAGNETIC POTENTIAL</b>	<b>Classes: 09</b>
<p>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;</p> <p>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.</p>		
<b>MODULE-V</b>	<b>TIME VARYING FIELDS AND WAVE PROPAGATION</b>	<b>Classes: 09</b>
<p>Faraday's laws of electromagnetic induction, integral and point forms, Maxwell's fourth equation, <math>\text{curl}(\mathbf{E})=\partial\mathbf{B}/\partial t</math>, statically and dynamically induced EMFs, modification of Maxwell's equations for time varying fields, displacement current.</p> <p>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.</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1 K.B. Madhu Sahu, "Electromagnetic Fields", Scitech Ltd., 2<sup>nd</sup> Edition.</li> <li>2 David J Griffiths, "Introduction to Electrodynamics" Pearson Education Ltd., 4<sup>th</sup> Edition, 2014.</li> <li>3 Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, 1<sup>st</sup> Edition, 2012.</li> <li>4 E Kuffel, W S Zaengl, J Kuffel, "High Voltage Engineering Fundamentals", Newnes, 2<sup>nd</sup> Edition, 2000.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1 Matthew N O Sadiku, S V Kulkarni, "Principles of Electromagnetics", Oxford University Press, 6<sup>th</sup> Edition, 2015.</li> <li>2 AS Mahajan, AA Rangwala "Electricity And Magnetism", McGraw Hill Publications, 1<sup>st</sup> Edition, 2000.</li> <li>3 MS Naidu, V Kamaraju "High Voltage Engineering", McGraw Hill Publications, 3<sup>rd</sup> Edition, 2013.</li> <li>4 William H Hayt, John A Buck, "Problems and Solutions in Electromagnetics", McGraw Hill Publications, 1<sup>st</sup> Edition, 2010.</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.calvin.edu/~pribeiro/courses/enr315/EMFT_Book.pdf">https://www.calvin.edu/~pribeiro/courses/enr315/EMFT_Book.pdf</a></li> <li>2. <a href="https://www.web.mit.edu/viz/EM/visualizations/coursenotes/modules/guide02.pdf">https://www.web.mit.edu/viz/EM/visualizations/coursenotes/modules/guide02.pdf</a></li> </ol>		

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](https://www.books.google.co.in/books/.../Fundamentals%20of%20Electromagnetic%20Fields)

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