SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester III

Subject Name: **Electromagnetics** **Subject Code: BTEC13303**
Type of course: **PCC**
Prerequisite: Vector Calculus
Rationale: EM (Electro Magnetics) is all around us. In simple terms, every time we turn a power switch on, every time we press a key on our computer keyboard, or every time we perform a similar action involving an everyday electrical device, EM comes into play. It is the foundation for the technologies of electrical and computer engineering, spanning the entire electromagnetic spectrum, from dc to light, from electrically and magnetically based (electro mechanics) technologies to electronics technologies to photonics technologies.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
2	1	0	3	60	25	15	--	--	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module % Weightage
1.	**Review of Vector Calculus:** Overview of Vector Algebra, Coordinate Systems – Cartesian, Cylindrical and Spherical coordinate System, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem; Curl of a Vector and Stokes Theorem.	6	20
2.	**Overview of Electrostatic & Steady Magnetic Fields Electrostatic Field**: Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface, and Volume Charge Distributions, Gauss's law, Electric Potential, Electrostatic Boundary Conditions **Magnetostatic Fields:** Biot-Savart Law, Ampere's Circuital Law, Magnetic Flux Density, Magnetic Scalar and Vector Magnetic Potentials, Magnetic Forces, Magnetic Dipole, Magnetic circuits.	14	25
3.	**Time-Varying Fields and Maxwell's Equations:**	5	10

	Faraday's law, Displacement current and conduction current, Maxwell's equations in point and integral forms for time-varying fields, interpretation of Maxwell's equations.		
4.	**Electromagnetic Wave Propagation:** Introduction to wave, wave propagation in Lossy Dielectrics, plane waves in lossless dielectrics, Propagation in Good Conductors: Skin Effect, Poynting vector and Poynting Theorem.	6	15
5.	**Ground wave and Ionospheric Wave Propagation:** Modes of propagation, Ground Wave Propagation, the structure of troposphere and ionosphere, characteristics of Ionospheric layers, Ionospheric absorptions. Skywave propagation: Virtual height, MUF (Maximum Usable Frequency) and Skip distance.	7	15
6.	**Antenna Fundamentals:** Directional Properties of Dipole Antennas, **Antenna Arrays:** Mathematics of Linear Arrays, Two Element Array, Linear Arrays, Multiplication of Patterns, Binomial Array, Antenna Gain, Effective Area, Transmission Loss Between Antennas, Space Communications, Antenna Synthesis.	7	15

Suggested Specification table with Marks (Theory):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	25	10	20	10	10

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Elements of Electromagnetics	Matthew N. O. Sadiku	Oxford University Publication	2018	7th
2.	Engineering Electromagnetics	William Hayt	McGraw Hill Education	2018	9th

3.	Electromagnetic wave & radiating systems	Jordan & Balmain	PHI Publication	2015	6th
4.	Antennas for all applications	J.D. Krauss	TMH	2008	4th
5.	Antenna Theory: Analysis and design	C. Balanis	Wiley India	2016	4th

Course Outcome:

Sr. No.	CO statement After learning this subject students will be able to,	Marks % weightage
CO-1	Apply the principles of electrostatics to the solutions of problems relating to the electric field and electric potential, boundary conditions and electric energy density.	15
CO-2	Apply the principles of magnetostatics to the solutions of problems relating to the magnetic field and magnetic potential and magnetic circuits.	20
CO-3	Apply and analyze the concepts related to Faraday‘s law, integral and point form of Maxwell's equations for solving the problems of electromagnetic field theory.	20
CO-4	Describe time-varying fields, propagation of electromagnetic waves in different media, and apply the theory of electromagnetic waves in practical problems related to Antenna, wave propagation, and microwave communication.	20
CO-5	Analyze ground wave and sky wave Propagation effects in microwave systems, satellite, space, and radar links.	10
CO-6	Describe basic principles and fundamentals of Antennas.	15

Mapping with POs:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO-1	3	2	2	3	1	2	1	2	2	2	2	3	2	3	2
CO-2	3	2	2	3	1	2	1	2	2	2	2	3	2	3	2
CO-3	2	3	3	3	2	1	2	2	2	3	3	2	3	1	1
CO-4	3	3	3	2	2	1	2	1	2	3	2	3	3	1	1
CO-5	3	2	2	2	2	2	3	2	2	2	2	3	2	1	1
CO-6	2	3	3	3	2	2	2	2	3	2	2	3	2	1	2

List of Open Source/learning website:

- https://nptel.ac.in/courses/108/106/108106073/
  Introduction To Vector, Coulomb's Law, Electric Field, Electro-Static Potential, The Gradient, Gauss's Law, Poisson's Equation
  Stokes Theorems, The curl, Field due to current loop, Ampere's law, Inductance, Mutual Inductance, Faraday's law, Magnetic Energy, Generalized Ampere's Law, The Wave Equation, Poynting Theorem, Skin Effect, Phasor Form Of Poynting Theorem, Reflection At Dielectric Boundaries.
- https://nptel.ac.in/courses/117/107/117107035/
  Introduction and types of antennas, Antenna Parameters: Short dipole, Finite-length dipole, Finite-length dipole: Radiated power, Radiation resistance, Directivity, Effective area, Half-wave dipole and its properties
- https://nptel.ac.in/courses/115/101/115101005/
  Electromagnetic waves and propagation