NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Electronics & Communication Engineering
Course Code:	3EC302CC24
Course Title:	Electromagnetic & Wave Propagation
Course Type:	Core
Year of Introduction:	2024-25

L	T	Practical component				C
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Course Learning Outcomes (CLOs):

At the end of the course, students will be able to

1. comprehend the laws prevailing in magnetostatics. BL-2
2. appraise the behavior of static electric, magnetic and electromagnetic fields using vector calculus and coordinate systems. BL-3
3. analyse the systems using fundamental laws of electrostatics and Maxwell's equations. BL-4
4. apply Maxwell's equations for the propagation of wave through a given medium. BL-3

Unit No.	Contents	Teaching hours (Total 45)
I	**Electromagnetic Field:** Basic concept of electromagnetics, The effect of charges at rest and motion, The basic concept of electrostatics, Magnetostatics and electromagnetic field, The basic concept of RF waves, Applications of electromagnetic filed	04
II	**Vector Analysis:** Scalars & Vectors, vector addition and subtraction, position and distance vector vector field, dot and cross products, introduction to coordinate systems, Cartesian coordinates system, circular coordinate system and conversions, spherical coordinate system and conversions	08
III	**Electrostatics:** Electrostatic field, Coulomb's law, Field due to different charge distributions. Electric flux density, Gauss's law, Streamlines and sketches of the field, Maxwell's first equation and divergence theorem, Applications of Gauss's law, the definition of potential difference and potential, a potential field of a point charge and system of charges, Potential gradient, the energy density in the electrostatic field, Definition of currents and current density, Continuity equation, Metallic conductors, Method of images, Semiconductors and dielectric materials, Boundary conditions, the capacitance of a parallel plate capacitor, Poisson's and Laplace equations	14
IV	**Magnetostatics:** Magnetostatics fields, Biot-Savart's law, Ampere's circuital law, the concept of flux density, Curl of the magnetic field, Scalar and vector magnetic potential, Magnetic forces, Stokes's theorem, Derivations of steady magnetic law, the force on a moving charge, Force on a differential current element, Force and torque on a close circuit, Magnetic boundary conditions, Magnetisation of the magnetic field	10
V	**Time-Varying Field and Maxwell's Equations:** Faraday's law, displacement current, Maxwell's equations in point and integral forms	04

VI	**The Uniform Plane Waves:** Uniform plane wave, Solution of a plane wave, wave polarisation, Wave propagation in conducting medium, Free space, Perfect dielectric, Pointing vector, Power consideration, propagation in a good conductor, Phenomena of skin effect	**05**

Self-Study:
The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggest List of Tutorials (not restricted to the following):
(Only for information)

Sr. No.	Title of the tutorial	Hours
1.	Arithmetic operations on given vectors.	01
2.	Representation of vector and vector field in different coordinate systems.	01
3.	Application of coulomb's law for force calculations in presence of multiple point charges.	02
4.	Evaluation of electric field intensity due to multiple point charges and charge distributions.	02
5.	Application of Gauss's law for the calculation of electric flux density and electric field intensity.	02
6.	Computation of work done to carry point charges in an electrostatic field for different possible path.	02
7.	Evaluation of electrical potential due to point charges and charge distributions under non-zero reference potential conditions.	02
8.	Determination of capacitance using boundary conditions and Laplace and Poisson's equations.	02
9.	Application of Biot Savart's law to determine magnetic field intensity due to current carrying elements.	02
10.	Application of Ampere's law to determine magnetic field intensity due to different current distributions.	02
11.	Application of Maxwell's equations for time varying fields to determine electric and magnetic field intensity.	02
12.	Stokes' theorem and divergence theorem to determine electric and magnetic field intensity.	02

Suggested Readings:

1. Matthew N. O. Sadiku, Principle of Electromagnetics, Oxford University Press
2. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw- Hill
3. William Hayt, J A Buck, Engineering Electromagnetic, McGraw- Hill
4. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall
5. Narayana Rao, N: Engineering Electromagnetics, Prentice Hall