EPCET LIBRARY BANGALORE 49

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY
An Autonomous Institution Affiliated to Visvesvaraya Technological University (VTU) Belagavi

USN | | | | | | | | | | |

24EC43

Fourth Semester B.E. Degree Examination, May 2026
ELECTROMAGNETIC THEORY

TIME:3 hrs. Max.Marks:100

Note: 1. Answer **any FIVE** full questions, choosing **ONE** question from **each MODULE.**
2. M: Marks, L: Bloom's level,C: Course outcomes.
3. Assume missing data suitably.

		Module-1	M	L	C
Q.1	a	State Coulomb's law in vector form and define Electric Field Intensity, E	6	L2	CO1
	b	Derive the expression for Electric Field Intensity, E due to an infinite line charge ρ_L located on the z-axis.	8	L3	CO1
	c	A point charge $Q_1 = 300\ \mu C$ located at (1, -1, -3) m and $Q_2 = 100\ \mu C$ at (4,1, -3) m. Determine the force on Q_2	6	L3	CO1
		OR			
Q.2	a	Define Electric Flux Density, D and explain its mathematical relationship with Electric Field Intensity, E	6	L2	CO1
	b	Using the principle of superposition, derive the Electric Field Intensity due to an infinite uniform sheet of charge	8	L3	CO1
	c	Calculate the total charge within the volume $0 < (x, y, z) < 0.1$ m if the volume charge density is given by $\rho_v = 30x^2 ymC/m^3$	6	L3	CO1
		Module–2			
Q.3	a	State Gauss's Law in integral form and list its primary applications in electrostatics	6	L2	CO2
	b	Derive the point form (differential form) of Gauss's Law, also known as Maxwell's First Equation	8	L3	CO2
	c	Given electric flux density, $D = z\rho\cos^2\phi a_z C/m^2$, calculate the divergence of D at the point $(1, \pi/4, 2)$ in cylindrical coordinate system	6	L3	CO2
		OR			
Q.4	a	Define Electric Potential, V. Derive the potential difference between two points in the field of a point charge	7	L3	CO2
	b	State the Continuity Equation for current and explain its physical significance regarding charge conservation	7	L2	CO2
	c	Calculate the work done in moving a $2\mu C$ charge from (2, 0, 0) to (0, 2, 0) in an electric field, $E = ya_x + xa_y V/m$	6	L3	CO2
		Module–3			
Q.5	a	Starting from Gauss's Law, derive Poisson's and Laplace's equations for an electrostatic field	7	L3	CO3
	b	State the Uniqueness Theorem and explain why it is important for solving boundary value problems	6	L2	CO3
	c	Solve Laplace's equation to find the capacitance of a parallel plate capacitor with plate area, A and separation, d	7	L3	CO3

		OR			
Q.6	**a**	State Biot-Savart Law. Use it to find the magnetic field intensity, H at the center of a circular current-carrying loop	**8**	**L2**	**CO3**
	b	State Ampere's Circuital Law and apply it to find the magnetic field intensity, H due to an infinitely long straight conductor.	**6**	**L3**	**CO3**
	c	Define the 'Curl' of a vector field and state Stokes' Theorem	**6**	**L2**	**CO3**
		Module–4			
Q.7	**a**	Derive the expression for the magnetic force exerted on a differential current element placed in a steady magnetic field.	**7**	**L3**	**CO4**
	b	Derive the expression for the force of attraction or repulsion between two infinitely long parallel current-carrying conductors	**7**	**L3**	**CO4**
	c	A point charge Q = 10 nC has a velocity v = $10^6 a_x$ m/s. Find the force exerted on it if magnetic flux density, B = 0.05 a_yTesla	**6**	**L3**	**CO4**
		OR			
Q.8	**a**	Define Magnetization, M and explain the concept of Relative Permeability in magnetic materials	**6**	**L2**	**CO4**
	b	Derive the magnetic boundary conditions for the normal and tangential components of B and H at an interface	**8**	**L3**	**CO4**
	c	Define the terms Reluctance and Magnetomotive Force (MMF) in the context of a magnetic circuit.	**6**	**L2**	**CO4**
		Module–5			
Q.9	**a**	State Faraday's Law of Electromagnetic Induction. Differentiate between Transformer EMF and Motional EMF	**8**	**L2**	**CO5**
	b	What is Displacement Current? Explain how Maxwell modified Ampere's Law to include this term.	**6**	**L2**	**CO5**
	c	Write down Maxwell's Equations in both point and integral forms for time-varying fields.	**6**	**L2**	**CO5**
		OR			
Q.10	**a**	Derive the wave equation for a uniform plane wave propagating in free space using Maxwell's equations	**7**	**L3**	**CO5**
	b	Explain the phenomenon of Skin Effect. Define Skin Depth and explain how it varies with frequency	**7**	**L2**	**CO5**
	c	State and prove Poynting's Theorem. What is the physical significance of the Poynting Vector?	**6**	**L3**	**CO5**

*****