Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May / June 2026

Date: 26 – 05- 2026 **Time:** 09:30am – 12:30pm

School: SOE	**Program**: B.Tech- EEE / ECE	
Course Code : EEE2501	**Course Name:** Electromagnetic Field Theory	
Semester: IV	**Max Marks**:100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	14	24	12	24	26

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Given vectors A = a_x + 3a_z and B = $5\boldsymbol{a_x}$ + 2$\mathbf{a_y}$ - 6$\mathbf{a_z}$, determine the component of A along $\mathbf{a_y}$.	**2 Marks**	**L2**	**CO1**
2.	Depending upon the nature of the quantity under consideration, the field may be a vector or a scalar field. Define a scalar and vector with some examples.	**2 Marks**	**L1**	**CO1**
3.	State Gauss law and write the mathematical expression	**2 Marks**	**L1**	**CO2**
4.	Define electric potential. List the expression for electric potential due to point charge and 'n' number of point charges.	**2 Marks**	**L1**	**CO2**
5.	Using Poisson's equation, relate electric potential to charge density.	**2 Marks**	**L1**	**CO3**
6.	Explain the condition under which a magnetic field exerts zero force on a current-carrying conductor.	**2 Marks**	**L2**	**CO4**
7.	Describe the direction of the force experienced by two parallel conductors carrying currents in opposite directions.	**2 Marks**	**L2**	**CO4**
8.	Differentiate between instantaneous Poynting vector and average Poynting vector.	**2 Marks**	**L2**	**CO5**

9.	Using Maxwell's equations, show the relation between electric field and magnetic field in a wave.	**2 Marks**	**L2**	**CO5**
10.	State the significance of displacement current in Maxwell's equations.	**2 Marks**	**L1**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

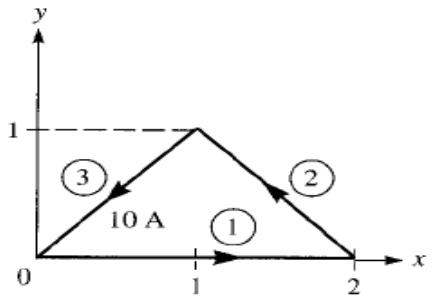
11.	**a.**	The curl of a vector field A, is a vector whose magnitude is the maximum net circulation of A per unit area as the area tends to zero and whose direction is the normal direction of the area when the area is oriented to make the net circulation maximum. Determine the curl of the function A given below is $A = \rho z^2 \cos\varphi\, a_\rho + z \sin^2\varphi\, a_z$	**10 Marks**	**L3**	**CO1**
		Or			
12.	a.	Calculate the divergence of the following vector fields at the specified points. (a) $A = yza_x + 4xya_y + ya_z$ at (1, -2,3) (b) $B = \rho z \sin\varphi\, a_\rho + 3\rho z^2 \cos\varphi\, a_\varphi$ at (5, π /2, 1) (c) $C = 2\rho\cos\theta\cos\varphi\, a_\rho + r^{1/2} a_\varphi$ at (1, π/6, π/3)	**10 Marks**	**L3**	**CO1**

13.	a.	If the electric field exists in a region consisting of two different media, the conditions that the field must satisfy at the interface separating the media are called boundary conditions. These conditions are helpful in determining the field on one side of the boundary if the field on the other side is known. With neat sketch explain the boundary conditions at an interface separating a) dielectric (ϵ_{r1}) and dielectric (ϵ_{r2}) b) conductor and free space c) conductor and dielectric	**10 Marks**	**L2**	**CO2**
		Or			
14.	**a.**	Two dipoles with dipole moments $-5\mathbf{a}_z$nC/m and $9\mathbf{a}_z$nC/m are located at points $(0,0,-2)$and (0,0,3) respectively. Determine the potential at the origin.	**10 Marks**	**L3**	**CO2**

15.	**a.**	Two-point charges -4 μC and 5 μC are located at (2, -1, 3) and (0, 4, -2), respectively. Calculate the potential at (1, 0, 1) assuming zero potential at infinity and explain the behaviors of conductors and dielectrics in the presence of Electro static field.	**10 Marks**	**L3**	**CO2**
		Or			

16.	**a.**	Let V = xy^2z, solve for the energy expended in transferring a 2μC point charge from (1, -1, 2) to (2, 1, -3) and explain the concept of energy density in Electrostatic fields.	**10 Marks**	**L3**	**CO2**
17.	**a.**	In free space, V = $6xy^2z + 8$. At point P (1, 2, -5), solve for E and ρ_v.	**10 Marks**	**L3**	**CO3**
		Or			
18.	**a.**	Apply Gauss's Law and Poisson's Equation to the electric potential $V = x^2 + y^2 - 2z^2$in a linear, homogeneous medium to calculate the electric field intensity **E**, compute the Laplacian $\nabla^2 V$, and calculate the volume charge density ρ_v. Further, apply the condition for Laplace's Equation to verify whether the region is charge-free and interpret the physical significance of the result.	**10 Marks**	**L3**	**CO3**

19.	**a.**	Planes z = 0 and z = 4 carry current K = -l0a_x A/m and K = l0a_x A/m, respectively. Determine H at (a) (1,1,1) (b) (0, - 3 , 10)	**10 Marks**	**L3**	**CO4**
		Or			
20.	**a.**	Using the Biot–Savart Law, determine the expression for the magnetic field intensity H at a point due to a straight, finite-length current-carrying filamentary conductor AB.	**10 Marks**	**L3**	**CO4**

21.	**a.**	Examine the contribution of side 3 of the triangular current loop shown in the figure, which carries a current of 10 A. Using appropriate magnetostatic principles (such as the Biot–Savart Law), determine the magnetic field intensity H at the observation point (0, 0, 5). Clearly explain the reasoning used to evaluate the direction and magnitude of the magnetic field produced by this current element.  	**10 Marks**	**L3**	**CO4**
		Or			
22.	**a.**	The length l and uniform cross-sectional area S of a rectangular magnetic circuit with iron core are 120 cm and 21 cm^2 respectively. The core carries two coils 1 and 2 of N_1 = 750 and N_2 = 357 turns respectively. The relative Permeability of the core material is 600. (a) Calculate external self-inductances of the coils.	**10 Marks**	**L3**	**CO4**

		(b) Calculate mutual inductance between the coils if the mutual flux is 92% of the self-flux.			

23.	**a.**	Using the Maxwell's Equations, apply the laws of electromagnetism to express the behavior of time-varying fields by writing all four equations in both integral and differential forms, and explain how each form relates to physical field quantities in a given region.	**10 Marks**	**L3**	**CO5**
		Or			
24.	**a.**	Consider the loop of Figure shown below. If B = 0.5 a_z Wb/m^2, R = 20 Ω, ℓ = 10 cm, and the rod is moving with a constant velocity of 8 a_x m/s,find (a) The induced emf in the rod (b) The current through the resistor (c) The motional force on the rod (d) The power dissipated by the resistor	**10 Marks**	**L3**	**CO5**

25.	**a.**	In free space. E = 20 cos(ωt - 50x) a_y V/m. Determine the following: 1.Displacement current density J_d 2. Magnetic Field Intensity, H	**10 Marks**	**L3**	**CO5**
		Or			
26.	**a.**	Apply the concept of the Poynting Vector to determine the power flow in an electromagnetic field. Given the electric field E and magnetic field H in a region, calculate the magnitude and direction of the Poynting vector S = E × H and explain its physical significance in energy transmission.	**10 Marks**	**L3**	**CO5**