Name:

Enrolment No:

UPES

End Semester Examination, May 2025

Course: Electromagnetic Field Theory **Semester: IV**

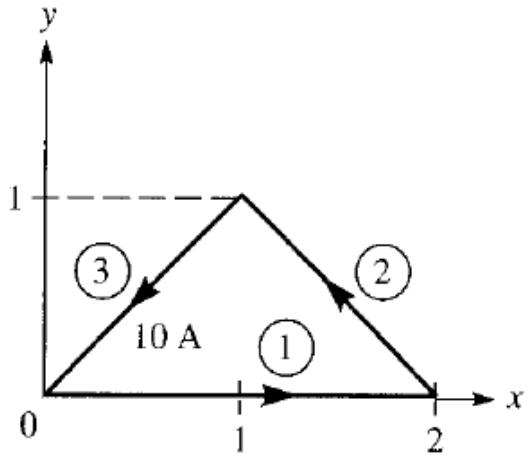
Program: B.Tech Electrical Engineering **Time : 03 hrs.**

Course Code: ECEG2007 **Max. Marks: 100**

Instructions: Use of Calculator is permitted. Assume any missing values.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Find out the divergence of the vector field $V(x,y,z) = -(x\,cosxy + y)\hat{\imath} + (y\,cosxy)\hat{\jmath} + (\sin z^2 + x^2 + y^2)\hat{k}$	**4**	**CO1**
Q 2	Three point charges - 1nC, 4nC, and 3nC are located at (0, 0, 0), (0, 0, 1), and (1, 0, 0), respectively. Find the energy in the system.	**4**	**CO2**
Q 3	A parallel plate capacitor has an electrode area of 100mm^2, with a spacing of 0.1mm between the electrodes. The dielectric between the plates is air with a permittivity of 8.85×10^{-12} F/m. The charge on the capacitor is 100V. Calculate the stored energy in the capacitor.	**4**	**CO3**
Q 4	Two dipoles with dipole moments -5a_znC/m and 9a_znC/m are located at points (0, 0, - 2) and (0, 0, 3), respectively. Find the potential at the origin.	**4**	**CO2**
Q 5	An inductor designed with 400 turn coils wound on an iron core 16cm2 cross sectional area and with a cut of an air gap length 1mm. The coil is connected to a 230V, 50Hz ac supply. Neglect coil resistance, core loss, iron reluctance and leakage inductance, ($\mu = 4\pi\times10^{-7}$H/m). Determine the current in the inductor.	**4**	**CO4**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	A charge distribution with spherical symmetry has density $\rho_v = \begin{cases} \frac{\rho_o r}{R}, & 0 \le r \le R \\ 0, & r > R \end{cases}$ Determine **E** everywhere.	**10**	**CO1**
Q 7	If $J = \frac{1}{r^3}(2cos\theta a_r + sin\theta a_\theta)$A/m^2, calculate the current passing through (a) A hemispherical shell of radius 20 cm (b) A spherical shell of radius 10 cm	**10**	**CO2**
Q 8	The conducting triangular loop in Figure below carries a current of 10A. Find H at (0, 0, 5) due to side 1 of the loop.	**10**	**CO3**

			
Q 9	Planes z = 0 and z = 4 carry current K = -l0a_xA/m and K = l0a_xA/m, respectively. Determine H at (a) (1,1,1) (b) (0, - 3 , 10) OR Given the magnetic vector potential A = $-\rho^2/_4\, a_z$ Wb/m, calculate the total magnetic flux crossing the surface $\varphi = \frac{\pi}{2}$, $1 \le \rho \le 2$m, $0 \le z \le$ 5m.	**10**	**CO4**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	An infinite plane $x = 2$ has surface charge density 10nC/m^2, an infinite line charge $x = 0$, $z = 2$ has line charge density 10πnC/m and a surface $y =$ 3 has surface charge density 15nC/m2. Calculate the Electric Field intensity at point (1, 1, -1).	**20**	**CO3**
Q 11	(a) Explain Faraday's law of electromagnetic induction and derive the expression for induced e.m.f? (b) A parallel-plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage 50sin10^{3}t V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_o$. OR (a) Explain Faraday's law of electromagnetic induction and there from derive maxwell's equation in differential and integral form. (b) A thin soap bubble of radius R = 1cm and thickness a = 3.3μm (a << R) is at a potential of 1V with respect to a reference point at infinity. The bubble bursts and becomes a single spherical drop of soap (assuming all the soap is contained in the drop) of radius r. The volume of the soap in the thin bubble is 4πR^{2}a and that of the drop is $\frac{4}{3}\pi r^2$. Find out the potential, in volts, of the resulting single spherical drop with respect to the same reference point at infinity.	**20** **20**	**CO4**