End-Semester Examination (May-2023)

Electromagnetic Field Theory (EC-223) 4th sem. Each question carries equal marks

[Q1] If $\mathbf{G}(r) = 10\, e^{-2z}\,(\rho a_\rho + a_z)$, determine the flux of **G** out of the entire surface of the cylinder $\rho = 1$, $0 \le z \ge 1$. Confirm the result by using divergence theorem.

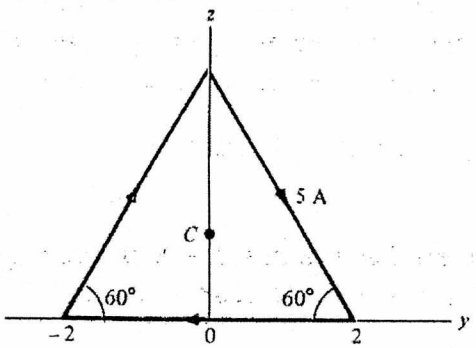
[Q2] Transform vector $\mathbf{A} = y\, a_x + (x + z)\, a_y$ to cylindrical coordinate system.

[Q3] A charge distribution with spherical symmetry has density $\rho_v = \begin{cases} \rho_0 r / R & if \quad 0 \le r \le R \\ 0 & if \quad r \ge R \end{cases}$

Determine E everywhere.

[Q4] Semi infinite conducting plates at $\phi = 0$ and $\phi = \pi/6$ are separated by an infinitesimal insulating gap at z-axis. If $V(\phi = 0) = 0$ and $V(\phi = \pi/6) = 100V$, calculate V and **E** in the region between the plates.

[Q5] Find **H** at the center *C* of an equilateral triangular loop of side 4 m carrying 5 A of current as in Figure



[Q6] A current distribution gives rise to the vector magnetic potential $\mathbf{A} = x^2 y a_x + y^2 x a_y - 4xyz a_z$ Wb/m. Calculate magnetic field **B** at (-1, 2, 5) and the magnetic flux through the surface defined by $z = 1$, $0 \le x \le 1$, $-1 \le y \le 4$.

[Q7] A lossy dielectric has an intrinsic impedance of $200\angle 30°\ \Omega$ at a particular frequency. If, at that frequency, the plane wave propagating through the dielectric has the magnetic field component $H = 10e^{-\alpha x}\cos\left(\omega t - \frac{1}{2}x\right) a_y$ A/m, find **E** and α.

[Q8] In free space, $H = 0.2 \cos(\omega t - \beta x) a_z$ A/m. Find the total power passing through a circular disc of radius 5 cm on plane $x = 1$

[Q9] A lossless transmission line with a characteristic impedance of 75 Ω is terminated by a load of 120 Ω. The length of the line is 1.25λ. If the line is energized by a source of 100 V (rms) with an internal impedance of 50 Ω, determine the input impedance, and the magnitude of the load voltage.

[Q10] A 75 Ω lossless line is to be matched to a 100 - j80 Ω load with a shorted stub. Calculate the stub length, its distance from the load, and the necessary stub admittance.