



National Institute of Technology Delhi

Mid Semester Examinations September 2018

Roll No:

Name of Specialization – B.Tech (EEE+ECE)
Course Name- Electromagnetics and Quantum Physics
Course Code: PHL-100

Year - 1st Semester - 1st

Maximum Marks – 25

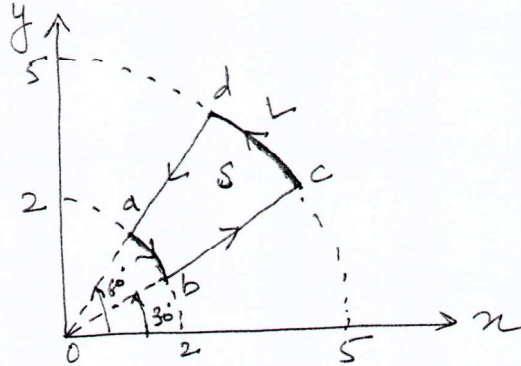
Total Time: 2:00 Hours

Instructions: All questions are compulsory.
Symbols used in the questions are having their usual meaning.
Assume if any data is missing.

Q-1: (a) For a position vector $\mathbf{R} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$. Find the values of (i) $\text{grad} 1/R$ (ii) $\text{div}(\mathbf{R}/R^3)$ and (iii) $\text{curl}(\mathbf{R}/R^3)$. (3)

(b) Write the physical significance of 'gradient' and 'divergence'. (2)

Q-2: Define the Stokes's theorem. If $\mathbf{E} = \rho \cos \phi \mathbf{a}_\rho + \sin \phi \mathbf{a}_\phi$, Evaluate $\oint \mathbf{E} \cdot d\mathbf{l}$ around the path shown Figure below. Also confirm this by using Stokes's theorem. (5)



Q-3: Write the integral form of the Ampere's for the magnetostatic fields and convert it into its differential form. A thin ring of radius 5 cm is placed on plane $z = 1\text{ cm}$ so that its center is at $(0, 0, 1\text{ cm})$. If the ring carries 50 mA along \mathbf{a}_ϕ , find \mathbf{H} at (a) $(0, 0, -1\text{ cm})$ and (b) $(0, 0, 10\text{ cm})$. (5)

Q-4: A medium is characterized by $\sigma = 0$, $\epsilon = 5\epsilon_0$, and $\mu = 2\mu_0$. If $\mathbf{H} = 2 \cos(\omega t - 3y) \mathbf{a}_z$ A/m, calculate ω and \mathbf{E} . (5)

Q-5: Define the skin depth of an EM waves. A uniform plane wave propagating in a medium has $\mathbf{E} = 2 e^{-\alpha z} \sin(10^8 t - \beta z) \mathbf{a}_y$ V/m. If the medium is characterized by $\epsilon_r = 1$, $\mu_r = 20$, and $\sigma = 3\text{ S/m}$, find α , β and \mathbf{H} . (5)
