National Institute of Technology Delhi

Mid Semester Examinations Sept.-Oct. 2019

Roll No:

Name of Specialization – B.Tech (ECE&EEE)
Course Name- Electromagnetics [redacted] & 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]: Find the Laplacian of the scalar field $U = \rho^2 z \cos 2\varphi$. **(2)**

[b]: Express the vector $\boldsymbol{V} = \frac{1.0}{r}\,\boldsymbol{a_r} + r\cos\theta\,\boldsymbol{a_\theta} + \boldsymbol{a_\varphi}$ in the cylindrical coordinate **(3)**

Q-2: [a]: What is the physical meaning of Divergence of a vector field? Calculate the value of $\nabla.(r^3\,\boldsymbol{r})$, where, $\boldsymbol{r} = x\,\boldsymbol{a_x} + y\,\boldsymbol{a_y} + z\,\boldsymbol{a_z}$. **(2)**

[b]: What is the limitations of Gauss law? Determine the gradient of the scalar field at P($2^{1/2}$, $\pi/2$, 5) defined in cylindrical coordinate system as A=25rsinϕ. **(2)**

[c]: Give three similarities between electrostatic and magneto static field. **(1)**

Q-3: A circular ring of radius **a** carries a uniform charge ρ_L C/m and is placed on xy-plane with axis same as the z-axis. Show that $\boldsymbol{E}(0,0,h) = \frac{\rho_L\, ah}{2\epsilon_0[h^2+a^2]^{3/2}}\boldsymbol{a_z}$. For what value of h you will get maximum value of **E.** **(5)**

Q-4: In what way displacement current is different from conduction current. In free space, $\boldsymbol{E} = 20\cos(\omega t - 50\,x)\boldsymbol{a_y}$ V/m. Calculate, (i)- $\boldsymbol{J_d}$, (ii)- $\boldsymbol{H}$ and (iii)- ω **(5)**

Q-5: Write down the Maxwell's equations for the linear, charge free dielectric medium, and constant field with time. Also derive the wave equation in conducting medium for finding the expression of skin depth. **(5)**

**********End of Paper**********