Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: Mid Sem Exam (Sep 2019)

Branch : ECE (B.Tech) **Semester** : III

Title of the Course : Electromagnetic Theory **Course Code** : ECL 203

Time: 2 Hours **Maximum Marks: 25**

Note : All questions are compulsory. Figure in right hand margin indicates full marks for the question.

Q1. Write short note on spherical coordinate system. **[1.5 Marks]**

Q2. Given $\mathbf{A}= 5\hat{\mathbf{a}}_x$ and $\mathbf{B} = 4\hat{\mathbf{a}}_x + B_y\,\hat{\mathbf{a}}_y$, then find B_y such that the angle between **A** and **B** is 45^0. If **B** also has a term $B_z\hat{\mathbf{a}}_z$, what relationship must exist between B_y and Bz? **[1.5 Marks]**

Q3. Discuss the following terms **[2 Marks]**
(a) Divergence
(b) Curl
(c) Gradient
(d) Laplacian

Q4. State and prove Stoke's theorem. **[2 Marks]**

Q5. Express vector $\mathbf{A}= 2xyz\hat{\mathbf{a}}_x - 5(x + y + z)\hat{\mathbf{a}}_z$ in spherical coordinate (variables and components). **[2 Marks]**

Q6. Q_1 and Q_2 are the point charges located at (0,-4, 3) and (0, 1, 1). If Q_1 is 2nC, find Q_2 such that the force on a test charge Q at (0,-3, 4) has no z component. **[3 Marks]**

Q7. Find **E** at P(1,5,2) m in free space if a point charge of 6μC is located at (0,0,1), the uniform line charge with density $\rho_L = 180$ nC/m along x axis.. **[3 Marks]**

Q8. Given a vector field $\mathbf{F} = 30e^{-r}\hat{\mathbf{a}}_r - 2z\hat{\mathbf{a}}_z$ in cylindrical coordinates. **[3 Marks]**
(a) Find the total flux due to this field from the closed surface of the cylinder $r = 3$, $z = 0$ and $z = 4$.
(b) Verify the divergence theorem.

Q9. A closed surface is defined in spherical coordinates by $3 < r < 5$, $0.1\pi < \theta < 0.3\pi$, $1.2\pi < \emptyset < 1.6\pi$. **[3 Marks]**
(a) Find the volume enclosed
(b) Find the distance from $P_1(r=3,\theta=0.1\pi, \emptyset=1.2\pi)$ to $P_2(r=5,\theta=0.3\pi, \emptyset=1.6\pi)$
(c) Find the total surface area.

Q10. What is Gauss's law? What are the properties of Gaussian surface? Derive the expressions for electric field intensity and electric flux density due to an infinite line charge of density ρ C/m lying along z-axis using Gauss's law. **[4 Marks]**