National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Mid-Semester Examination September, 2019

Branch   : EEE   Semester   : 3rd

Title of the Course   : Electromagnetic Field Theory   Course Code   : EEL 203

Time: 2 Hours

Maximum Marks: 25

Note : 1. All the 5 questions are compulsory. Make suitable assumptions wherever required.

        2. All the symbols have their usual meaning.

Q1. In Cartesian coordinates, vector $\vec{A}$ points from the origin to the point $P_1 = (2, 3, 3)$ and vector $\vec{B}$ is directed from P_1 to point $P_2 = (1, -2, 2)$. Find:

     (a) vector $\vec{A}$, its magnitude A and the unit vector $\hat{a}$.

     (b) the angle between $\vec{A}$ and the y-axis.

     (c) vector $\vec{B}$.

     (d) the angle θ between $\vec{A}$ and $\vec{B}$.

     (e) perpendicular distance from the origin to the vector $\vec{B}$.   **(5M)**

Q2. Consider the separation vector $\vec{r_s}$ from a fixed point (x_o, y_o, z_o) to the point (x, y, z). Let the length of $\vec{r_s}$ be denoted by r_s. Find the gradient of $\frac{1}{r_s}$.   **(5M)**

Q3. Evaluate $(\vec{v}_1 . \nabla)\vec{v}_2$ where $\vec{v}_1$ and $\vec{v}_2$ are the vector functions: **(5M)**

$\vec{v}_1 = x^2 \hat{x} + 3xz^2 \hat{y} - 2xz\hat{z}$ and $\vec{v}_2 = xy\hat{x} + 2yz\hat{y} + 3xz\hat{z}$

Q4. Find the potential inside and outside a uniformly charged solid sphere whose radius is R and whose total charge is q. Use infinity as the reference point. Also, compute the gradient of the potential in each region.   **(5M)**

Q5. An inverted hemispherical bowl of radius R carries a uniform surface charge density σ. Find the potential difference between the north pole of the bowl and the center of the bowl.   **(5M)**