SC217: Electromagnetic Theory, **AUTUMN'17 MIDSEM 1**

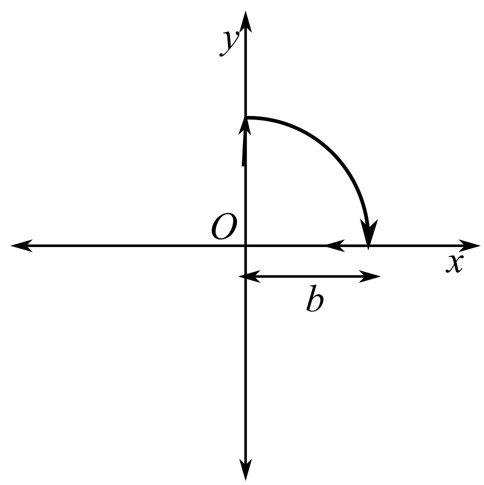
DA-IICT, B.Tech, Sem III 16:30-18:00 PM 30^{th}Aug.2017 **25 marks**

1. Find $\vec{\nabla}(\sin(\vec{n}\cdot\vec{r})), \vec{\nabla}\times(\vec{n}\times\vec{r})$ where $\vec{n}$ is a constant vector. **(5)**

2. If $\vec{A}$ and $\vec{B}$ are vectors prove that $\vec{A}\cdot\vec{B}$ transforms as a scalar under rotation. **(5)**
   (*You may use two dimensional case.*)

3. A wheel, lying in the xy plane with its center at the origin, rotates clockwise about its center with an angular velocity ω about the z axis. The velocity of any point on the wheel can be described by a vector field $\vec{v}(x, y)$. Determine $\vec{v}(x, y)$ and $\vec{\nabla}\times\vec{v}$. **(5)**

4. Verify stokes' theorem for the vector field $\vec{A} = (y\hat{i} - x\hat{j})$ over the region shown in the figure. The loop consists of a quarter arc of a circle of radius b and two straight paths along the y and the x axes traversed clockwise.



5. Consider a cubical surface S formed by the planes $x = a \pm l;\quad y = b \pm l;\quad z = c \pm l$.
   Let $\vec{\mathrm{A}} = x^2\hat{\mathrm{i}} + y^2\hat{\mathrm{j}} + z^2\hat{\mathrm{k}}$. Verify that at the point (a, b, c),

$$\vec{\nabla}\cdot\vec{A} = \lim_{l\to 0}\frac{1}{8l^3}\oint_S \vec{\mathrm{A}}\cdot\vec{\mathrm{da}}$$

(5)

Gradient, divergence and curl

$\vec{\nabla}F = \hat{i}\frac{\partial F}{\partial x} + \hat{j}\frac{\partial F}{\partial y} + \hat{k}\frac{\partial F}{\partial z}$ $\quad\vec{\nabla}\cdot\vec{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$

$\vec{\nabla}\times\vec{A} = \hat{i}\left(\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z}\right) + \hat{j}\left(\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x}\right) + \hat{k}\left(\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y}\right)$

$\nabla^2 F = \frac{\partial^2 F}{\partial x^2} + \frac{\partial^2 F}{\partial y^2} + \frac{\partial^2 F}{\partial z^2}$