(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2012-13

ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours *Total Marks : 100*

Note : *Attempt **all** the questions.*

1. Answer any **four** parts :

(a) If $\overline{A} = 3a_r + 2a_\theta - 6a_\phi$ and $B = 4a_r + 3a_\phi$. Determine :

(i) $\overline{A} \cdot \overline{B}$

(ii) $|\overline{A} \times \overline{B}|$

(b) Prove that the total outward flux of a vector field $\overline{A}$ through the closed surfaces S is the same as the volume integral of the divergence of $\overline{A}$.

(c) Evaluate $\nabla \times \overline{A}$ and $\nabla \cdot \nabla \times \overline{A}$, if

$$\overline{A} = x^2 y\, a_x + y^2 z\, a_y - 2xz\, a_z.$$

(d) Prove that :

$$\nabla \cdot (V\overline{A}) = V\nabla \cdot \overline{A} + \overline{A} \cdot \nabla V$$

where V is a scalar field and A is a vector field.

(e) If $U = xz - x^2y + y^2z^2$ evaluate div grad U.

(f) Explain Stoke's theorem.

2. Answer any **four** parts :

(a) Explain Coulomb's law and field intensity.

(b) Define Electric potential.

(c) If $J = \frac{1}{r^3}(2\cos\theta\, a_r + \sin\theta\, a_\theta)\ A/m^2$. Calculate the current passing through a hemisphere shell of radius 20 cm.

(d) A wire of diameter 1 mm and conductivity 5×10^7 S/m has 10^{29} free electrons/m^3 when an electric field of 10 mV/m is applied. Determine :

(i) The current density

(ii) The current in the wire

(iii) The charge density of free electrons.

(e) Explain Dielectric Boundary conditions.

(f) Explain Free-space Boundary condition.

3. Answer any **two** parts :

(a) Given the magnetic vector potential $A = -\rho^2/4a_z$ Wb/m, calculate the total magnetic flux crossing the surface $\phi = \pi/2$, $1 \le \rho \le 2$ m, $0 \le z \le 5$ m.

(b) Explain magnetic boundary conditions.

(c) A charged particle moves with a uniform velocity $4\ a_x$ m/s in a region where $E = 20\ a_y$ V/m and $B = B_o\ a_z$ Wb/m^2. Determine B_o such that the velocity of the particle remains constant.

4. Answer any **two** parts :

(a) Prove that the net power flowing out of a given volume V is equal to the time rate of decrease in energy stored within volume V minus the conduction losses.

(b) A parallel plate capacitor with a plate area of 5 cm^2 and plate separation of 3 mm has a voltage 50 sin 10^3t V applied to its plates. Calculate the displacement current assuming $\varepsilon = 4\ \varepsilon_o$.

(c) In a free space $H = 0.2 \cos(wt - Bx)\ a_z$ A/m. Find the total power passing :

(i) A square plate of side 10 cm on plate $x + z = 1$.

(ii) A circular disc of radius 5 cm on plane $x = 1$.

5. Answer any **two** parts :

(a) Find the input impedance of 75 Ω lossless transmission line of length 0.1 λ when the load is short by using Smith chart.

(b) Derive the relation between reflection coefficient and voltage standing wave ratio (VSWR). Explain what will be the input impedance of transmission line when output impedance is short.

(c) A lossless transmission line used in a TV receiver has a capacitance of 50 PF/m and an inductance of 200 nH/m. Find the characteristics impedance for sections of a line 10 meter long and 500 meter long.