This question paper contains 4 printed pages.

3290 *Your Roll No.....*

B.Tech.(Part Time) / II J

Paper IV - ELECTROMAGNETICS
(EEE - 204)

Time : 3 hours *Maximum Marks :70*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer any five out of eight questions. All questions carry equal marks.

1. a) Find $(\nabla \times \vec{A})\ \overline{A} = \frac{5}{r^2}\sin\theta\ \hat{a}_r + r\cot\theta\ a_\theta^{\wedge} + r\sin\theta\cos\phi\ a_\phi$. *05*

b) Verify Guass divergence theorem for $\vec{D} = \frac{10x^3}{3}\ \hat{a}_x$ for the volume of a cube 2m on a edge centred at the origin and its edges parallel to the axis. *05*

c) Prove that $\nabla \times (\vec{A} \times \vec{B}) = \vec{B}.(\nabla \times \vec{A}) - \vec{A}.(\nabla \times \overline{B})$ *04*

2 a) Find the energy stored in the hemispherical region $r \le 2m\ 0 < \theta < \pi$ where
$E = 2r\sin\theta\cos\phi a_r^{\wedge} + r\cos\theta\cos\phi\ a_\theta^{\wedge} - r\sin\phi\ a_\theta^{\wedge} V/m$ *05*

b) In free space $\overline{D} = 2y^2 i + 4xyj - k^A\ mc/m^2$. Find the tota! charge enclosed in the region
$1 < x < 2,\ 1 < y < 2,\ -1 < z < 4$. *04*

P.T.O

c) A spherical capacitor has inner and outer radius as a and b respectively and filled with $\in = \varepsilon_0 K/r^2$. Show that the capacitance

$$C = \frac{4\pi\varepsilon_0 k}{b - a}$$ *05*

3 a) State and explain Ampere law of forces. *04*

b) Given that $\overline{A} = -\frac{\mu_0 Ir^2}{4\pi a^2}\overline{k}$ within cylindrical conductor find $\vec{H}$. *05*

c) For the cylindrical conductor with $0 \leq r \leq 2m$ of height 5m and with $B = 4\sin^2 wt\, z\, \hat{a}_z$. Find induced emf if the conductor is stationary as well it is moving with 40m/s. *04*

4 a) State and explain Bio-Savart's law. *04*

b) Show that magnetic field intensity at any point (x, y, z) due to current element $Id\overline{l}\,\hat{a}_z$ located at the origin is given by :

$$d\overline{H} = \frac{Id\overline{l}}{4\pi}\left(\frac{-yi + xj}{(x^2 + y^2)^{3/2}}\right)$$ *05*

c) Derive an expression for $\overline{B}$ in the region outside the conductor using the vector potential due to long wire of small circular cross section carrying the current of I ampere. *05*

5 a) Derive an equation of continuity for
   a) Static field
   b) Time varying field. *05*

   b) Write down the Maxwell equation for sinusoidally varying fields. *04*

   c) State and explain the boundary conditions in Electromagnetic field. *05*

6 a) A conducting circular loop of radius 20cm lies in z = 0 plane in a magnetic field $\bar{B} = 10\cos(377t)\,\hat{a}_z$ m(wb/m^2). Calculate the induced voltage in the loop. *05*

   b) Electric vector $\bar{E}$ of a wave in free space

   $$E_x = E_z = 0$$
   $$E_y = A\cos w(t - z/c)$$

   Using Maxwell equation, find the expression of $\vec{H}$. *04*

   c) In free space $D = D_m \sin(wt + \beta_z)\,\hat{a}_x$.
   Using Maxwell equation

   $$\bar{B} = \frac{-w\mu_0 Dm}{\beta} \text{ Sn } (wt + \beta_z)\,\hat{a}_y. \qquad 05$$

7 a) State and prove Poyrting theorem. *04*

   b) Show that $\bar{E}_y = E_0 \sin(wt - \beta_z)$ and
   $\bar{H}_x = \frac{-\beta E_0}{\mu_0 w} \sin(wt - \beta_z)$. Travels with velocity of light in free space. Find E/H ratio. *05*

P.T.O

c) Find δ, γ, velocity of propogation at a frequency of 1.6MHz for aluminium with $\sigma = 38.2 \times 10^6$ s/m. $\mu_r = 1$. *05*

8 a) State and explain VSWR. *04*

b) Given $E_0 = \frac{E_0 \sin\theta}{r} \cos(wt - \beta r)$.
Find magnetic field and power radiated by the antenna. *05*

c) Discuss the wave propagation in good dielectric. *05*