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

PAPER ID : 3081   **Roll No.** [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

B.Tech.

(SEM.IV) EVEN THEORY EXAMINATION 2012-13

ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours   *Total Marks : 100*

Note :– All questions carry equal marks.

1.   Attempt any **four** of the following :   **(5×4=20)**

  (a)   Given A = 6i + 2j + 5k, B = 2i + 4j + 7k. Find :

   (i)   Angle between A and B

   (ii)   The unit vector normal to the plane containing them

   (iii)   The distance between their tips

   (iv)   A·B

   (v)   A × B.

  (b)   Transform the cartesian vector $A = 3a_x - 2a_y - 3a_z$ at point P(–2, –3, 4) into spherical coordinates.

  (c)   Why the gradient of a scalar field is a vector quantity ? Write down the gradient of a field in different coordinates.

  (d)   Derive the expression for the electric field due to infinite sheet of charge.

  (e)   A charge distribution with spherical symmetry has density

   $\rho_v = \rho_0 \dfrac{r}{R}$ for $0 \le r \le R$ and 0 for $r > R$. Determine E everywhere.

2. Attempt any **four** parts of the following : (5×4=20)

(a) State and explain Coulomb's Law. If current density $J=1/r^2(\cos\theta\,\hat{a}_r+\sin\theta\,\hat{a}_\theta)$ A/m^2. Find the current passing through a sphere of radius 1.0 m.

(b) Derive Possion's equations.

(c) Derive Laplace's equations.

(d) Calculate the potential of a point outside or inside a uniformly charged sphere radius 'a'.

(e) Three point charge $Q_1 = 10^{-6}$ C, $Q_2 = 10^{-6}$ C and $Q_3 = 0.5 \times 10^{-6}$C are located at the corners of an equilateral triangle of 50 cm side. Determine the magnitude and divergence of the force of Q_3.

3. Attempt any **four** parts of the following : (5×4=20)

(a) Find H due to infinitely long straight conductor.

(b) Write all forms of Maxwell's equations and also write Maxwell's equation for good conductor.

(c) Given that

$H_1 = -2a_x + 6a_y + 4a_z$ A/m in region $y - x - 2 \le 0$ where $\mu_1 = 5M_0$. Calculate M_1 and B_1.

(d) In a material for which $\sigma = 5$ S/m and $\varepsilon_r = 1$, the electric field intensity is $E = 250 \sin10^{10}t$ V/m. Find conduction and displacement current densities and the frequency at which both have equal magnitude.

(e) Define diamagnetic, paramagnetic and ferromagnetic materials. Write down the relation between B, H and M.

4. Attempt any **two** of the following : (10×2=20)

(a) Explain skin effect. Derive the expression for α and β in a conducting medium.

(b) Derive the wave equations in free space in terms of E.

(c) The electric field amplitude of a uniform plane wave propagation in $\hat{a}_z$ direction if 250 V/m. If $E = E_x\,\hat{a}_x$ and $w = 1M$ rad/s, find :

 (a) Frequency (b) Wave length

 (c) Period (d) Amplitude of H.

5. Attempt any **two** of the following : (10×2=20)

(a) Find the expression of propagation constant and phase velocity in case of lossless line and distortion less line.

(b) Explain Standing Wave Ratio. An ideal Lossless transmission line of $z_0 = 100\Omega$ is connected to unknown z_L. If S.W.R. = 5, find the reflection coefficient.

(c) What do you mean by term 'Waveguides' ? Explain the classification of guided electromagnetic wave in waveguide. Write the defining equation of rectangular waveguide.