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Printed Pages : 4 **TEC – 401**

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

PAPER ID : 3081 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2006-07

ELECTRO MAGNETIC FIELD THEORY

Time : 3 Hours] *[Total Marks : 100*

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

1 Attempt any **four** of the following :

(a) Write down gradient of any scalar and divergence and curl of any vector. $\vec{A}$ in different co-ordinate system. **5**

(b) If $\vec{A} = \alpha \hat{a}_x + 2\hat{a}_y + 10\hat{a}_z$ and $\vec{B} = 4\alpha \hat{a}_x + 8\hat{a}_y - 2\alpha \hat{a}_z$ find out the value of α for which the two vectors become perpendicular. **5**

(c) Given points $A(x = 2, y = 3, z = -1)$ and $B(\rho = 4, \phi = -50°, z = 2)$ find the distance A to B. **5**

(d) State the word statement of Coulomb's law of forces. Three point charges $q_1 = 10^{-6} C$, $q_2 = -10^{-6} C$ and $q_3 = 0.5 \times 10^{-6} C$ are located in air at the corners of an equilateral triangle of 50 cm side. Determine the magnitude and direction of the force of q_3. **5**

(e) Two uniform line charges of density $\rho_e = 4\,nc/m$ lie in the $x = 0$ plane at $y = 4m$. Find $\vec{E}$ at $(4, 0, 10)m$. **5**

(f) Charge distributed throughout a volume V with density ρ gives rise to an electric field with energy content $W_E = \frac{1}{2}\int_V \rho\, V dV$. Show that its equivalent is $W_E = \frac{1}{2}\int \varepsilon\, E^2\, dV$ where ε is permittivity of the medium. **5**

2 Attempt any four of the following :

(a) Explain convection current and conduction current. Derive ohm's law in point form. **5**

(b) The electric field intensity in polystyrene $(\varepsilon_r = 2.55)$ filling the space between the plates of a parallel plate capacitor is 10 kV/m. The distance between the plates is 1.5 mm. Calculate : (i) The surface charge density of free charge on the plates (ii) The potential difference between the plates. **5**

(c) Derive dielectric - dielectric boundary conditions. **5**

(d) Two conducting cones $(\theta = \pi/10 \text{ and } \theta = \pi/6)$ of infinite extent are separated by an infinitesimal gap $r = 0$. If $V(\theta = \pi/10) = 0$ and $V(\theta = \pi/6) = 50\,V$ find V and E between the cones. **5**

(e) The electric field intensity at a point on the surface of a conductor is given by $\vec{E} = 0.2\,\hat{a}_x - 0.3\,\hat{a}_y - 0.2\,\hat{a}_z\ V/m$. Find the surface charge density at that point. **5**

(f) Determine $\vec{E}$ in spherical co-ordinates from Poisson's equation, assuming a uniform charge density ρ. **5**

3 Attempt any **two** of the following :

(a) Define Bio Savart law and Amper's law A long, straight conductor cross section with radius a has a magnetic field strength $\vec{H} = \left(\frac{Ir}{2\pi a^2}\right)\hat{a}_\phi$ with in the conductor $(r < a)$ and $\vec{H}\left(\frac{I}{2\pi r}\right)\hat{a}_\phi$ for $(r < a)$. Find $\vec{J}$ in both the region. **10**

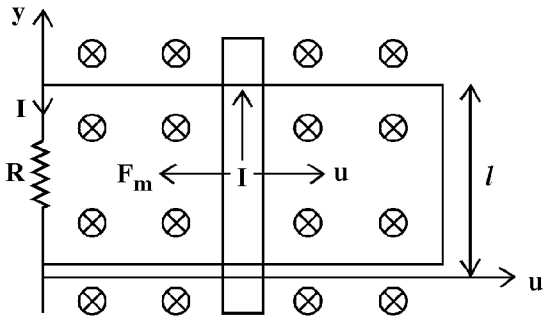
(b) A charge a particle of mass 2 kg and charge IC starts at the origin with velocity $3\hat{a}_y$ m/s and travels in the region of uniform magnetic field $\vec{B} = 10\,\hat{a}_z\ Wb/m^2$ At $t = 4s$, calculate **10**

(i) The velocity and acceleration of the particle.
(ii) The magnetic force on it.
(iii) Kinetic energy and localon

(c) Consider the loop of Fig. (1). If 10

$\vec{B} = 0.5\,\hat{a}_z\ Wb/m^2$, $R = 20\,\Omega$, $l = 10\ cm$ and the rod is moving with a constant velocity of $8\,\hat{a}_x$ m/s, find :

(i) The induced emf in the rod
(ii) The current through the resistance
(iii) The motional force on the rod
(iv) The power dissipated by the resistance.



4 Attempt any two of the following :

(a) A lossy dielectric has an intrinsic impedance of $200 \angle 30^\circ\ \Omega$ at a particular frequency. If at that frequency the plane wave propagating through the dielectric has the magnetic field component **10**

$$\vec{H} = 10\, e^{-\alpha x} \cos\left(wt - \frac{1}{2}x\right)\hat{a}_y \quad A/m$$

final $\vec{E}$ and α and skin depth.

(b) Determine the polarization. State of plane wave with electric field **10**

$$\vec{E}(z, t) = \hat{a}_x 3\cos(wt - kz + 30^\circ)$$
$$-\hat{a}_y 4\sin(wt - kz + 4s^\circ)\ mV/m$$

(c) How the wave propagation takes place in dispersive medium ? Light is incident from air to glass at Brewsters angle. Determine the incident and transmitted angles. **10**

5 Attempt any two of the following :

(a) Derive transmission line differential equation Derive the condition of lossless transmission from it. **10**

(b) (i) A $50\ \Omega$ lossless transmission line is terminated by a load inpedance $Z_l = (50 - j75)\Omega$. If the incident power is 100 mW, find the power dissipated by the load **10**

(ii) A transmission line operating at 500 MHz has $Z_0 = 80\Omega$, $\alpha = 0.04$ N p/m, $\beta = 1.5$ rad/m, find the line parameters.

(c) Using the concept of Maxwell's equation explain how waves propagates in guided waves. **10**