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B. TECH THEORY EXAMINATION (SEM-IV) 2017-18 ELECTROMAGNETIC FIELD THEORY

Time: 3 Hours Max. Marks: 100

Note: Be precise in your answer. In case of numerical problem assume data wherever not provided

SECTION - A

1. Attempt all parts of the following questions:

 $2 \times 10 = 20$

- (a) Explain Faraday's law.
- (b) State point form of ohms law & Gauss's law.
- (c) Explain Biot-Savart's Law.
- (d) Give the relation between Magnetic field and Magnetic flux density?
- (e) Define Dot and Cross products of vectors. Given $\mathbf{A} = 2 \mathbf{a} \mathbf{x} + 4 \mathbf{a} \mathbf{y}$ and $\mathbf{B} = 6 \mathbf{a} \mathbf{y} 6 \mathbf{a} \mathbf{z}$, find the smaller angle between them using the cross and dot product.
- (f) Transform the point P (2,1,6) in spherical coordinate system.
- (g) Write the Maxwell's equations in integral and differential form.
- **(h)** State and prove divergence theorem for a vector field.
- (i) Explain reflection and transmission coefficient of a plane wave at normal incidence.
- (j) Explain the Method of Images for electrostatics.

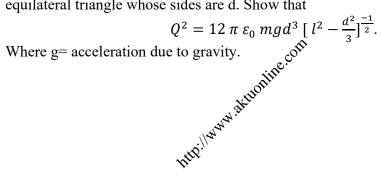
SECTION B

2. Attempt any three parts of the following questions:

 $3 \times 10 = 30$

- (a) Given the potential $V = \frac{10}{r^2} \sin\theta \cos\emptyset$. Find the electric flux density D at $\left(2, \frac{\pi}{2}, 0\right)$.
- (b) State and derive ampere circuital law. A single turns circle coil of 50 meters in diameter carries current 28 × 10⁴ Amp. Determine the magnetic field intensity H at a point on the axis of coil and 100 meters from the coil. The relative permeability of free space surrounding the coil is unity.
- (c) Explain Electric Dipole. Find the electric field intensity due to electric dipole. An electric field is given by E = 10 y ax + 10 x ay V/m. Find the potential function V. Assuming V = 0 at origin.
- (d) Determine the magnetic flux density B at a distance d meter from an infinite straight wire carrying current I. Also find out when the length of the wire is semi-infinite.
- (e) Three identical small spheres of mass m are suspended from a common point by threads of negligible masses and equal lengths l. A charge Q is divided equally among the spheres, and they come to equilibrium at the corners of a horizontal equilateral triangle whose sides are d. Show that

$$Q^2 = 12 \pi \varepsilon_0 mgd^3 \left[l^2 - \frac{d^2}{3} \right]^{\frac{-1}{2}}$$



SECTION C

Attempt any one part of each of the following questions:

 $5 \times 10 = 50$

- 3. (a) State and prove divergence theorem. Determine the flux over the closed surface of cylinder 0 < z < 1, p = 4 if $D = p^2 cos2(\varphi) \hat{a}_p + z \sin \varphi \hat{a}_{\varphi}$. Verify the divergence theorem for above mentioned case.
 - (b) Find the potential function and electric field intensity for the region between two concentric right circular cylinder where $V=V_0$ at r=a and V=0 at r=b (b>a)?
- 4. (a) Explain Skin effect. Derive the expression for α and β in a conducting medium.
 - (b) Define propagation constant and characteristic impedance. Derive the boundary conditions for electric field between two dielectrics having different permittivity interfaces.
- **5.** (a) State Poynting theorem. Derive the mathematical expression for Poynting theorem.
 - (b) Point charges $Q_1 = 1nC$, $Q_2 = -2nC$, $Q_3 = 3nC$ and $Q_4 = -4nC$ are positioned one at a time in that order at (0,0,0), (1,0,0), (0,0,-1) and (0,0,1) respectively. Calculate the energy in the system after each charge is positioned.
- **6.** (a) A uniform plane wave propagating in good conductor. If the magnetic field intensity is given by $H = 0.1e^{-15}\cos(2\pi \times 10^8 l 15z)i$ A/m, determine the conductivity and corresponding component of E field. Also calculate the average power loss in a block of unit area and thickness t.
 - (b) Define phase velocity, group velocity, propagation constant and phase-shift constant. For a lossy dielectric material having $\mu_r = 1$, $\varepsilon_r = 40$, $\sigma = 20$ S/m, calculate the attenuation constant, phase shift and intrinsic impedance at a frequency of 9 GHz.
- 7. (a) What do you mean by intrinsic impedance of a medium? Derive intrinsic impedance for plane waves in lossless dielectrics.
 - (b) A cable pair has the following primary coefficient at an angular velocity of 5000 rad/sec, R=30 ohm/km, G=1 μ v/km, L=1.1 mH/km and C=0.2 μ p/km
 - Calculate (i) the characteristic impedance (ii) The attenuation coefficient (iii) the phase shift coefficient (iv) The attenuation is decibels over a length of 15 Km.