Code No: OR311052 **OR**

III B.Tech I Semester Supplementary Examinations, May 2005
ELECTROMAGNETIC THEORY
(Common to Electronics & Instrumentation Engineering and Electronics & Control Engineering)

Time: 3 hours **Max Marks: 70**

Answer any FIVE Questions
All Questions carry equal marks

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1. State Coulomb's law of force between any two point charges and indicate the units of the quantities in the force equation. Point-charges of 3×10^3 micro-micro coulombs are situated at each of the three corners of a square whose side is 0.2m. Find the magnitude and direction of the electric field at the vacant corner-point of the square.

2. (a) State and explain boundary conditions for electric fields.
   (b) Derive the expression for capacitance of two parallel plates.

3. Find the magnetic field intensity due to the presence of a finite straight filament conductor carrying current I using Ampere's Law for current element: Hence establish the relations for semi-infinite and infinite wires.

4. (a) Given E = E_m sin(ωt -βz)a_y in free space, find D, B and H.
   (b) A current sheet K= $(8/\mu_0)$ a_y (A/m), at x = 0 separates region 1, x < 0 and $\mu_{r1} = 3$, from region 2, x > 0 and $\mu_{r2} = 1$. Given $H_1 = (10/\mu_0)$ (a_y + a_z) A/m find H_2.

5. (a) Derive a general expression for the relation between Electric and Magnetic fields.
   (b) A wave propagating in a lossless dielectric has the components$\overline{E}$ = 500 cos(10^7t - βz)$\hat{a}_x$ V/m and $\overline{H} = 1.1\cos(\ 10^7t-\beta z)\ \hat{a}_y$ A/m. if the wave is traveling at v = 0.5C, where C is the velocity of light, find $\mu_r, \varepsilon_r, \beta, \lambda$ and η.

6. (a) Explain EM wave propagation in a lossless medium.
   (b) A charged particle travels at a velocity u in the field of a plane EM wave in free space, the velocity of particle being parallel to the direction of propagation of the wave. Show that the net transverse force is in the direction of E, but that it tends to zero as the velocity of the particle approaches c .

7. (a) In free space **E(z, t)**= 50cos(ωt - βz)$\mathbf{a}_x$ v/m. find the total power passing through a rectangular area, of sides 90mm and 45mm, in the z=0 plane.
   (b) In a non magnetic material, **H** = 30 Cos (2 π 10^8 t - 6 x) $\mathbf{a}_y$ m A/m. find the pointing vector and the time average power crossing the surface x=1, 0 < y< z, 0<z < 3 m.

8. (a) Discuss the significance and applications of Poynting Theorem.

(b) Explain the utility of Poynting vector. If the peak poynting vector in free space is 10w/m^2.find the amplitudes of electric and magnetic fields.

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