Code No: NR211003 **NR**

II B.Tech I Semester Supplementary Examinations, November 2006
ELECTROMAGNETIC THEORY
(Common to Electronics & Instrumentation Engineering and Electronics & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A hemispherical surface is uniformly charged with a surface charge density of ρ_s using Coulomb's law, calculate electric field intensity at the center of hemisphere. [8M]
   (b) Transform E field given in cylindrical coordinates: E= 2 cos θ a_r + sin θ a_θ into Cartesian coordinates. [8M]

2. Show that the energy stored in a capacitor is proportional to its capacitance and square of the voltage across it. Three capacitors of 10,25 and 50 micro-farads are connected [16M]
   (a) in series
   (b) in parallel.

   Find the equivalent capacitance and energy stored in each case. When the combination is connected across a 500V supply.

3. (a) An infinite conductor carries a current of 2A in the Z direction . Find the magnitude of the force on 1m length of the conductor , if the field in which the conductor is placed is given as $\overline{B}$ = (0.1 $\hat{u}_x$ - 0.2 $\hat{u}_y$) Tesla. [12M]
   (b) Explain why ∇. B = 0 ? [4M]

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

5. (a) Starting from the Maxwell's curl equations, derive the wave equation in Electric field for free space. [6M]
   (b) Given a non-magnetic material having ε_r = 2.35, σ = 10_4 mhos/m., find the loss tangent, attenuation, phase factor and intrinsic impedance at 2.5 MHz. [10M]

6. (a) What do you mean by wave polarization? Explain different types of polarizations. [6M]
   (b) A wave is resultant of two elliptically polarized waves one with components E_x = 5cosωt, E_y= 3sinωt and the other with components E_x = sinωt, E_y = sin(ωt+45^0). For the resultant wave draw the polarization ellipse and determine the axial ratio. [10M]

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. [6M]

   (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. [10M]

8. (a) Derive the pointing theorem from Maxwell's equations and explain its physical significance. [10M]

   (b) A plane wave is traveling in a medium for which σ=0, εr=3,μr=1 if E_{peak}=5v/m find [6M]

   i. Peak poynting vector
   ii. Average poynting vector
   iii. Peak value of H
   iv. Impedance of medium

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