Code No: NR211002 **NR**

**II B.Tech I Semester Supplementary Examinations, November 2005**
**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. What is dipole, quadrupole and dipole moment? Find an expression for [16M]
   (a) Potential due to a dipole at a point '0', not in the line connecting the two poles of the dipole.
   (b) for the torque experienced by a dipole moment 'ql' in a uniform field E, which makes an angle '$\theta$' with the dipole axis.

2. (a) Discuss the various methods of solving the static field boundary value problems. [8M]
   (b) Obtain by means of Laplace's equation the potential distribution between two concentric spherical conductors separated by a single dielectric. The inner conductor of radius 'a' is at potential $V_0$ and the other conductor of radius'b' is at zero potential. [8M]

3. (a) Derive the boundary condition for the magnetic field at the interface between two magnetic mediums with and without surface current at the interface.[12M]
   (b) Obtain the Amperes law for current element in differential form. [4M]

4. (a) What are the different ways to produce an emf in a conducting loop? [4M]
   (b) Let $\mu = 10^{-5}$ H/m, $\varepsilon = 4 \times 10^{-9}$ F/m, and $\sigma = 0$, and $\rho_v = 0$. Find k if the following pair of fields satisfy Maxwell's equations.
   D = 6 $a_x$ - 2y $a_y$ + 2z $a_z$ nC/m$^2$, H = kx $a_x$ + 10y $a_y$ - 25z $a_z$ A/m [6M]
   (c) A current sheet, K = 9$a_y$ A/m, is located at z = 0, the interface between region 1, z < 0, with $\mu_{r1} = 4$, and region 2, z > 0, $\mu_{r2} = 3$. Given that $H_2$ = 14.5 $a_x$ + 8$a_z$ A/m, find $H_1$. [6M]

5. (a) Starting from the Maxwell's curl equations, derive the wave equation in magnetic field for free space. [6M]
   (b) Consider a material for which $\mu_r = 1$, $\varepsilon_r = 4$, and loss tangent is 0.1 at frequency 50 MHz. Calculate conductivity, wavelength, phase velocity and intrinsic impedance. [10M]

6. (a) What is the relation between 1/e depth of penetration and 1% depth of penetration. [6M]
   (b) For what frequency range may sea water with $\mu_r = 1$, $\varepsilon_r = 81$, $\sigma = 4$ mhos/m. be considered as a good conductor. Assume that the loss tangent > 100 for good conductor. [10M]

7. (a) A uniform plane wave normally incident upon the plane air-dielectric interface, show that the standing wave ratio is $1/\sqrt{\in_r}$. [8M]

   (b) A plane wave travelling in air with RMS electric field E=100mv/m is incident normally on a large body of salt water with constants $\sigma$=3mho/m, $\varepsilon_r$=80, $\mu_r$=1.If the constants are independent of frequency, find the depth at which E=1$\mu$v/m at 1MHz. [8M]

8. (a) Define and explain the significance of the terms: Polyting vector. Instantomeors, Average and complex pointing vectors. [8M]

   (b) Obtain an expression for the power loss in a plane conductor. [8M]

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