USN

06ES36

Third Semester B.E. Degree Examination, December 2010
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Assume any missing data suitably.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Show that the electric field intensity at a point, due to 'n' number of point charges, is given by $\overline{E} = \frac{1}{4\pi \in_0} \sum_{i=1}^{n} \frac{Q_i}{R_i^2} \hat{a}_{R_i} v/m$. **(05 Marks)**

b. A uniform line charge of infinite length with $\rho_L = 40$ nc/m , lies along the z-axis. Find $\overline{E}$ at (-2, 2, 8) in air. **(05 Marks)**

c. State and prove the Gauss's law. **(06 Marks)**

d. Determine the volume charge density, if the field is $\overline{D} = \frac{10\cos\theta\sin\phi}{r}\hat{a}_r \ c/m^2$. **(04 Marks)**

2 a. Derive an equation for the potential at a point, due to an infinite line charge. **(06 Marks)**

b. If the potential field $V = 3x^2 + 3y^2 + 2z^3$ volts, find
i) V ii) $\overline{E}$ iii) $\overline{D}$ at P(-4, 5, 4) **(06 Marks)**

c. Deduce an equation for the capacitance of a coaxial cable of length 'L', radius of inner conductor 'a' and out conductor 'b'. **(08 Marks)**

3 a. State and prove the uniqueness theorem. **(06 Marks)**

b. Find the capacitance between the two concentric spheres of radii r = b and r = a, such that b > a, if the potential V = 0 at r = b, using the Laplace's equation. **(10 Marks)**

c. Determine whether or not the potential equations i) $V = 2x^2 - 4y^2 + z^2$ and ii) $V = r^2\cos\phi + \theta$ satisfy the Laplace's equation. **(04 Marks)**

4 a. State and prove the Stoke's theorem. **(04 Marks)**

b. If the magnetic field intensity in a region is $\overline{H} = (3y-2)\hat{a}_z + 2x\hat{a}_y$, find the current density at the origin. **(06 Marks)**

c. A co-axial cable with radius of inner conductor a, inner radius of outer conductor b and outer radius c carries a current I at inner conductor and –I in the outer conductor. Determine and sketch variation of $\overline{H}$ against r for i) r < a ii) a < r < b iii) b < r < c iv) r > c. **(10 Marks)**

PART – B

5 a. Derive an equation for the force between the two differential current elements. **(06 Marks)**

b. Derive the magnetic boundary conditions at the interface between the two different magnetic materials. Discuss the conditions. **(08 Marks)**

c. Calculate the inductance of a solenoid of 400 turns wound on a cylindrical tube of 10 cm diameter and 50 cm length. Assume the solenoid is in air. **(06 Marks)**

6 a. Using the Faraday's law, deduce the Maxwell's equation, to relate time varying electric and magnetic fields. **(08 Marks)**

b. Derive the Maxwell's equations in the point form of the Gauss's law for time varying fields. **(06 Marks)**

c. Given $\overline{E} = E_m \sin(\omega t - \beta z)\hat{a}_y$ in free space. Find $\overline{D}$, $\overline{B}$ and $\overline{H}$. **(06 Marks)**

7 a. Obtain the solution of wave equation for uniform plane wave in free space. **(10 Marks)**

b. State and explain the Poynting's theorem. **(04 Marks)**

c. For a wave traveling in air, the electric field is given by $\overline{E} = 6\cos(\omega t - \beta t)\hat{a}_z$ at f = 10 MHz. Calculate the average Poynting vector. **(06 Marks)**

8 a. Explain the reflection of uniform plane waves, with normal incidence at a plane dielectric boundary. **(10 Marks)**

b. Write short notes on:
   i) Standing wave ratio.
   ii) Skin effect in conductors.

(10 Marks)

* * * * *