Code No. 4118/N

FACULTY OF ENGINEERING

B.E. 2/4 (ECE) I Semester Suppl. Examination

May/June - 2008

Subject : Electro Magnetic Theory

Time : 3 hours] [Max. Marks : 75

Note : Answer ***all*** questions of Part-A.
Answer ***five*** questions from Part-B.

PART - A

1. Write the equation for $\nabla \times \vec{A}$ in cylindrical co-ordinates. 2

2. Write the expressions for the dirac delta function $\delta(\vec{r} - \vec{ry})$ in cylindrical and spherical co-ordinate systems. 2

3. For a two dimensional system in which $r = \sqrt{x^2 + y^2}$ write the expression for $\nabla^2 V$. 2

4. A circular disk of radius R has a surface charge density that increases linearly away from the center; the constant of proportionality being 'k'. Determine the total charge on the disk. 2

5. A sphere of 200 mm radius contains electrical charge of density $\frac{2}{r\text{Sin}\theta}$ c/m^3. What is the total charge contained within the sphere ? 2

6. A 100μc point charge Q_1 is located in a rectangular co-ordinate system at (1, 1, 1). Another point charge Q_2 of 50μc is located at (–1, 0, –2). Find the vector force on the first charge. 2

7. Find the current distribution that produces a magnetic field of the form $\vec{H} = K \text{ Sin } x \, \vec{a}_y$ where K is a constant and $\vec{a}_y$ is the unit vector along y-axis. 2

8. A cylindrical conductor carries a current that produces $\vec{H} = 3r\,\vec{a}_\phi$ (A/m). Determine the current density within the conductor. $\vec{a}_\phi$ is the unit vector along ϕ. 2

9. Express the magnetic scalar potential in an integral form and identify its units. 2

10. A lossy dielectric has $\mu_r = 1$; $\epsilon_r = 10$, $\sigma = 20$ nS/m. An electric field $\vec{E} = 200$ Sin wt $\vec{a}_z$ (V/m) exists in the dielectric. At what frequencies will the conduction current density and the displacement current density have equal amplitudes ? 2

PART - B

11. (a) Determine by integration the volume 'V' of a region defined in a cylindrical co-oridinate system as $1 \leq r \leq 2m$; $0 \leq \phi \leq \pi/3$ radians and $0 \leq z \leq 1m$. Sketch the appropriate figure. 6

(b) Derive the identity div$(g\vec{F}) = g$ div $\vec{F}$ + (grad g). $\vec{F}$ where $\vec{F}$ is any vector field and 'g' is any scalar field. 5

12. (a) A circular disk of radius 3m carries a uniformly distributed charge of 450 μπc. Calculate the force on a 75μc charge located on the axis of the disk and 4m from its center. Draw the appropriate figure. 6

(b) A point charge 'q' is located at a distance 'h' above an infinitely conducting plane. Find the displacement density normal to the plane. Obtain an expression for the surface charge density on the plane. 5

13. (a) Obtain an expression for the far field expansion of an infinitesimal dipole using an appropriate expression for the charge density. 6

(b) Obtain an expression for the capacitance of an isolated sphere of radius 'R'. 5

14. (a) Determine the capacitance per unit length between two infinitely long concentric conducting cylinders with the outside radius of the inner cylinder being 'a' and the inside radius of the outer conductor being 'b'. 5

(b) Derive a set of solutions to Laplace's equation in cylindrical co-ordinates starting with $V = k\,\phi$ where 'k' is a constant. 6

15. (a) Obtain an expression for the magnetic field intensity $\vec{H}$ within a cylinder at a distance 'r' from the center carrying a current I. The radius of the wire is 'R' and the current density is constant across the cross-section of the conductor. 5

(b) A very long thin sheet of copper having a width 'b' meters carries a current 'I' in the direction of its length. If the sheet is assumed to lie in the x-z plane with the z-axis along its center line, determine the magnetic field components H_x, H_y along the strip. 6

16. (a) Using the statement of ampere's work law for elemental area in cylindrical co-ordinates derive the expansion for $\nabla \times \vec{H}$ in these co-ordinates. 5

(b) Prove for parallel polarization, that

$\frac{E_r}{E_i} = \frac{Tan(\theta_1 - \theta_2)}{Tan(\theta_1 + \theta_2)}$. The symbols have their usual meanings. 6

17. (a) Show that the displacement current through a parallel plate capacitor connected parallel to an alternating voltage source is equal to the conduction current I. 5

(b) Using Maxwell's equation, show that $\vec{H}$ must always be zero for time varying fields within a perfect conductor. 6
