Roll No. ....

EE/EX–401(NGS)

B. E. (Fourth Semester) EXAMINATION, June, 2012

(Non-Grading System)

(Common for EE & EX Engg. Branch)

ELECTROMAGNETIC THEORY

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note :   Attempt any *five* questions. All questions carry equal marks.

1. (a) Establish the relation between cylindrical and spherical co-ordinate systems.   6

   (b) Determine the distance of point $A\,(r = 5, \theta = 20°, \phi = 120°)$ from $B\,(r = 2, \theta = 80°, \phi = 30°)$.   8

   (c) What do you understand by Irrotational fields ? Determine the value of constants l, m, n so that :   6

   $$V\,(x + 2y + lz)a_x + (mx - 3y + z)\,a_y + (4x + ny + 2z)\,a_z$$

2. (a) What is Gaussian Surface ? State and prove Gauss's law to determine charge enclosed in a differential volume and hence define divergence.   10

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   (b) A circular disc of radius "a" metre is charged uniformly with a charge density of ρ coulombs/m³. Find the electric intensity at a point n metre from the disc along its axis.   10

3. (a) Explain polarization in dielectrics and show that for a dielectric material, the electric field density D is :   10

   $$D = \varepsilon_0 E + P$$

   (b) At the boundary of two perfect dielectric materials ε_1 and ε_2, D_1 is incident at an angle θ_1 with respect to normal to the boundary surface. Prove that :   10

   $$D_2 = D_1\left[\cos^2\theta_1 + \left(\frac{\varepsilon_1}{\varepsilon_2}\right)^2 \sin^2\theta_1\right]^{1/2}$$

4. (a) Show that the e. m. f. equation as obtained from Faraday's law of electromagnetic induction in a general case is given by :   10

   $$e = -\int_s \frac{\partial B}{\partial t} \cdot ds + \oint (V \times B) \cdot dl$$

   (b) Determine the volume charge density that is associated with each the following fields :   10

   (i) $D = xy^2 a_x + yx^2 a_y + z\,a_z \; c/m^2$

   (ii) $D = \rho z^2 \sin^2\phi\, a_\rho + \rho z^2 \sin\phi \cos\phi\, a_\phi + \rho^2 z \sin^2 a_z \; c/m^2$

   (iii) $D = a_r \; c/m^2$

5. (a) Explain Biot-Savart law. Derive an expression for magnetic field of a current carrying loop.   10

   (b) Derive the Poisson's equation and Laplace's equation from the point form of Gauss's law.   10

6. (a) From Maxwell's equations show that E × H represents flow of power. 10

(b) State Divergence theorem and hence derive and explain E = − grad V. 10

7. (a) Derive potential and field between two co-axial cylinders with inner radius 'a' and outer radius 'b' and hence derive the capacitance between co-axial cycliner. 12

(b) Deduce the expression of energy density for a magnetic field. 8

8. What is uniform plane wave ? Distinguish between a travelling wave and a standing wave and deduce the relation between E and H for a uniform plane wave in free space. 20