T E ETRX V
Electromagnetic Eng.

39 ws April-11

Con. 3288–11.

RK–2229

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** from question Nos. **2** to **7**.
(3) Assume **suitable** data if **necessary**.

1. (a) Explain Cartesian, cylindrical and spherical co-ordinate systems with equations and neat diagrams. 10
   (b) A point in Cartesian system is given by P(1, 2, 3). Express it in cylindrical and spherical co-ordinates. 5
   (c) If a potential function is given by $V = x^2 y z + A y^3 z$ 5
      (i) Find A so that Laplace's equation is satisfied.
      (ii) Using the value of A determine the electric field at (2, 1, –1).

2. (a) State and explain Maxwell's equations in differential and integral form for static and time varying fields. 12
   (b) $\overline{B} = 2 \sin(wt - \beta x)\, \overline{ax} + 2y \cos(wt - \beta x)\, \overline{ay}$. Assume $\rho v = 0, \sigma = 0, J = 0, \epsilon r = 1, \mu r = 1$; Applying Maxwell's equations find the electric field $\overline{E}$. 8

3. (a) Derive the wave equation for free space and for a conducting medium. 8
   (b) Derive the uniform plane wave equation. 6
   (c) For a medium in which a wave with a frequency f = 0·3 GHz is propagating, determine the propagation constant and intrinsic impedance of the medium when $\sigma = 0, \epsilon r = 9, \mu = \mu_0$. 6

4. (a) State and prove the Poynting theorm. Explain the integrals involved in the statement. 10
   (b) In free space $\overline{H} = 0 \cdot 2 \cos(wt - \beta x)\, \overline{az}$ A / m. Find the total power passing through – 10
      (i) A square plate of side 10 cm on plane x + z = 1.
      (ii) A circular disc of radius 5 cm.

5. (a) Derive the expressions for the reflection and transmission coefficients for a parallel polarised plane wave incident on a perfect dielectric at oblique incidence. 12
   (b) Derive the boundary conditions for the normal and tangential components of magetic field. 8

6. (a) Derive an expression for the input impedance of a two wire transmission line starting from the general voltage and current equations of a transmission line. For open and short circuited transmission lines find the expression for the input impedance. 12

(b) A transmission line is lossless and 25 m long. It is terminated in a load of $Z_L = 40 + j\,30\ \Omega$ at a frequency of 10 MHz. The inductance and capacitance of the line are L = 300 n H/m, C = 40 pF/m. Find the input impedance at the source and at the midpoint of the line. 8

7. (a) Explain the following methods to eliminate EMI with equations – 12

(i) Shielding (ii) Grounding (iii) Bending (iv) Filtering.

(b) Find the rediation resistance of a Hertzian dipole of length 4

$\lambda/40$, $\lambda/60$, $\lambda/80$

(c) Find the directivity of a half wave dipole. 4