

Time: 3 Hours

Max. Marks: 80

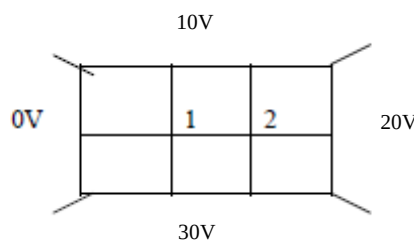
- Note:** (1) Question number 1 is compulsory.
 (2) Solve any THREE out of remaining.
 (3) Assume suitable data if necessary.
 (4) Figures to the right indicate full marks.

Q.1 Attempt any **FOUR**

- (a) Starting with Maxwell's equations derive the expression for the wave equation for an electromagnetic wave propagating in a perfect dielectric. (5)
- (b) Derive the Poisson's and Laplace's equations. (5)
- (c) Explain the Dirichlet-type, Neumann-type and mixed boundary conditions. (5)
- (d) Explain the radiation intensity, directivity and directive gain of the antenna. (5)
- (e) State and explain Coulomb's law. Point charges 1mC and -2mC are located at (2,3,-1)m and (-2,-1,4)m respectively. Calculate the electric force on a 10nC charge located at (0,3,1)m. (5)

- Q.2** (a) Derive Maxwell's equations in integral & Point form for time varying fields. (10)
- (b) Define and explain skin depth. Derive the expression for the skin depth. Calculate the skin depth and the velocity of propagation for a uniform plane wave at a frequency of 100MHz traveling in aluminum. $\epsilon_r=1$, $\mu_r=1$, $\sigma=3.5 \times 10^7$ S/m. (10)

- Q.3** (a) Explain Poynting vector. Derive Poynting theorem and describe significance of each term. (10)
- (b) Use the finite difference method to calculate the potentials at nodes 1 and 2 in the potential system shown in figure using iteration method and band matrix method. (10)



- Q.4** (a) Derive the expression for radiation resistance in far field region of an infinitesimal dipole. (10)
- (b) Find the directive gain and directivity if $U(\theta, \phi) = 10 \sin \theta \sin^2 \phi$, $0 < \theta < \pi$, $0 < \phi < 2\pi$. (5)
- (c) An antenna has a field pattern given by $E(\theta) = \sin^2 2\theta$ for $0 < \theta < \pi$. Find the half power beamwidth and the first null beamwidth. (5)

- Q.5** (a) Explain sky wave propagation. (5)
- Calculate the skip distance for flat earth with MUF of 20 MHz if the wave is reflected from a height of 200km where the maximum value of refractive index of the earth is 0.95. (5)

- (b) What is line of sight propagation? Obtain expression for range of line of sight for space wave propagation in terms of antenna's transmitting and receiving heights. (10)
- Q.6 (a) A transmission line is lossless and 0.25m long. It is terminated in a load of $Z_L = 50 + j25\Omega$ at a frequency of 10MHz. The inductance and the capacitance of the line are $12.5\mu\text{H}/\text{m}$ and $5\text{nF}/\text{m}$, respectively. Use Smith chart to find the reflection coefficient, VSWR, the input impedance at the source. (05)
- (b) Find the characteristic impedance and propagation constant of a transmission line if $R = 4\Omega/\text{m}$, $L = 6\text{nH}/\text{m}$, $G = 0.8\text{mS}/\text{m}$, and $C = 0.3\text{pF}/\text{m}$, the operating frequency of the transmission line is 100MHz. (05)
- (c) Derive the expression for the input impedance of a transmission line. (10)
