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)**

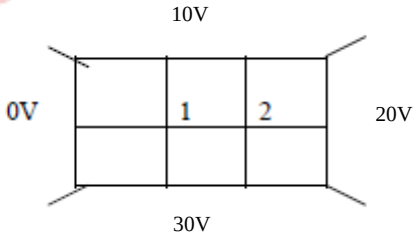
(e) State and explain Coulomb's law. Point charges 1mC and -2mC are located at (2,3,-1)m and (- 2,-1,4)m respectively. Calculate the electric force on a 10nC charge located at (0,3,1)m. **(5)**

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. ϵ_r=1, μ_r=1, σ=3.5x10^7 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)**

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(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 12.5μH/m and 5nF/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=4Ω/m, L=6nH/m, G=0.8mʊ/m, and C=0.3pF/m, the operating frequency of the transmission line is 100MHz. **(05)**

(c) Derive the expression for the input impedance of a transmission line. **(10)**

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