(3 Hours) **Total Marks: 80**

N. B. 1) Question No. 1 is compulsory.
2) Attempt any three questions out of the remaining five questions.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever required but justify the same.

1. Attempt any **four**:
   a. State and explain Gauss's law. 5
   b. Explain the concept of skin depth. 5
   c. Define critical frequency and angle of incidence. Derive an expression for critical frequency in terms of ionization density. 5
   d. Explain the concept of retarded potential. 5
   e. Define radiation intensity, directive gain and directivity with respect to an antenna. 5

2. a. Derive Maxwell's equations in point and integral form for time varying fields. 10

   b. A boundary exists at z = 0 between two dielectrics, ϵ_r=2.5 for region 1and for region 2 ϵ_r is 4 for z > 0. The electric field for region 1 is 10

$$\bar{E}_1 = -30\bar{a}_x + 50\bar{a}_y + 70\bar{a}_z V/m.$$

   Find:- (i) Normal component of $\bar{E}_1$ (ii) tangential component of $\bar{E}_1$ (iii) angle θ_1 between $\bar{E}_1$ and normal to the surface (iv) normal component of $\bar{D}_2$ (v) tangential component of $\bar{D}_2$ (vi) angle θ_2 between $\bar{D}_2$ and normal to the surface

3. a. Define Polarization of a wave. Explain different types of polarization in detail. 10
   b. State Poynting theorem. Derive the Poynting vector and derive the power terms involved in the derivation. 10

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4. a. Differentiate between FDM, FEM and MOM. 10
   b. Derive an expression for the radiation resistance of an infinitesimal dipole antenna 10

5. a. Explain the radiation patterns, half power beam width, first null beam width, antenna efficiency and effective length of an antenna. 10
   b. Explain various factors affecting field strength of a space wave signal. 10

PTO ….

6. a. Define wave tilt. Explain ground wave propagation in detail. 10

b. Define OWF and MUF. Derive the expression of MUF in terms of critical frequency and virtual height. A high frequency communication link is to be established between two points on the earth 2000 km away. If the reflection region of the ionosphere is at a height of 200 Km and has a critical frequency of 5 MHz, Calculate MUF for the given path. 10
