Q.P. CODE: 36047

[Time: 3 Hours] **[Total Marks: 80]**

Note the following instructions.

1. Question **No. 1** is **compulsory.**
2. Attempt **any three out of the remaining five**
3. Draw neat diagrams wherever necessary.
4. Assume data, if missing, with justification
5. Figures to the Right indicate full marks.

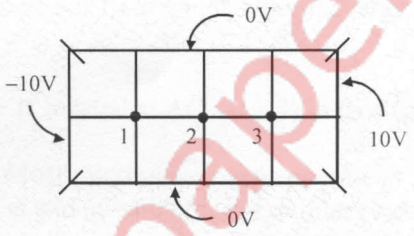
Q1. **Attempt ANY FOUR out of the FIVE**

(a) Define parallel polarization and perpendicular polarization with the help of a diagram. **[05]**

(b) Find the charge in the volume defined by $0 \leq x \leq 1m$, $0 \leq y \leq 1$ m, if the $\rho v = 120x^2y\ \mu C/m^3$. **[05]**

(c) Explain the term super refraction with a neat labeled diagram. **[05]**

(d) Determine the potential at the free nodes in the potential system of the following figure using Finite Difference Method (Band Matrix Method). **[05]**



(e) State the Maxwell's Equations in free space in terms of E and H only. Explain its significance in wave motion. **[05]**

Q2. **(a)** Derive boundary conditions for electric field for a dielectric-dielectric interface stating its significance. **[05]**

(b) In free space ($z \leq 0$), a plane wave with $Hi = 10\cos(10^8t - \beta z)a_x$ mA/m is incident normally on a lossless medium ($\varepsilon = 2\varepsilon o$, $\mu = 8\mu o$) in the region $z \geq 0$. Determine the reflected wave Hr, Er and the transmitted wave Ht, Et. **[10]**

(c) Define Polarization of a wave. State the conditions to achieve Linear polarization. **[2+3]**

Q3. **(a)** A 300MHz wave is propagating through fresh water. Assuming a lossless medium $\mu_r = 1$, $\varepsilon_r = 78$ (at 300MHz). Find the phase constant, the velocity of propagation, the wavelength and the intrinsic impedance. If $E_o = 0.1$V/m, also find E_x and H_y. **[8+2]**

(b) Derive an expression for the Maximum Usable Frequency (MUF) in terms of the skip distance and virtual height. **[05]**

(c) A VHF communication is to be established with a 35W transmitter at 90MHz. Determine the distance up to which LOS communication may be possible if the height of the transmitting and receiving antennae are 40mts and 25mts respectively. **[05]**

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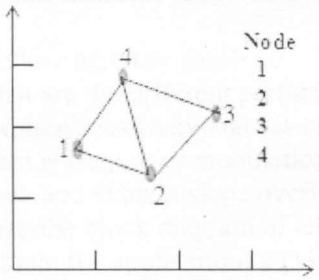
Q4. **(a)** Obtain reflection coefficient and transmission coefficient of perpendicularly polarized wave incident on a dielectric-dielectric boundary with oblique incidence. Define the Brewster angle for this case. **[8+2]**

(b) Consider the two element mesh shown in the fig below. Using the finite element method, determine the potentials within the mesh. **[10]**



Node	(x, y)
1	(0.8, 1.8)
2	(1.4, 1.4)
3	(2.1, 2.1)
4	(1.2, 2.7)

Q5. **(a)** What is the loss tangent of a material? How does it classify materials? **[2+3]**

(b) Derive Helmholtz equations. **[5]**

(c) A point charge $Q_1 = 10\mu C$, is located at $P_1(1, 2, 3)$ in free space, while $Q_2 = -5\mu C$ is at $P_2(1, 2, 10)$. **[5+5]**

(a) Find the vector force exerted on Q_2 by Q_1.

(b) Find the coordinates of P_3 at which a point charge Q_3 experiences no force.

Q6. **(a)** A 5nC point charge is located at A(2, -1, -3) in free space. Find E, at the origin. **[05]**

(b) Define skin depth. Most microwave ovens operate at 2.45GHz. Assume $\sigma = 1.1 \times 10^{\wedge}6$mho/m and $\mu_r = 600$ for the stainless steel interior. Find the depth of penetration. **[05]**

(c) Explain Ducting. State the conditions under which a duct is formed. **[05]**

(d) With respect to the application of Electromagnetic Waves, explain the working of an Electromagnetic Pump. **[05]**

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