Q. P. Code: 24232

Time: 3 Hours **Marks: 80**

NOTE :

1. Question No.**1.** is **compulsory.** Attempt any **four** out of **five** in it.
2. Attempt any **three** out of remaining **five.**
3. Assume suitable data, wherever **necessary** and **justify** the same.
4. Figures to the right indicate marks.

1. A) A point charge $Q_1 = 300\ \mu C$ is located at $P_1(1, -1, -3)$ m experiences a force $\overrightarrow{F_{21}} = 8\,\hat{a}_x - 8\,\hat{a}_y + 4\,\hat{a}_z$ (N) due to a point charge Q_2 at $P_2(3, -3, -2)$ m. Determine Q_2. **(5)**

B) What is Ionosphere? Which layers are present during day and night time? Where does maximum attenuation of an electromagnetic wave take place inside the ionosphere? Hence define critical frequency. **(1+1+1+2)**

C) Explain Super refraction and Sub-refraction. **(5)**

D) State the Maxwell's equations for free space in integral and point form. Also state their significance. Which one of these equations tells us the propagation of electromagnetic wave in air? **(2+2+1)**

E) Compare MOM, FEM and FDM. **(5)**

2. A) Derive boundary conditions for both Electric and Magnetic fields for conductor-dielectric interface. **(10)**

B) State Poynting theorem. Derive its final expression and explain the meaning of each term. **(2+5+3)**

3. A) If the electric flux density $\vec{D} = 4xy\,\hat{a}_x + 2(x^2 + z^2)\,\hat{a}_y + 4yz\,\hat{a}_z$ (C/m²), using Gauss's Law find the following **(10)**

i) The volume charge density at (-1, 0, 3).

ii) The flux through the cube defined by $0 \le x \le 2,\ 0 \le y \le 3,\ 0 \le z \le 5$.

iii) The total charge enclosed by the cube.

B) For the one dimensional differential equation $\frac{\partial^2 V}{\partial x^2} = 0\,,\, 0 \le x \le 4$. Obtain V(1) using FDM. Given V(0)=0 and V(4)=20. Perform band matrix method. **(5)**

C) State some applications of electromagnetism. With the help of neat schematic, explain the working of electromagnetic pump. **(1+4)**

4. A) Obtain the reflection and transmission coefficient in case of reflection from perfect dielectric at normal incidence. **(10)**

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B) Derive an expression for the electric field intensity $\vec{E}$ due to a conductor of infinite length and having charge density ρ_l . (10)

5. A) Obtain an expression for MUF in terms of d, H and f_c. (5+5)
If a high frequency communication link is to be established between two points on the Earth 2000 km away, and the reflection region of ionosphere is at height of 200 km and has critical frequency of 5 MHz, then calculate the MUF for the given path.

B) Find the maximum distance that can be conveyed by a space wave when the transmitting and receiving antenna heights are 60 m and 6 m respectively. Assume standard atmosphere. (5)

C) With regards to the ionosphere discuss the following : (5)
   i) E layer
   ii) Sporadic E layer

6. A) Derive wave equations in lossy media. (10)

B) A media has the following properties $\varepsilon_r = 1$; $\mu_r = 1$; $\sigma = 10^{-4}$ (mho/m) at 1 GHz. Determine : (5)
   i) Propagation constant
   ii) Attenuation constant in dB
   iii) Wavelength
   iv) Refractive index
   v) Loss tangent
Is the media behaving like a conductor or dielectric?

C) Explain formation of duct and condition for duct propagation. (5)

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