ELTL/IV/CBGS/WTP / wave Theory & Propagation

15-12-16

QP CODE : 546003

(3 Hours) (Total Marks : 80)

K.G.C.E. EXAM KARJAT, RAIGAD

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) Given the potential $V = 2x^2y - 5z$ (V) and a point P (-4, 3, 6), find (2+2+1)
   a) Electric field intensity at P
   b) Electric flux density at P
   c) Volume charge density at P

B) State the Maxwell's equations for good dielectric in integral and point form. Also state their significance. (5)

C) Explain Super refraction. (5)

D) With the help of neat schematic diagram, explain the working of an Electromagnetic Pump. (5)

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

2. A) Two extensive homogeneous isotropic dielectrics meet on plane $z = 0$. For $z > 0$, $\varepsilon_{r1} = 4$ and for $z < 0$, $\varepsilon_{r2} = 3$. A uniform electric field $\vec{E}_1 = 5\hat{a}_x - 2\hat{a}_y + 3\hat{a}_z$ (kV/m) exists for $z \geq 0$. Find, (5+5)
   a) $\vec{E}_2$ for $z \leq 0$.
   b) The angles E_1 and E_2 make with the interface.

B) State Poynting theorem. Write its final expression and explain the meaning of each term. (5)

C) Obtain the reflection and transmission coefficient of a perpendicular polarized wave incident between a dielectric-dielectric boundary with an oblique incidence. (5)

3. A) Determine the potential at the free nodes in the potential system of Fig.1. using Finite Difference Method (Band Matrix Method). (10)

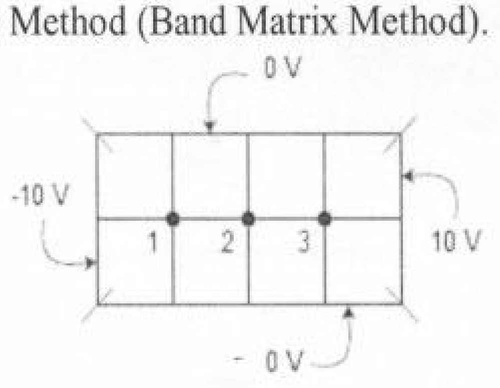

Fig.1.

B) Derive Helmholtz equations for electromagnetic fields in free space. (5)

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C) For the normal incidence, determine the amplitudes of reflected and transmitted $\vec{E}$ and $\vec{H}$ at interface of two regions at $z = 0$. (5)
Given: Incident $E_i = 1.5 \times 10^{-3}$ (V/m); $\varepsilon_{r1} = 8.5$; $\mu_{r1} = 1$; $\sigma_1 = 0$. Second region is free space.

4. A) State and derive FRISS transmission equation. (10)
B) Calculate skin depth and wave velocity at 1.6 MHz in aluminum with the conductivity 38.2 mS/m and $\mu_r = 1$. (5)
C) What is ionosphere? Which layers are present during day and night time? Where maximum attenuation of electromagnetic waves takes place inside the ionosphere? (5)

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) The receiving antenna is located at 80 km from the transmitting antenna. The height of transmitting antenna is 100 m. Find the required height of receiving antenna. (5)
C) Explain the formation of inversion layer in troposphere. (5)

6. A) Consider a two element mesh as shown in Fig.2. Using FEM determine the potentials at free nodes. (10)

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

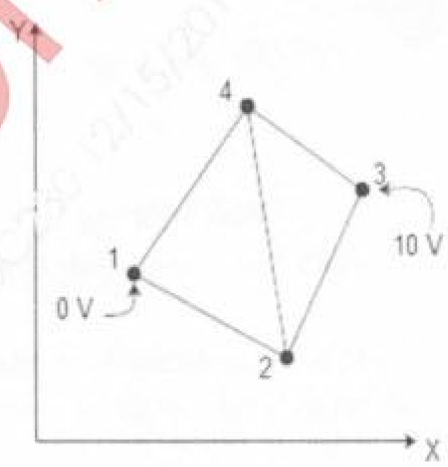

Fig.2.

B) Define critical frequency as a measure of ionospheric propagation and determine critical frequency for reflection at vertical incidence if the maximum value of electron density is 1.24×10^6 per CC. (2+3)
C) Explain formation of duct and condition for duct propagation. (5)

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