

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 3007**

Roll No.

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### B.Tech.

FIFTH SEMESTER EXAMINATION, 2004-2005

### ANTENNA AND WAVE PROPAGATION

Time : 2 Hours

Total Marks : 50

**Note :** (i) Attempt **ALL** the questions.

(ii) All questions carry equal marks.

1. Answer **any three** of the following:

[4x3= 12]

- (a) For a source (J,P) in a medium whose properties are represented by  $\mu$ ,  $\epsilon$  and  $\sigma$ . Starting with Maxwell's equations in phasor form, derive the differential equation,

$$\Delta V - r^2 V = -P/\epsilon$$

- (b) Starting with the expression  $I_{dl}$  for a current element, show that the phasor equations for vector potential and field strengths will be ,

$$A_z = (\mu I_{dl} / (4\pi r)) e^{-j\beta r}$$

$$E_\theta = \{(\eta I_{dl}) / (4\pi r)\} \cdot \{\sin\theta e^{-j\beta r} \cdot (j\beta + (1/r) + (1/(j\beta r^2)))\}$$

- (c) What functions does an antenna fulfill ? What does the principle of reciprocity say about the properties of the antenna ?
- (d) Why is the maximum radiation from a half wave dipole in a direction at right angles to the antenna ?
- (e) Explain fully what is meant by the term resonant antenna.
- (f) Discuss bandwidth, as applied to the major parameters of an antenna. Also define beam width and polarization.

2. Answer *any three* of the following : [ 4 x 3 = 12]

- (a) Design an end – fire array that will have an approximately semicircular pattern given by

$$f(\phi) = 1, 0 < \phi < (\pi/2)$$

$$f(\phi) = 0, (\pi/2) < \phi < \pi$$

The apparent spacing is to be  $\lambda/4$ .

- (b) Explain the difference between driven and parasitic elements in an antenna array.
- (c) What is an antenna array ? What specific properties does it have that make it so useful at HF ?
- (d) Describe the various factors that decide what should be 'optimum length' of a grounded medium frequency antenna.

- (e) Sketch and interpret the input impedance vs.  $\log f$  plot of a log periodic antenna.
- (f) In what basic way does the rhombi antenna differ from arrays such as broad side and end fire? What are advantages and disadvantages of the difference?

3. Answer *any two* of the following : [6x2 = 12]

- (a) A half wave radiator is elevated 15.24 m above the ground. A receiving dipole 4.5 km distant is elevated 4.5 m. Determine the space and surface wave field strengths at the receiving antenna when the transmitting antenna carries a current of 1 amp at a frequency of 50 MHz. Assume an average earth having  $\epsilon_r = 15$  and  $\sigma = 5 \times 10^{-2}$ , for horizontal half wave dipoles ( $R_h = 0.995 \angle -180^\circ$ )
- (b) Derive the approximate formula used for VHF propagation in practical application. State the approximations made for derivation.
- (c) Prove with a diagram, that e.m. wave passing from a denser to rarer medium are bent away from the normal.

4. Answer *any two* of the following : [ 7 x 2 = 14]

- (a) Draw sketch showing tropospheric scatter and explain its basic principles. What are some of the frequencies which may be propagated by forward scatter? What are said to be the causes of such scattering?

- (b) Discuss the effect of Earth's magnetic field on Ionospheric radio wave propagation and estimate the Gyro frequency.
- (c) Briefly discuss the following terms connected with sky wave propagation, virtual height, critical frequency, fading maximum usable frequency and skip distance.