

B. TECH.

FIFTH SEMESTER EXAMINATION, 2003-2004

ANTENNA & WAVE PROPAGATION

Time : 2 Hours

Total Marks : 50

Note : Attempt ALL questions.

1. Attempt any FOUR parts of the following :— (3.5×4)

- (a) Show that for an oscillating current along the z-axis, the expression for $\mu H = \nabla \times A$, is —

$$\mu H_{\phi} = -\sin \theta \frac{\partial A_z}{\partial r},$$

when only distant field is considered.

- (b) Derive and interpret the equation —

$$E = -\nabla V - \dot{A},$$

where the terms have their usual meaning.

- (c) Explain the effective length of an antenna as a radiator of electromagnetic energy.
- (d) Define effective area of an antenna. Find the maximum directive gain and hence effective area of a half-wave dipole.
- (e) Differentiate between 'Directive Gain' & 'Directivity' of an antenna. Establish that —

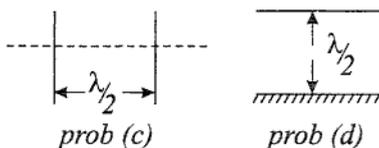
$$g_d = \frac{120\pi^2}{R_{rad}} \left(\frac{l_{eff}}{\lambda} \right)^2,$$

where the terms have their usual meaning.

- (f) Explain the lumped-constant representation of antenna input impedance. Mention the nature of input impedance of a half-wave dipole, if it is operated at a frequency
- higher than its resonant frequency,
 - lower than its resonant frequency,
 - equal to the resonant frequency.

2. Attempt any FOUR parts of the following :— (3×4)

- What is understood by 'Uniform Linear Array' of antennas? Derive an expression for horizontal pattern of an n -element Uniform Linear Array of vertical radiators.
- Derive an expression for the width of the principal lobe of a uniform end-fire array.
- Two identical short dipoles are placed parallel to horizontal plane, separated by a distance $d = \lambda/2$ and fed with equal inphase currents. Sketch the resultant field pattern in the horizontal plane.



- A short antenna is placed above the earth at a height $\lambda/2$. Sketch its vertical radiation pattern above the earth surface (using the principle of images and principle of multiplication of patterns).
- Explain how top loading improves efficiency of low frequency antennas.

(f) Sketch and interpret the input impedance vs $\log f$ plot of a log periodic antenna.

3. Attempt any TWO parts of the following :— (6×2)

(a) Write a short account of the part played by ionosphere in long distance radio communication, describing in particular, what factors govern the selection of operating frequency for a particular channel at a given time. Comment on the service areas embraced both by day and night by transmitting stations, using carriers of

(i) 500 kHz

(ii) 12 MHz

(iii) 150 MHz

(b) Two aircrafts are flying at altitudes of 4000 m and 8000 m respectively. What is the maximum distance along the surface of the earth over which they can have effective point to point microwave communication ?

Radius of earth = 6.37×10^6 metres.

(c) Discuss the effect of Earth's magnetic field on Ionospheric Radio wave propagation and estimate the Gyro frequency.

4. Attempt any TWO of the following :— (6×2)

(a) Explain the following Ionospheric abnormalities :—

(i) Sudden Ionospheric Disturbances

(ii) Sunspot Cycle

(iii) Tides and Winds in the Ionosphere

- (b) Explain the phenomenon of inversion layer formation in coastal areas and state how it leads to duct propagation. Estimate approximately the maximum cut off wavelength for a duct of height 12 m.
- (c) Explain the required formula and calculate the value of the factor by which the horizon distance of a transmitter will be modified, if the gradient of refractive index of air near ground is $-0.06 \times 10^{-6}/\text{m}$. The radius of the earth is given to be 6370 km.

