

Sixth Semester B.E. Degree Examination, Feb./Mar.2022

Antenna & Propagation

Time: 3 hrs.

Max. Marks:100

- Note:** 1. Answer any FIVE full questions, selecting at least TWO questions from each part.
2. Assume any missing data suitably.

PART – A

- 1 a. Define the following terms with respect to antenna :
 (i) Directivity
 (ii) Antenna field zones
 (iii) Beam efficiency
 (iv) Half power beam width
 (v) Effective aperture. (10 Marks)
- b. Derive Frii's formula and find the power delivered to the receiver of a radio link having 150 watts transmitter connected to an antenna of 2m^2 aperture at 2 GHz. The receiving antenna has an aperture of 1.5m^2 and is located at 10 km. (10 Marks)
- 2 a. Derive an expression for maximum effective aperture and directivity of $\frac{\lambda}{2}$ dipole. (07 Marks)
- b. Derive an expression and draw the field pattern for an array of two isotropic point sources with equal amplitude and opposite phase. (06 Marks)
- c. Explain the principle of pattern multiplication and find directivity of $U = U_m \sin \theta \sin^2 \phi$ where $0 \leq \theta \leq \pi$ and $0 \leq \phi \leq \pi$. (07 Marks)
- 3 a. Derive an expression for radiation resistance for $\frac{\lambda}{2}$ dipole. (07 Marks)
- b. Explain long wire antenna and its types. (08 Marks)
- c. For a short dipole $\frac{\lambda}{10}$ long find the efficiency, radiation resistance if loss resistance is $1\ \Omega$. Find also the effective aperture. (05 Marks)
- 4 a. Derive the expression for the impedance of slot antenna. (06 Marks)
- b. State Babinet's principle and derive an expression of impedance of complementary screen. (07 Marks)
- c. Derive an expression for directivity of a circular loop antenna. Also find the directivity for a loop of circumference $1\ \lambda$ if it is placed $\frac{\lambda}{10}$ distance from ground plane. (07 Marks)

PART – B

- 5 a. Explain with neat diagram of, (i) Yagi-Uda antenna (ii) Parabolic reflector (iii) Log periodic antenna. (12 Marks)
- b. Explain the types of rectangular horn antenna and determine the length 'L' and directivity in both planes for a pyramidal electromagnetic horn antenna for which aperture $a_E = 8\lambda$. The horn is fed with rectangular waveguide with TE₁₀ mode. Assume $\delta = \frac{\lambda}{10}$ in E-plane and $\delta = \frac{\lambda}{4}$ in H-plane. (08 Marks)

- 6 a. Explain briefly with neat diagram of, (i) Plasma Antenna (ii) Antenna for GPR. (10 Marks)
b. Explain helical antenna in its two modes of operations. Also find HPBW and axial ratio of a 16-turn helical beam antenna has a circumference of λ and turn spacing of $\frac{\lambda}{4}$. (10 Marks)
- 7 a. Explain the principle of surface wave propagation and obtain an equation for tilt angle ' α ' of the wave. (10 Marks)
b. Estimate the wave tilt in degrees of the surface wave over an earth of $5 \text{ m}\Omega$ conductivity and relative permittivity of 10 at 1 MHz. (05 Marks)
c. The transmitter is mounted at a height 100 m. A receiver height of 50 m is mounted at a distance 50 km. Find the space wave field strength at receiving antenna at 150 MHz if the field strength per unit distance in the directivity of receiving antenna is 60 V/m. (05 Marks)
- 8 a. Derive an expression for skip distance. (06 Marks)
b. Explain briefly fading and its types. (10 Marks)
c. A distance of 1500 km is to be covered along the earth's surface using a communication link. If the reflection region of ionosphere (f_c) has 6 MHz and f_{muf} is 7.5 MHz. Calculate height of the region. (04 Marks)

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