Printed Pages – 5 Roll No. : .....

# C028612(028)

## B. Tech. (Sixth Semester) Examination, April-May 2022

**(AICTE ~~Branch~~)** Scheme

## ANTENNA & WAVE PROPAGATION

***Time Allowed : Three hours***

***Maximum Marks : 100***

***Minimum Pass Marks : 35***

***Note :*** *Attempt all questions. Part (a) of each question is compulsory. Attempt any* ***two*** *parts from (b), (c) and (d). Part (a) is of 4 marks and part (b), (c) and (d) each are of 8 marks.*

### Unit-I

**1.** (a) Define dominant mode in a waveguide. Write TE dominant modes in a parallel plane, rectangular and circular waveguides.

(b) Deduce the expression for cut-off frequency, guide wavelength, phase constant, group and phase velocity in case of a rectangular wave guide excited in TE mode.

(c) A hollow rectangular waveguide with dimensions 6 cm × 4 cm operates at 3 GHz. Find $\lambda_c$, $\lambda_g$, $\beta_z$ and $\eta$ for the $TE_{10}$ mode.

(d) Write the advantages of circular waveguide over rectangular wave guide. An air filled circular waveguide is to be operated at a frequency of 6 GHz and is to have dimensions such athat $f_c = 0{\cdot}8\ f$ for $TE_{11}$ mode. Determine diameter of the wave guide and guide wavelength.

**Unit-II**

**2.** (a) Write different modes of wave propagation and the frequency range in which they are suitable.

(b) Define radio horizon and calculate its value. Transmitting antenna is placed at a height of 166 meters. If the signal is to be received at a distance





of 66 km, what should be the height of the receiving antenna?

(c) Prove that the R.I. of layer of the atmosphere is given by :

$$\mu = \sqrt{1 - \frac{81N}{f^2}}$$

(d) Explain the following in relation to sky wave propagation :

(i) Skip distance

(ii) Critical frequency

(iii) Maximum usable frequency

(iv) Virtual height

(v) Optimum working frequency

**Unit-III**

**3.** (a) State Reciprocity theorem.

(b) What is a half wave dipole? Assuming a sinusoidal current distribution over the dipole length derive an

expression for the vector potential $A$ at a large distance from the dipole and field values.

(c) Find out maximum effective aperture of short current element.

(d) For a given antenna $\phi = \phi_m \sin^2\theta \sin^3\phi$ where $0 \le \theta \le \pi$, $0 \le \phi \le \pi$. Find directivity D.

## Unit-IV

**4.** (a) State the difference between broadside and end fired array.

(b) Derive the array factor of linear array consisting of n-isotropic radiators. Draw the radiation pattern of an array of 8 isotropic elements for broadside case, spacing between elements to be taken $\lambda/2$.

(c) Prove that the directivity for an end fire array of two identical isotropic in phase point sources spaced distance $d$ apart is given by :

$$D = 2/\left[1 + (\sin 2\beta d / 2\beta d)\right]$$





(d) Design a five element broad-side array which has the optimum pattern for a side lobe level of (–20 dB). The spacing between elements has to be $\lambda/2$.

## Unit-V

**5.** (a) What is antenna top loading and turning?

(b) Explain loop antenna as a direction finder. How sense of direction is determined in direction finding applications.

(c) Derive emf equation of loop antenna.

(d) What is Log-Periodic antenna? Mention important characteristics of this antenna.