

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2023

Subject Code:2161003

Date:05-12-2023

Subject Name:Antenna & Wave Propagation

Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) Define a) Directivity b) Effective height c) Solid angle, in context of antenna. **03**
- (b) 1. Find beam area for antenna pattern described by $P_n(\theta) = \cos^3\theta$. **04**
2. Write expression of finding directivity from solid angle. Calculate directivity of a) isotropic antenna b) antenna having solid angle $\pi/4$.
- (c) Derive Friss transmission formula. A radio link has a 30-W transmitter connected to an antenna of 3 m^2 effective aperture at 4 GHz. The receiving antenna has an effective aperture of 0.5 m^2 and is located at a 25 km line-of-sight distance from the transmitting antenna. Assuming lossless, matched antennas, find the power delivered to the receiver. Express value in dBm. **07**
- Q.2** (a) Define Effective aperture. Calculate effective aperture for antenna designed for 125 MHz carrier signal for case a) isotropic antenna b) antenna having directivity 15. **03**
- (b) 1) Explain difference between radian and steradian. Show that one steradian is 3282 square degrees. **04**
2) Define linear array and linear uniform array.
- (c) Explain principle of pattern multiplication for array of point sources. Take example of two short dipole and show it with pattern figures. What is significance of Array Factor? **07**
- OR**
- (c) Design a linear array with a spacing between the elements of $d = \lambda/6$ such that it has zeros at $\theta = 0^\circ$, 45° and 90° . Determine the number of elements, their excitation and plot the received pattern. Use Schelkunoff's method. **07**
- Q.3** (a) Draw approximate current distribution for dipole antenna having length a) $\lambda/2$ **03**
b) λ c) 0.01λ .
- (b) Define steps for designing broadside Dolf -Tchebyscheff' array for given ratio of major to minor lobe and spacing. **04**
- (c) Derive AF (array factor) for N element linear uniform array. Calculate value of progressive phase shift to achieve broadside and end fire antenna array. **07**
- OR**
- Q.3** (a) Draw the structure of 5 element yagi uda antenna. Draw its radiation pattern and provide its properties. **03**
- (b) Explain Resonant long wire antenna. Draw the graph of long wire antenna length versus gain over dipole & Explain it. **04**
- (c) Explain different Feeding methods of Micro strip antenna with diagram. **07**
- Q.4** (a) Find the Capture area for a rectangular horn antenna operating at 2 GHz frequency with a gain of 12 dBi. **03**
- (b) Define Babinet's Principle. Explain how this principle can be used in the working of slot antenna. **04**

- (c) Explain the working of artificial dielectric lens antenna and derive the expression for effective refractive index of a lens formed by conducting sphere. **07**

OR

- Q.4** (a) State Rumsey's Principle and discuss the criteria for the antenna to be frequency independent. **03**
 (b) What is the difference between Reflector antenna and Lens antenna? Explain the concept of Zonning of Lens antenna with equation. **04**
 (c) Design a log periodic dipole array to cover the frequency range 54-216 MHz and to have a gain of 8.5 dB. Take $\sigma = 0.149$ and $\tau = 0.822$. **07**

- Q.5** (a) Define Scattering. Draw the diagram of Tropospheric scatter and explain it. **03**
 (b) What are the properties of Plasma antenna? Give the working principle of plasma antenna. **04**
 (c) Using friss transmission formula, derive the equation of different methods to measure the Gain of test antenna. **07**

OR

- Q.5** (a) The observed critical frequencies of E and F layer at Guwahati at a particular times are 2.5 MHz and 8.4 MHz respectively. Calculate the Maximum electron concentration of the layers. **03**
 (b) Derive the equation of measurement of Impedance of Antenna under test (AUT) using slotted line. **04**
 (c) Define Radio Horizon and Optical Horizon. Derive the equation of effective earth radius with proper diagram. **07**

$$r_e = (4/3) * r$$

where : r_e – effective earth radius
 r – actual earth radius
