Hall Ticket No | | | | | | | | | | | Question Paper Code: AEC011

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations (Supplementary) - January, 2019

Regulation: IARE – R16

ANTENNAS AND PROPAGATION

Time: 3 Hours **(ECE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Define the radiation resistance and with the help of neat diagrams explain the principle of radiation mechanism in antennas. **[7M]**

   (b) The power radiated by a lossless antenna is 10W. The directional characteristics of the antenna are represented by the radiation intensity of $U = B_0 cos^3\theta$ (W/unit solid angle) $0 \leq \theta \leq \Pi/2$, $0 \leq \Phi \leq 2\Pi$. Find the directivity of the antenna. **[7M]**

2. (a) Describe the natural current distribution on a thin wire antenna with the help of neat diagrams. **[7M]**

   (b) As related to antennas explain the following terms: **[7M]**

   (i) Radiation Pattern
   (ii) Beam efficiency
   (iii) Effective length

UNIT – II

3. (a) Comment on binomial arrays and describe how side levels are reduced by non-uniform amplitude distribution in broadside array. **[7M]**

   (b) With neat diagram explain how an array of 2 isotropic point sources can produce different radiation patterns by varying the phase excitation. **[7M]**

4. (a) Explain the characteristics and constructional details of Yagi-Uda antenna. **[7M]**

   (b) With the suitable diagram describe the construction and principle of Helical antenna in normal mode of operation. **[7M]**

UNIT – III

5. (a) Comment on fringing effect, describe the design considerations and how microstrip antenna radiates with neat diagram. **[7M]**

   (b) Determine the length L, aperture a_H and half angles in E and H planes for a pyramidal. electromagnetic horn for which the aperture a_E=8λ. The horn is fed with a rectangular waveguide with TE_{10} mode. Take $\delta = \lambda/2$ in the E-plane and $\delta = \lambda/4$ in the H-plane. What is the HPBW in E plane and directivity? **[7M]**

6. (a) State Babinet's principle and explain its application to slot antennas. **[7M]**
   (b) A microstrip antenna with overall dimensions of L=0.906 cm(0.357 inches) and W= 1.186 cm(0.467 inches), substrate with height h=0.1588 cm(0.0625 inches) and dielectric constant of 2.2 is operating at 10 GHz. Find **[7M]**
   (i) The input impedance.
   (ii) The position of the inset feed point where the input impedance is 50 ohms.

UNIT – IV

7. (a) Explain the procedure to measure the directivity of an antenna. **[7M]**
   (b) A paraboloid reflector of circular cross-sectional area 8000 sq.cm is uniformly excited at 5GHz. Calculate the HPBW and the gain. **[7M]**

8. (a) Explain working principle of Cassegrain antenna and mention its advantages over parabolic reflector. **[7M]**
   (b) Find the diameter of the reflector antenna that has a 0.5^0 HPBW at a frequency of 8.2 GHz. Assume an efficiency constant = 0.6. Calculate the antenna gain and effective aperture. **[7M]**

UNIT – V

9. (a) Write down the salient features of ground wave propagation. **[7M]**
   (b) Calculate the critical frequency for the F_1, F_2 and E layers for which the maximum ionic densities are $2.3\text{x}10^6$, $3.5\text{x}10^6$ and $1.7\text{x}10^6$ electrons per c.c respectively. **[7M]**

10. (a) Write short notes on **[7M]**
    i) Virtual height
    ii) MUF
    iii) Critical frequency
    iv) Skip distance
    (b) Calculate the value of operating frequency of ionosphere layer specified by refractive index of 0.85 and electron density of 5×10^5 electrons/m^3 . Calculate the critical frequency and MUF with i =300. **[7M]**

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INSTITUTE OF AERONAUTICAL ENGINEERING

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Regulation: IARE – R16

ANTENNAS AND PROPAGATION

Time: 3 Hours **(ECE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
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UNIT – I

1. (a) Illustrate the natural current distributions of the linear centre fed half wave dipole of different length. **[7M]**

   (b) A short dipole antenna of length 5cm is operated at a frequency of 100 MHz with terminal current I_O=100 mA. At time t=5s, angle θ=45 and distance r=2m.Find (i) E_r(b) E_θ and (ii)=H_ϕ. **[7M]**

2. (a) Derive the expression for the far field due to an alternating current element. **[7M]**

   (b) An antenna has a field pattern given by $E(\theta) = cos\theta cos2\theta$ for $0^0 \leq \theta \leq 90^0$. Find (i)Half-power beamwidth (HPBW) and (ii) Beam width between first nulls (FNBW). **[7M]**

UNIT – II

3. (a) Compare antenna with an array and derive the array factor of linear array of a 2-isotropic point sources with same amplitude and equal spacing. **[7M]**

   (b) A broadside array operating at 100 cm wavelength consists of four half wave dipoles spaced 50 cm. Each element carries radio frequency current in the same phase and magnitude 0.5 A. Calculate the radiated power. **[7M]**

4. (a) With the suitable diagram describe the construction and principle of helical antenna in axial mode of operation. **[7M]**

   (b) Find the directivity of 10 turn helix antenna having pitch angle 10^0, circumference C equal to and draw the helical antenna with geometry **[7M]**

UNIT – III

5. (a) State Fermat's principle with suitable illustrations and explain how optimum design considerations increases the directivity of pyramidal horn antenna. **[7M]**

   (b) Design an optimum horn antenna with mouth height h=20 λ and path difference $\delta = 0.20\ \lambda$. Find L and θ. **[7M]**

6. (a) Explain how spherical wave front is converted into planar wave front using non-metallic dielectric lens antenna with necessary diagram. **[7M]**

   (b) Design a plano - convex dielectric lens for 5GHz with a diameter of 10λ. The lens material is to be paraffin and the F number is to be unity. **[7M]**

UNIT – IV

7. (a) Explain the working principle of a parabolic reflector antenna. With a neat diagram explain the procedure to measure radiation pattern of an antenna? **[7M]**

   (b) A parabolic reflector antenna with diameter 20 m, is designed to operate at frequency of 6GHz and illumination efficiency of 0.54. Calculate antenna gain. **[7M]**

8. (a) Describe the sources of error while doing the measurement and draw the IEEE co-ordinate system. **[7M]**

   (b) Find the diameter of the reflector antenna that has a 0.5^0 HPBW at a frequency of 8.2 GHz. Assume an efficiency constant = 0.6. Calculate the antenna gain and effective aperture. **[7M]**

UNIT – V

9. (a) Describe in detail about the causes of wave tilt in ground wave propagation **[7M]**

   (b) At a 150 km height in the ionosphere, the electron density at night is about $2\times10^{12}\ m^{-3}$ and the signal MUF is 1.5 times the critical frequency for a transmission distance of 600 km. Compute the following. i) Critical frequency ii) Relative dielectric constant iii) Phase constant iv) wave impedance **[7M]**

10. (a) With neat diagram brief about the structure of ionosphere and describe how EM wave with certain frequency range penetrate the layers of ionosphere. **[7M]**

    (b) Assume the reflection takes place at a height of 400 km and maximum density corresponds to 0.9 refractive index at 10 MHz. What will be the range for which MUF is 10 MHz? **[7M]**

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