Code: 13A04501 **R13**

B.Tech III Year I Semester (R13) Regular & Supplementary Examinations November/December 2016

ANTENNAS & WAVE PROPAGATION

(Electronics and Communication and Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Give the far field expressions for half wave dipole antenna.

(b) The radiation intensity of an antenna is given by $U(\phi,\theta) = 2\cos(\theta)$ in the region $0 \le \theta \le \frac{\pi}{2}, 0 \le \phi \le 2\pi$. It is zero otherwise. Find the total radiated power by the antenna.

(c) A 10-turn helix is constructed at 8 GHz with a circumference of 3.45 cm and a pitch angle of 15^o. Find the gain in dB.

(d) What is the purpose of using folded dipole in place of a half wave dipole? Draw the folded dipole and its equivalent models.

(e) Sketch the four contact feeds for patch antenna.

(f) A parabolic reflector of circular cross sectional area of 8000 sq.cm is uniformly excited at 5 GHz. Calculate the half power beam width (HPBW).

(g) Apply signal amplitudes in the form of binomial distribution to the array of five isotropic antennas spaced $\lambda/2$ apart, and draw its normalized field pattern. Compare this field pattern with that of isotropic uniform array having same length, and write your inference.

(h) In gain measurement of a horn antenna at 10 GHz, the transmitting and receiving horns are identical and placed at 5 m apart. The output of the test horn is connected to an attenuator of 10 dB. Find the gain of the horn.

(i) Find the basic path loss for communication between two stations 300 km apart at a frequency of 300 MHz.

(j) Explain the terms 'critical frequency' and 'skip distance' briefly with suitable sketches.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) State and explain the following terms with respect to antenna: (i) Radiation intensity. (ii) Directive gain (iii) Effective height. (iv) Beamwidth.

(b) Prove that the directivity of an infinitesimal electric dipole is 1.76 dB.

OR

3 (a) Starting from the expressions of retarded potentials, derive the far field expressions for small electric dipole and also obtain the expression for radiation resistance of the dipole.

(b) Draw Thevenin's equivalent circuit of an antenna in its transmitting mode, and give the expression for power delivered to the antenna for radiation in terms of the circuit parameters.

UNIT – II

4 (a) Discuss about the operation of helical antenna in two different modes along with necessary sketches and expressions.

(b) A pyramidal horn antenna is operated at a frequency of 10 GHz. Find the axial length, aperture $'A'$ (in the E-Plane), the flare angles θ_E in E-plane and θ_H in H-plane for which the aperture height $'B'$ (in the H-Plane) is 30 cm. Assume that the horn is fed by a rectangular waveguide with dominant mode, and edge illumination phase deviation is given by path difference δ = 0.6 cm in both the planes.

OR

5 (a) Explain the role and size of each parasitic element in a 3-element array antenna & draw the 6-element Yagi – Uda antenna with dimensions.

(b) Give the far field expressions and radiation resistance for a small loop antenna.

(c) What are the different types of horn antennas? Discuss about them briefly with suitable sketches.

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UNIT – III

6 (a) Give the comparison between parabolic and corner reflectors.
(b) Explain the principle of Cassegrain reflector with suitable sketch & mention its applications.
(c) Using principle of equality of electrical path length, deduce the expression for path that determines the shape of lens antenna.

OR

7 (a) Sketch a rectangular patch antenna indicating the electric field lines in it. Explain the characteristics of microstrip antennas.
(b) Explain in detail about different feed systems that are used for parabolic reflector antennas.

UNIT – IV

8 (a) Prove that the beamwidth of a long end-fire array proposed by Hansen-Woodyard is 71% of beamwidth obtained from ordinary end-fire array.
(b) With suitable sketches, explain the procedure to determine the radiation pattern of an antenna in both the planes.

OR

9 (a) Given a linear uniform array of 10 isotropic antennas with quarter-wavelength separation between them, find the directivity of the array if it is: (i) broadside. (ii) end-fire. Comment on the result obtained.
(b) Explain the Gain measurement of an antenna using three-antenna method.

UNIT – V

10 (a) Derive the expression for maximum usable frequency (MUF) considering flat and curved surfaces of the earth separately in terms of critical frequency and other parameters.
(b) List out the effects of (i) Imperfect Earth. (ii) Curvature of the Earth.

OR

11 (a) Describe the structure of the ionosphere and how its layers are aiding long distance communication at radio frequencies.
(b) A plane wave at 20 MHz is transmitted to ionosphere and reflected from a height of 500 km from the flat earth. If the refractive index corresponding to maximum electron density is 0.5, determine the horizontal range for which the signal frequency is MUF.

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