

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 161003**Date: 25/11/2011****Subject Name: Antenna and Wave Propagation****Time: 10.30 am -1.00 pm****Total marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define: (i) End fire array (ii) Far Field (iii) effective length of an antenna **03**
- (b) Justify the statements: **06**
- (i) For a uniform linear array, the first secondary maximum is 13.5 dB below the principal maximum.
- (ii) The directivity of an antenna is equal to the number of point sources that the antenna can resolve.
- (iii) The impedance of the folded dipole is 292 ohms.
- (c) Obtain expression for the resultant field due to two isotropic point sources placed at a distance 'd' and fed with the same amplitude of currents but with a phase of ' α '. Sketch the radiation pattern for the spacing of $d = \lambda/2$ and phase $\alpha = 180^\circ$ **05**
- Q.2** (a) Derive the expression for radiation resistance of a half-wave dipole antenna **07**
- (b) A rhombic antenna in a horizontal plane is to radiate at 20° in the vertical plane. The operating frequency is 15 MHz. Find the required (i) tilt angle (ii) leg length (iii) height above ground. What will happen if rhombic antenna is not terminated by a suitable resistance. **07**
- OR**
- (b) Two planes 20 KM apart are in radio communication. The transmitting plane delivers 1000 Watts. Its antenna gain being 20 in the direction of other plane. The power absorbed by the receiving antenna of the second plane is 10 μ watts. Calculate (i) electric field strength of the incident wave at the receiving antenna (ii) the effective aperture. **07**
- Q.3** (a) State the fundamental theorems due to Skelkunoff's for the analysis and synthesis of antenna arrays. Explain the significance of each theorem with the help of examples. **07**
- (b) Using reciprocity theorem to antennas show that effective lengths of transmitting and receiving antennas are the same. **04**
- (c) Explain Binomial array with examples. **03**
- OR**
- Q.3** (a) Explain the following antenna parameters : (i) Radiation intensity (ii) Directivity and Gain (iii) Effective aperture (iv) Polarisation. Obtain the relation between effective aperture and gain of an antenna. **07**
- (b) Discuss the following with respect to Chebyshev's distribution : (i) Chebyshev's polynomials $T_m(x)$ and its curve for both m even and m odd. (ii) polynomial $T_4(x)$ **04**

- (c) Explain the features of Yagi Uda antenna. **03**
- Q.4** (a) Draw the figure of helix with its associated dimensions showing the relationship between the circumference, spacing, turn length and pitch angle of helix. State the limits of C_λ , α and n for a helix to produce an axial mode. Calculate the directivity, half power beamwidth and terminating resistance for a helix operating in an axial mode with following dimensions:
 (i) Number of turns = 9 (ii) Operating Frequency = 2 GHz
 (iii) Circumference = 0.8λ (iv) Distance between turns = 0.2λ **07**
- (b) Derive the far field components and the radiation resistance of a small circular loop with radius 'a' and with a uniform phase current. **07**
- OR**
- Q.4** (a) What is a slot antenna and where is it used? State Babinet's principle and illustrate its application to slot antennas and complementary antennas **07**
- (b) Draw the cross section of cylindrical parabolic reflector and a reflector with paraboloid of revolution and derive the field intensity ratio in the aperture plane for both. Calculate gain in dB and beamwidth of a paraboloidal reflector of a 4 m diameter at 5 GHz. The reflector has an overall efficiency of 65% **07**
- Q.5** (a) Describe the structure of ionosphere and the characteristics of ionospheric layers. Prove that maximum usable frequency $f_c = f_o \sec i$ where f_o is the critical frequency and 'i' is the angle of incidence of EM wave at the ionosphere. **07**
- (b) Explain the working of an artificial dielectric lens antennas and derive the relation for effective index of refraction of such a lens formed by conducting spheres. **07**
- OR**
- Q.5** (a) Explain the terms: (i) Virtual height (ii) Maximum usable frequency (iii) Critical frequency (iv) Skip distance. Explain duct propagation with a neat diagram. **07**
- (b) Write brief note on (i) Horn antennas (ii) Experimental setup for the measurement of radiation pattern of an antenna. **07**
