Code No: R31045 **R10** **Set No: 1**

III B.Tech. I Semester Supplementary Examinations, June/July -2014

ANTENNAS AND WAVE PROPAGATION

(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Briefly explain Fresnel and Fraunhofer field regions of an antenna?
   (b) Differentiate Isotrophic directional and Omni-directional radiation patterns of an antenna?
   (c) Briefly explain the current distribution on a thin wire antenna?

2. (a) Find the radiation resistance of a single-turn and an 8-turn small circular loop. The radius of the loop is $\lambda/25$ and the medium is free space?
   (b) Compare the far fields of small loop and short dipole?
   (c) Explain radiation from Small electric dipole in Fraunhofer region?

3. (a) Explain the field pattern of two element array of broadside and end fire case.
   (b) Explain the principle of pattern multiplication.

4. (a) Explain the construction and operation of Helical antenna in detail.
   (b) Write a short notes on Uni-directional and Bi-directional V-antenna.

5. (a) Explain the geometrical configuration of different reflector systems in detail?
   (b) Find the maximum power delivered to a 50Ω matched load by a 1μ vm^{-1} field from a U.S channel 36 (602 – 608 MHz) station into a 900 corner reflector with 11 dBi gain.

6. (a) Write a short note on the features of Lens antenna.
   (b) Explain Non metallic dielectric Lens antennas in detail.

7. (a) Explain MUF and skip distance in detail.
   (b) Calculate the skip distance for flat earth with MUF of 20 MHz, if the wave is reflected from a height of 200 km where the maximum value of n is 0.95.

8. (a) Explain space wave propagation mechanism in detail.
   (b) Find the basic path loss for communication between two points, 2000km apart at a frequency of 5GHz.
   (c) Define radio horizon.

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Code No: R31045 **R10** **Set No: 2**

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(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

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1. (a) Explain the following terms with respect to antenna?
   (i) Directivity (ii) Radiation intensity
   (b) Discuss the radiation mechanism of single wire and two wire configurations?
   (c) The maximum radiation intensity of 90% efficiency antenna is 200 mW/unit solid angle. Find the directivity(dimensionless) and gain(dB), when the
   (i) input power is 125.66 mw (ii) radiated power is 125.66 mw

2. (a) The radius of a small loop of constant current is λ/25. Find the physical area of the loop and compare it with its maximum effective aperture?
   (b) Calculate the radiation resistance of short electric dipole?
   (c) Find the power radiated by 10 cm dipole antenna operated at 50MHz with an average current of 5mA. How much average current would be needed to radiate power of 1Watt?

3. (a) Define array factor. Derive an expression for array factor?
   (b) Explain Binomial array?
   (c) Given a linear Broadside, uniform array of 10 Isotropic elements (N=10) with a separation of λ/4 (d=λ/4) between the elements, find the directivity of the array in dB?

4. (a) Discuss geometry and radiation characteristics of Rhombic antenna?
   (b) Calculate the field strength of long wire antenna?
   (c) Mention any two design considerations for monofilar helical antenna?

5. (a) A square corner reflector has a driven element λ/2 from the corner.
   (i) Calculate and plot the far field pattern in both principal planes.
   (ii) What are the HPBWS in the two principal planes?
   (iii) What is the terminal impedance of the driven element?
   (iv) Calculate the directivity?
   (b) Explain Yagi-Uda array in detail?

6. (a) Design a pyramidal horn antenna with optimum gain at a frequency of 10GHz. The overall length of the antenna from the imaginary vertex of the horn to the center of the aperture is 10λ and is nearly the same in both planes. Determine the
   (i) aperture dimension of the horn (in cm).
   (ii) gain of the antenna(in dB).
   (iii) aperture efficiency of the antenna (in %) assume the reflection, conduction and dielectric losses of the antenna are negligible.
   (iv) Power delivered to the matched load when the incident power density is $10\mu w/m^2$
   (b) Explain different types of Horn antenna in detail?

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7. (a) Calculate the maximum single hope distance for D,E,F_1 and F_2 layers if their heights are assumed to be 50km,110km,20^0km and 300 km respectively above the earth and the angle of incidence is 200 in all cases?
   (b) Explain ground wave propagation in detail?

8. (a) A transmitting antenna of 100m height radiates 50kw at 30MHz uniformly in azimuth plane. Calculate the maximum line of sight range and strength of the received signal at 9m high receiving antenna at a distance of 20km at what distance would the signal strength reduced to half of that received at 20km?
   (b) Discuss the effects of imperfect Earth?

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ANTENNAS AND WAVE PROPAGATION

(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) A hypothetical isotropic antenna is radiating in free space at a distance of 100m from the antenna, the total electric field (E_0) is measured to be 5v/m.
   Find (i) The power density (W_{rad}) ? (ii)The power radiated (P_{rad}) ?
   (b) Briefly explain the following terms with respect to antenna.
   (i) Beam area (ii) effective height (iii) gain

2. (a) Evaluate the field components of Half wave dipole?
   (b) For a thin center-fed dipole λ/15 long,
   Find (i) Directivity (D) (ii) Gain (G) (iii) Effective aperture (A_e)
   (iv) Beam solid angle (Ω_A) and (v) radiation resistance. The antenna current tapers linearly from its value at the terminals to zero at its ends. The loss resistance is 1Ω.
   (c) State any one antenna theorem.

3. (a) For a 10-element binomial array with spacing of λ/2 between the elements. Determine the half power beam width (in degrees) and maximum directivity (dB) ?
   (b) Explain End fire array with increased directivity in detail?
   (c) Define array factor?

4. (a) Briefly explain the characteristics of non resonant antennas?
   (b) Design a five turn Helical antenna which at 400MHz operates in the normal mode. The spacing between the turns is λ/50. It is desired that the antenna possesses circular polarization. Determine (i) circumference of the helix (in meters)
   (ii) Length of a single turn (in λ and in meters)
   (iii) Overall length of the entire helix (in λ and in meters)
   (iv) Pitch angle (in degrees)
   (c) Give any one example for non-resonant antennas?

5. (a) A reflector antenna with a total subtended angle of 120^0 is illuminated at 10GHz with a specially designed feed so that its aperture efficiency is nearly unity. The focal distance of the reflector is 5m. Assuming the radiation pattern is nearly symmetric.
   Determine the (**i**) half power beam width (in degrees) (**ii**) side lobe level (in dB)
   (**iii**) directivity (in dB) (**iv**) loss in directivity (in dB), if the surface has RMS random roughness of 0.64 mm.
   (b) Explain folded dipoles and their characteristics?

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6. (a) Briefly explain different techniques used for measuring the gain?
   (b) Determine the length 'L', aperture a_H and half angles in E & H planes for a pyramidal electromagnetic horn for which the aperture $a_e=8\lambda$. The horn is fed with a rectangular wave guide with TE_{10} mode. Take $\delta=\lambda/10$ in the E-plane and $\delta=\lambda/4$ in the H-plane.

7. (a) Explain optimum frequency, LUF, virtual height with respect to ionosphere propagation?
   (b) A ground wave of 0.5 mv/meter at 20 kms distance is obtained from a transmitter operating at 2MHz. the horizontally polarized field produced is proportional to $\cos\theta$, where θ is the angle of elevation. The other related parameters are antenna efficiency=30%, σ=5*10-5 and ϵ_r=12. Estimate the transmitted power?

8. (a) Calculate the maximum distance at which signal from transmitting antenna with 121mts height would be received by the receiving antenna of 16mts height. Also calculate the radio horizon distance for k=4/3 model of earth with standard value of radius.
   (b) Explain duct propagation in detail?

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1. (a) An antenna has a field pattern given by $E(\theta)=\cos(\theta)\cos(2\theta)$ for $0^0 \leq \theta \leq 90^0$. Find
   (i) Half- power beam width (HPBW)
   (ii) The beam width between first nulls(FNBW)
   (b) Explain the radiation mechanism of a dipole and two wire configurations?

2. (a) Explain the current distributions of Quarter wave monopole?
   (b) Calculate the radiation resistance of short electric dipole?

3. (a) Discuss the effects of uniform and non-uniform amplitude distributions in antenna arrays?
   (b) Briefly explain the concept of scanning arrays?
   (c) A 2-element End-fire array in free space consists of 2-vertical side by side $\lambda/2$ elements with equal out-of-phase currents. At what angles in the horizontal plane is the gain equal to unity?
   (**i**) When the spacing is $\lambda/2$ (**ii**) When the spacing is $\lambda/4$

4. (a) Explain the operation of the Helical antenna in normal mode?
   (b) Design an End-fire right hand circularly polarized helix having a half-power beam width of 45^0,pitch angle of 13^0, and a circumference of 60 cm at a frequency of 500MHz. Determine the
   (i) turns needed (ii) directivity in dB (iii) axial ratio
   (iv) lower and upper frequencies of the bandwidth over which the required parameters remain relatively constant.
   (c) Mention any two design considerations of monofilar helical antenna?

5. (a) Explain the following terms with respect to parabolic reflector antennas.
   (i)aperture blocking (ii) spill over (iii) cassegrains feeds
   (b) A reflector antenna with a total subtended angle of 120^0 is illuminated at 10GHz with a specially designed feed so that its aperture efficiency is nearly unity. The focal distance of the reflector is 5m. Assuming the radiation pattern is nearly symmetric.
   Determine the (i) Half power beam width (in degrees) (ii) side lobe level (in dB)
   (iii) Directivity (in dB)
   (iv) loss in directivity (in dB), if the surface has RMS random roughness of 0.64 mm.

6. (a) Write down the different applications of the lens antenna?
   (b) Explain the technique used for measuring the directivity in detail?

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7. (a) Explain sky wave propagation mechanism?
   (b) Explain structural details of the ionosphere?

8. (a) The transmitting and receiving antennas with respective heights of 49m and 25m are installed to establish communication at 100MHz with a transmitted power of 100watts. Determine the LOS distance and the received signal strength there at?
   (b) Discuss tropospheric scattering in brief?
   (c) What is the fundamental equation for free space propagation?

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