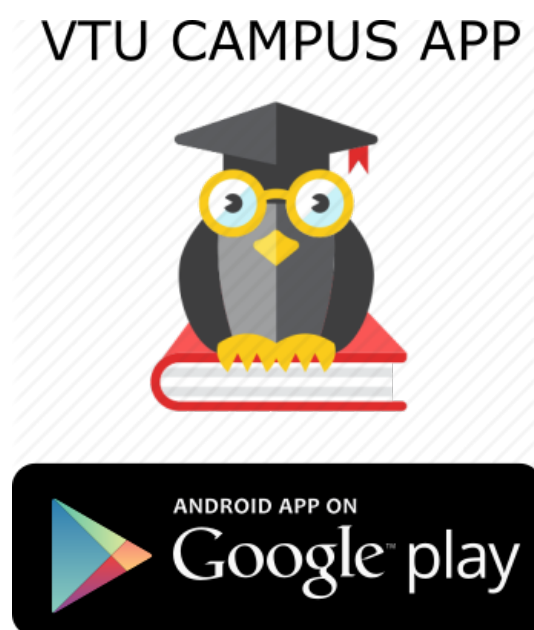


# Antennas and Propagation VTU Question Paper Set



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## Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017

### Antennas and Propagation

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer any FIVE full questions, selecting  
atleast TWO questions from each part.  
2. Draw diagram wherever necessary.**

#### PART – A

- 1
  - a. Obtain relation between directivity and beam width and also write equation for estimating directivity. (05 Marks)
  - b. A parabolic reflector antenna is circular in cross – section with a diameter 1.22 m. If the maximum effective aperture equals 55% of the physical aperture, calculate gain of antenna in dB at 20 GHz. (07 Marks)
  - c. Show that the maximum effective aperture of a  $\lambda/2$  dipole is  $\frac{30}{73\pi}\lambda^2$  and also obtain radiation resistance of  $\lambda/2$  dipole is  $73\Omega$ . (08 Marks)
- 2
  - a. Derive Hansen–Woodyard condition for ‘n’ element end fire array for enhancing directivity. (08 Marks)
  - b. A linear uniform array of isotropic antennas satisfy the following parameter, obtain the field pattern and find BWFN and HPBW  $\eta = 4$  ;  $\delta = 0$ ;  $d = \lambda/2$ . (07 Marks)
  - c. Explain in detail pattern multiplication method in array synthesis. (05 Marks)
- 3
  - a. Derive an expression for power radiated by current element and radiation resistance of short dipole. (09 Marks)
  - b. Obtain an expression for field of dipole in general ( $\ell \geq \lambda/4$ ) for thin linear antenna. (06 Marks)
  - c. A half wave dipole in free space is radiating with a current of 1A(rms) at the antenna terminals. Find the angle  $\theta$  for maximum field strength and determine the field strength and power density at a point 1 mile from the antenna at the corresponding angle. (05 Marks)
- 4
  - a. Obtain expression for radiation resistance of loop antenna. (08 Marks)
  - b. The multiturn rod antenna of a broadcast receiver has 10 turns of 1 mm diameter copper wire wound on a ferrite rod 1 cm in diameter and 10cm long. For the ferrite rod  $\mu_r = \mu_r' - j\mu_r'' = 250 - j2.5$ . Take the effective relative permittivity of ferrite rod  $\mu_{er} = 50$ . At 1 MHz find : i) the radiation efficiency ii) the Q factor iii) Half power bandwidth. (06 Marks)
  - c. The diameter of a circular loop antenna is  $0.04 \lambda$ . How many turns of antenna will give a radiation resistance of  $36 \Omega$ ? (06 Marks)

#### PART – B

- 5
  - a. Explain the radiation mechanism of microstrip patch antenna and its characteristics. (06 Marks)
  - b. Determine length  $\rho$  of the horn, H – plane aperture and flare angles  $\theta_E$  and  $\theta_H$  in (E and H plane) of a pyramidal horn for which E – plane aperture is  $10\lambda$ . The horn is fed with a rectangular waveguide with  $TE_{10}$  mode. Let  $\delta = 0.2 \lambda$  in E plane and  $0.375 \lambda$  in H plane. Calculate beam width and directivity. (08 Marks)
  - c. Explain the basic concepts of reflector antenna and concepts involved in plane and corner reflector. (06 Marks)

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- 6 a. Explain with suitable sketches perpendicular mode of radiation in helical antenna and obtain an expression for axial ratio and pitch angle. (05 Marks)
- b. Write a short note on :
- Sleeve antenna
  - plasma antenna
  - embedded antennas. (09 Marks)
- c. Explain in brief antenna for satellite communication. What are different design consideration for the same? (06 Marks)
- 7 a. Derive relation between radius of curvature of earth and the change in refractive index with height. (08 Marks)
- b. Obtain an expression for field strength at receiving antenna for the wave propagation in free space. (07 Marks)
- c. If a transmitting aerial is located at the top of a tower 200 m above the surface of the earth. Determine the maximum distance at which an air craft flying at an altitude 3000m will be able to receive signal form the transmitter. Assume that only LOS propagation involved. If the transmitting aerial has a power gain of 13 dB in direction of aircraft and the power radiated is 400 watts, determine the electric field strength of signal at the air craft. Assume an earth of 6350 kms radius. (05 Marks)
- 8 a. Explain what will happen if a radio wave with a frequency greater than the critical frequency is propagated to the ionosphere? Will it return back? Obtain the condition such that such a wave return back to the earth. (07 Marks)
- b. Define the following :
- optimum working frequency
  - maximum usable frequency. (06 Marks)
- c. In ionospheric propagation, consider that the reflection takes place at height of 300 km and that the maximum density in ionosphere corresponds to refractive index of 0.8 at 15 MHz frequency. Determine ground range for curved earth for which given frequency is MUF. (07 Marks)

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## Sixth Semester B.E. Degree Examination, June/July 2016

### Antennas and Propagation

Time: 3 hrs.

Max. Marks: 100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

#### PART – A

- 1 a. Explain the following terms as related to antenna systems:
  - i) Beam area
  - ii) Directivity
  - iii) Power gain
  - iv) Effective aperture
  - v) Radiation resistance

(10 Marks)
- b. Find the directivity of the power pattern given by  $U = U_m \sin^2 \theta \sin^3 \phi$ ;  $0 \leq \theta \leq \pi$ ;  $0 \leq \phi \leq \pi$ .  

(05 Marks)
- c. An antenna has a field pattern given by  $E(\theta) = \cos \theta \cos 2\theta$  for  $0 \leq \theta \leq 90^\circ$ . Find half power beam width (HPBW) and beam width between first nulls (BWFN).  

(05 Marks)
- 2 a. Derive an expression for array factor and relative field of linear array of 'n' isotropic point sources of equal magnitude and spacing.  

(08 Marks)
- b. Complete the field patterns and find BWFN and HPBW for an array of 4 point sources spaced  $\lambda/6$  distance apart. They have a phase difference of  $\pi/3$  between adjacent elements.  

(06 Marks)
- c. Explain the principle of pattern multiplication with an example.  

(06 Marks)
- 3 a. Derive the far field components of short dipole.  

(07 Marks)
- b. For a short dipole of  $\lambda/15$  long and loss resistance of  $1\Omega$ . Find:
  - i) Efficiency
  - ii) Radiation resistance
  - iii) Effective aperture

(06 Marks)
- c. Write short notes on:
  - i) V-antennas
  - ii) Folded dipole antennas
  - iii) Rhombic antenna

(07 Marks)
- 4 a. Derive the far field expressions for small loop antenna.  

(07 Marks)
- b. Explain patch or microstrip antennas with necessary sketch.  

(06 Marks)
- c. With relevant sketches, explain the principle of Babinet's principle for complementary linear antennas.  

(07 Marks)

#### PART – B

- 5 a. Explain the practical design considerations for the axial mode helical antennas.  

(10 Marks)
- b. Write short notes on:
  - i) Yagi-Uda antenna
  - ii) Corner reflector antenna

(10 Marks)

**10EC64**

- 6 a. Explain the constructional details of Sleeve antenna and Turnstile antenna. (08 Marks)  
 b. Write short notes on:  
 i) Embedded antennas  
 ii) Ultra wideband antennas  
 iii) Plasma antennas (12 Marks)
- 7 a. Derive an expression for wave tilt of surface wave. (08 Marks)  
 b. Explain duct propagation in detail. (06 Marks)  
 c. Estimate the wave tilt in degrees of the surface wave over an earth of 5 millimhos conductivity and relative permittivity of 10 at 1 MHz. (06 Marks)
- 8 a. Derive an expression for refractive index of an ionospheric propagation. (06 Marks)  
 b. A high frequency link is established for a range of 2000 km. If the reflection region of ionosphere is at a height of 200 km and has a critical frequency of 6 MHz, calculate maximum usable frequency (MUF). (06 Marks)  
 c. Define the following terms related to ionospheric propagation:  
 i) MUF  
 ii) Critical frequency  
 iii) Virtual height  
 iv) Skip distance (08 Marks)

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**Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016**  
**Antennas and Propagation**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting  
at least TWO questions from each part.**

**PART – A**

1. a. Define directivity. Obtain the relationship between directivity and beam area to show that smaller the beam area, larger is the directivity. (07 Marks)  
 b. Define antenna aperture. Derive the relationship between aperture and beam area. (06 Marks)  
 c. Show that maximum effective aperture of a short electric dipole is equal to  $0.119 \lambda^2$ . (07 Marks)
2. a. Find the power radiated and the directivity for the following:  
 i)  $U = U_m \sin^2 \theta \sin^3 \phi$      $0 \leq \theta \leq \pi$      $0 \leq \phi \leq \pi$   
 ii)  $U = U_m \cos^n \theta$      $0 \leq \theta \leq \pi/2$      $0 \leq \phi \leq 2\pi$  (08 Marks)  
 b. Obtain the relative field pattern for two isotropic point sources of same amplitude but opposite phase, spaced  $\frac{\lambda}{2}$  apart. (08 Marks)  
 c. State and explain power theorem. (04 Marks)
3. a. Derive the equation for radiation resistance of a short electric dipole. (08 Marks)  
 b. Explain the following : i) Folded dipole, ii) Rhombic antenna. (08 Marks)  
 c. A half wave dipole radiating in free space is driven by a current of 0.5 amperes at the terminals. Calculate E and H field at a distance 1 km from the antenna at angles of  $45^\circ$  and  $90^\circ$ . (04 Marks)
4. a. Obtain the radiation resistance of a small loop antenna. (07 Marks)  
 b. Write short notes on: i) Slot antenna, (ii) Patch antenna. (08 Marks)  
 c. Find the radiation efficiency of a 1 meter diameter loop of 10 mm diameter copper wire at (i) 1MHz, (ii) 10 MHz. (05 Marks)

**PART – B**

5. a. Determine the length L, H plane aperture and flare angles  $\theta_E$  and  $\theta_H$  of a pyramidal horn for which E-plane aperture  $a_E = 10 \lambda$ . The horn is fed by rectangular waveguide with  $TE_{10}$  mode. Let  $\delta = 0.2 \lambda$  in the E-plane and  $0.375 \lambda$  in the H-plane. Also find beam width and directivity. (08 Marks)  
 b. Write short notes on: i) Lens antenna; ii) Log periodic antenna (08 Marks)  
 c. Design a Yagi-Uda six element antenna for operation at 500 MHz with a folded dipole field. What are the lengths of (i) reflector element, (ii) driven element, (iii) four director element? What is the spacing between reflector and driven element? (04 Marks)

**10EC64**

- 6 a. Derive an expression for resultant field intensity in the case of a space wave propagation. (10 Marks)
- b. Evaluate the roughness factors for the earth at 10 MHz, if  $\sigma = 5$ , for ' $\theta$ ' equal to (i)  $30^\circ$ , (ii)  $45^\circ$ , (iii)  $60^\circ$ . (05 Marks)
- c. A transmitting antenna of 100 m height radiates 40 kW at 100 MHz uniformly in azimuth plane. Calculate maximum LOS range and strength of the received signal at 16 m high, receiving antenna at a distance of 10 km. At what distance would the signal strength reduce to 1 mV/m? (05 Marks)
- 7 a. Explain the structure of ionosphere. Derive an expression for refractive index of ionospheric layer. (10 Marks)
- b. Define the following with respect to ionospheric propagation:
- Critical frequency
  - Virtual height
- (06 Marks)
- c. Obtain the relationship between maximum usable frequency (MUF) and skip distance. (04 Marks)
- 8 Write short notes on:
- Principle of pattern multiplication
  - Scanning array
  - Embedded antennas
  - Ground wave propagation
- (20 Marks)

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**Sixth Semester B.E. Degree Examination, June/July 2015**  
**Antennas and Propagation**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions, selecting  
atleast TWO questions from each part.**

**PART – A**

1. a. Define: i) Radiation intensity ii) Power density. Derive the relation between these two parameters. (06 Marks)  
 b. Show that the maximum effective aperture of a short dipole antenna is  $0.119 \lambda^2$ . (06 Marks)  
 c. Determine the directivity of a system, if the radiation intensity is  
 i)  $U_m \sin \theta \cdot \sin^2 \phi$ ; for  $0 \leq \theta \leq \pi$ ,  $0 \leq \phi \leq \pi$ .  
 ii)  $U_m \sin^2 \theta \sin^3 \phi$ ; for  $0 \leq \theta \leq \pi/2$ ,  $0 \leq \phi \leq 2\pi$ . (08 Marks)
2. a. State and prove power theorem. How power theorem is applied to find power radiated by an isotropic antenna in terms of it's' radiation intensity? (06 Marks)  
 b. Derive an expression for 'array factor' of an array of n-isotropic sources. (08 Marks)  
 c. A linear antenna array consists of four isotropic sources. The distance between adjacent sources is  $\lambda/2$ . The power applied to the array is with equal amplitude and a phase difference  $-d_r$ . Obtain the field pattern and find FNBW and HPBW. (06 Marks)
3. a. Derive an expression for radiation resistance of a short electric dipole. (06 Marks)  
 b. Show that the radiation resistance of  $\lambda/2$  antenna is 73 ohms. (06 Marks)  
 c. With the help of neat diagrams, explain following antennas:  
 i) Long-wire antenna ii) Folded dipole antenna. (08 Marks)
4. a. Derive the expressions for field strengths  $E_\theta$  and  $H_\phi$  incase of a small loop. (08 Marks)  
 b. The radius of a circular loop antenna is  $0.02\lambda$ . How many turns of the antenna will give a radiation resistance of  $35\Omega$ ? (06 Marks)  
 c. Explain Babinet's principle with illustrations. (06 Marks)

**PART – B**

5. a. Explain different types of rectangular horn antennas. Why flaring of walls of waveguide in case of horn antennas is necessary? (06 Marks)  
 b. Describe a helical antenna with the help of a neat diagram. Explain its two modes of operation with relevant equations. (08 Marks)  
 c. Find number of elements in a log-periodic dipole array with 7dBi gain and a 4 to 1 bandwidth. The scale constant  $K = 1.2$  for apex angle of  $15^\circ$ . (06 Marks)
6. a. Explain the construction and working of lens antenna. (06 Marks)  
 b. With neat diagram, explain embedded antenna. (06 Marks)  
 c. Explain following antenna types with neat sketches:  
 i) Ultra wide band antenna ii) Plasma antenna. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.



- 7 a. Derive an expression for space wave field intensity and show that it varies sinusoidally. (08 Marks)  
b. Explain duct propagation with diagram. (06 Marks)  
c. A free-space LOS (Line-of-Sight) microwave link operating at 10 GHz consists of a transmit and a receive antenna each having a gain of 25dB. The distance between the two antennas is 30km and the power radiated by the transmit antenna is 10W. Calculate the path loss of the link and the received power. (06 Marks)
- 8 a. Explain the mechanism of ionospheric propagation. Also derive an expression for the refractive index of an ionospheric layer. (08 Marks)  
b. Discuss the effect of the earth's magnetic field on ionospheric propagation. (06 Marks)  
c. Calculate the angle of incidence and the maximum single-hop distance for a sky wave reflected from the E-layer with height ' $h$ ' = 100 km. (06 Marks)

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**Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015**  
**Antennas and Propagation**

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting  
atleast TWO questions from each part.**

**PART – A**

1. a. With the help of Maxwell's equation, explain how radiation and reception of EM takes place? (06 Marks)  
 b. Explain the following terms as related to antenna system:  
 i) Directivity; ii) HPBW; iii) Effective length; iv) Beam efficiency. (08 Marks)  
 c. Show that the directivity for unidirectional operation is  $2(n+1)$  for an intensity variation of  $u = u_m \cos^n \theta$ . (06 Marks)
2. a. With a neat diagram, obtain an expression for maximum effective aperture of a  $\lambda/2$  dipole. (07 Marks)  
 b. Derive relationship between maximum effective aperture and directivity of an antenna. (08 Marks)  
 c. Find the maximum power received at a distance of 0.75km over free space 110 Mhz circuit consisting of a transmitting antenna of 30dB gain and a receiving antenna of 25dB gain, if the power i/p to the transmitting antenna is 120 watts. (05 Marks)
3. a. Starting from fundamentals derive the equation for radiation resistance of Hertzian dipole. (08 Marks)  
 b. A dipole antenna of length 5cm is operated at a frequency of 100MHz with terminal current,  $I_0 = 120\text{mA}$ . At time,  $t = 1 \text{ sec}$ ,  $\theta = 45^\circ$  and  $r = 3\text{m}$ . Find: i)  $E_\theta$ , ii)  $E_\phi$  and iii)  $H_\phi$ . (08 Marks)  
 c. Calculate the radiation resistance of a dipole of length  $= \lambda/5$ . (Assume triangular current distribution). (04 Marks)
4. a. Derive the far field expressions for small loop antenna. (08 Marks)  
 b. Derive an expression and draw the field pattern for an array of two isotropic point sources with equal amplitude and opposite phase. Take  $d = \lambda/2$ . (08 Marks)  
 c. Find half power beam width and directivity of a linear broadside array of four isotropic point sources of equal strength with  $d = \lambda/2$ ? (04 Marks)

**PART – B**

5. a. Write explanatory note on: i) Folded – dipole antenna; ii) Yagi-uda antenna. (10 Marks)  
 b. Find the length, L, H-plane aperture and flare angles  $\theta_E$  and  $\theta_H$  of a pyramidal horn for which E-plane aperture is  $10\lambda$ . Horn is fed by a rectangular waveguide with  $TE_{10}$  mode. Assume  $\delta = 0.2\lambda$  in E-plane and  $0.375\lambda$  in H-plane. Also find E-plane, H-plane beam widths and directivity. (06 Marks)  
 c. A dish antenna operating at a frequency of 1.43 GHz has a diameter of 64mts and is fed by a directional antenna. Calculate HPBW, BWFN and gain with respect to  $\lambda/2$  dipole with even illumination. (04 Marks)

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- 6 a. Write short notes on: i) Parabolic reflectors; ii) Log – periodic antenna. (12 Marks)
- b. Determine the cut-off frequencies and bandpass of a log periodic dipole array with a design factor of 0.7. Ten dipoles are used in the structure, the smallest having a dimension  $L/2$  equal to 0.3m. (08 Marks)
- 7 a. Define a wave tilt of a surface wave propagation. Also, prove that
- $$\text{Wave tilt, } \alpha = \tan^{-1} \frac{E_n}{E_v} = \tan^{-1} \left[ \frac{1}{\sqrt{\epsilon_r}} \cdot \frac{1}{[1 + x^2]^{1/4}} \right]. \quad (10 \text{ Marks})$$
- b. Derive the expression for resultant field strength at a point due to space wave propagation. (05 Marks)
- c. For a VHF communication link, a 35 watt transmitter is operating at 90MHz. Determine the distance upto which LOS would be possible given that height of the transmitting and receiving antenna are 40m and 25m respectively. Evaluate the field strength at the receiving point. (05 Marks)
- 8 a. Define the following: i) MUF; ii) Critical frequency; iii) Virtual height; iv) Skip distance. (08 Marks)
- b. Calculate the value of the operating frequency of the ionosphere layer specified by refractive index of 0.85 and an electron density  $5 \times 10^5$  electrons/ $\text{m}^3$ . Calculate the critical frequency and MUF of the system with  $\theta_i = 30^\circ$ . (06 Marks)
- c. Calculate the critical frequencies for  $f_1$ ,  $f_2$  and E layers, for which, the maximum ionic densities are  $2.3 \times 10^6$ ,  $3.5 \times 10^6$  and  $1.7 \times 10^6$  elections/ $\text{cm}^3$  respectively. (06 Marks)

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**Sixth Semester B.E. Degree Examination, June / July 2014**  
**Antennas and Propagation**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting  
at least TWO questions from each part.**

**PART – A**

- 1 a. Define the following terms with respect to antenna:  
 i) Gain                      ii) Isotropic radiator                      iii) Beam area                      iv) Radiation resistance. (08 Marks)
- b. Prove that maximum effective aperture for a  $\frac{\lambda}{2}$  antenna is  $0.13\lambda^2$ . (06 Marks)
- c. The effective apertures of transmitting and receiving antennas in a communication system are  $8\lambda^2$  and  $12\lambda^2$  respectively, with a separation of 1.5 km between them. The e.m. wave is travelling with a frequency of 6 MHz and the total I/P power is 25 KW. Find the power received by the receiving antenna. (06 Marks)
- 2 a. Derive an expression for power radiated from an isotropic point source with “sine squared power pattern”. Also find directivity “D” and draw power pattern. (06 Marks)
- b. Find the power radiated and directivity for the unidirectional point sources, having the following point sources power patterns:  
 i)  $U = U_m \cos^2 \theta \sin^3 \phi$ ,  $0 \leq \theta \leq \pi$ ,  $0 \leq \phi \leq \pi$   
 ii)  $U = U_m \sin^2 \theta \sin^3 \phi$ ,  $0 \leq \theta \leq \pi$ ,  $0 \leq \phi \leq \pi$  (06 Marks)
- c. Eight point sources are spaced  $\frac{\lambda}{6}$  apart. They have a phase difference of  $\frac{\pi}{3}$  between adjacent elements. Obtain the field pattern. Also find BWFN and HPBW. (08 Marks)
- 3 a. Show that the radiation resistance of a half wave  $\left(\frac{\lambda}{2}\right)$  dipole antenna is  $73 \Omega$ . (06 Marks)
- b. Write an explanatory note on folded dipole antenna, giving neat figures. (06 Marks)
- c. A magnetic field strength of  $20 \mu A/m$  is required to be produced at a point 2.5 km from the antenna in the broadside plane, in free space. How much power is transmitted by,  
 i) a hertzian dipole, with  $l = \frac{\lambda}{15}$ .  
 ii) a half wave dipole and  
 iii) a monopole antenna. (08 Marks)
- 4 a. Discuss the features of a loop antenna. Derive an expression for the far field components of a loop antenna. (10 Marks)
- b. Explain Babinet's principle with illustrations. Discuss features of complementary antennas, with neat figures. (10 Marks)



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**PART – B**

- 5 a. With a neat figure, explain the working of Yagi-Uda antenna. Write the design formulae for different components, used in Yagi-Uda antenna. Also mention the applications of Yagi-Uda antennas. (08 Marks)
- b. Determine :
- i) The length  $L$  aperture ' $a_H$ ' and half angles in E and H planes for a pyramidal Horn antenna, for which  $a_E = 10 \lambda$ . The horn is fed with a rectangular wave guide in  $TE_{10}$  mode. Let  $\delta = \frac{\lambda}{12}$  in the E-plane and  $\delta = \frac{\lambda}{6}$  in the H-plane.
- ii) Calculate directivity 'D'. (08 Marks)
- c. Write a note on Corner Reflector antenna. (04 Marks)
- 6 a. Write notes on:
- i) Plasma antenna. (08 Marks)
- ii) Embedded antenna. (06 Marks)
- b. With a neat sketch, explain the principle of lens antenna. (06 Marks)
- c. A paraboloid reflector of 2 m diameter is used at 10 GHz. Calculate the beam width between first nulls (BWFN) HPBW and gain in dB. (06 Marks)
- 7 a. Discuss various forms of radio-wave propagation. (08 Marks)
- b. Derive the expression for resultant electric field strength ( $E_R$ ) at a point, due to space wave propagation. (06 Marks)
- c. Derive the expression for 'Line of sight' distance (LOS) between transmitting and receiving antennas. (06 Marks)
- 8 a. A high frequency radio link is to be established between two points on the earth 350 km apart. The reflection region of the atmosphere is at a height of 250 km and has a critical frequency of 8 MHz. Calculate the maximum usable frequency (MUF), for the given path in case of flat earth. (06 Marks)
- b. Define skip distance. Derive an expression for skip distance (D), for a flat earth. (06 Marks)
- c. Define critical frequency. Find the critical frequency for a particular ionospheric layer with  $N_m = 9 \times 10^6 / \text{cm}^3$ . Also find maximum usable frequency (MUF), if the angle of incidence  $\angle i = 60^\circ$ . (08 Marks)

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**Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014**  
**Antennas and Propagation**

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer FIVE full questions, selecting at least TWO questions from each part**  
**2. Draw diagrams wherever necessary.**

**PART – A**

1. a. What is directivity? Obtain the value of beam area in terms of radiation intensity. (05 Marks)  
 b. What is effective length for an antenna? Obtain the value in the case of  $\lambda/2$  dipole. (06 Marks)  
 c. Calculate the exact directivity for the following sources having following power patterns:  
     i)  $U = U_m \cdot \sin^3 \theta \cdot \sin^3 \phi$ .  
     ii)  $U = U_m \cdot \sin \theta \cdot \sin^3 \phi$ .  
     iii)  $U = U_m \cdot \sin^2 \theta \cdot \sin^3 \phi$ .  
     U has value only for  $0 \leq \theta \leq \pi$  and  $0 \leq \phi \leq \pi$  and is zero else where. (09 Marks)
2. a. State and explain power theorems in terms of power density and radiation intensity. (05 Marks)  
 b. Explain the different radiation patterns for an antenna. (07 Marks)  
 c. Derive the expression for the field intensity in the case of 'n' number of isotropic sources with uniform spacing. (08 Marks)
3. a. Obtain the electric field intensity in the case of a thin linear antenna. (10 Marks)  
 b. Calculate the value of radiation resistance in the case of a short dipole. (06 Marks)  
 c. Obtain the value of directivity when two isotropic sources oppositely excited. (04 Marks)
4. a. Explain with neat diagrams different types of slot antenna and its working concept. (08 Marks)  
 b. Obtain the value of impedance of slot antenna in terms of its complementary dipole antenna impedance. (06 Marks)  
 c. Explain Babinet's principle with illustrations. (06 Marks)

**PART – B**

5. a. Explain various types of horn antennas with neat diagrams. (06 Marks)  
 b. Explain the working of a log-periodic antenna with a neat diagram. (08 Marks)  
 c. Determine the cut-off frequencies and band pass of a log-periodic dipole array with a design factor of 0.7. Ten dipoles are used in the structure, the smallest having a dimension equal to  $\frac{l_1}{2} = 0.3 \text{ mtrs.}$  (06 Marks)
6. a. Explain a yagi-uda antenna structure with a neat diagram. (07 Marks)  
 b. Explain lens antenna and find the radius of curvature (R) in the case of a convex lens. (07 Marks)  
 c. A paraboloid reflector of 1.8mtr diameter is used at 6 GHz. Calculate beam width between the nulls and gain in dB. Area factor for dish is 0.65. (06 Marks)

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- 7 a. Derive an expression for field intensity in the case of a space wave propagation. (10 Marks)  
 b. Explain duct propagation. (05 Marks)  
 c. A transmitter radiates 100 watts of power at a frequency of 50MHz in space wave propagation. The transmitting antenna has a gain of 5 and a height of 50mtrs. The receiving antenna height is 2mtrs. It is estimated that a field strength of  $100\mu\text{V}/\text{meter}$  is required to give satisfactory signals at the receiver. Calculate the distance between the transmitting and receiving antennas assuming flat earth. (05 Marks)
- 8 a. Explain the mechanism of ionospheric wave propagation. Also derive an expression for the refractive index of ionosphere. (10 Marks)  
 b. Define the terms: i) Critical frequency and ii) Skip distance for ionosphere with neat diagrams. (05 Marks)  
 c. Calculate the value of frequency at which the electromagnetic wave should be propagated in the D-region. It is given that refractive index  $\mu = 0.5$  and electron density  $N = 10^{12}$  electrons/ $\text{m}^3$ . (05 Marks)

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