Antennas and Propagation VTU CBCS Question Paper Set 2018

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10EC64

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, $I_0 = 120$mA. At time, $t = 1$ sec, $\theta = 45°$ and $r = 3$m. Find: i) E_r; ii) E_θ and iii) H_ϕ. **(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 θ_E and θ_H of a pyramidal horn for which E-plane aperture is 10λ. Horn is fed by a rectangular waveguide with TE_{10} mode. Assume $\delta = 0.2\lambda$ in E-plane and 0.375λ 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)**

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

$$\text{Wave tilt, } \alpha = \tan^{-1}\frac{E_n}{E_v} = \tan^{-1}\left[\frac{1}{\sqrt{\epsilon_r}}.\frac{1}{\left[1+x^2\right]^{1/4}}\right].$$ **(10 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 5×10^5 electrons/m^3. Calculate the critical frequency and MUF of the system with $\theta_i = 30^o$. **(06 Marks)**

c. Calculate the critical frequencies for f_1, f_2 and E layers, for which, the maximum ionic densities are 2.3×10^6, 3.5×10^6 and 1.7×10^6 elections/cm^3 respectively. **(06 Marks)**

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Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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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) $U = U_m \sin^2\theta \sin^3\phi \quad 0 \le \theta \le \pi \quad 0 \le \phi \le \pi$

ii) $U = U_m \cos^n\theta \quad 0 \le \theta \le \pi/2 \quad 0 \le \phi \le 2\pi$ **(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° and 90°. **(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 θ_E and θ_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)**

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 'θ' equal to (i) 30°, (ii) 45°, (iii) 60°. **(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:
   i) Critical frequency
   ii) Virtual height **(06 Marks)**

c. Obtain the relationship between maximum usable frequency (MUF) and skip distance. **(04 Marks)**

8 Write short notes on:

a. Principle of pattern multiplication

b. Scanning array

c. Embedded antennas

d. Ground wave propagation **(20 Marks)**

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10EC64

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 73Ω. **(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 θ 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 $\mu_r = \mu_r' - \mu_r'' = 250 - j2.5$. 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 λ. How many turns of antenna will give a radiation resistance of 36 Ω? **(06 Marks)**

PART – B

5 a. Explain the radiation mechanism of microstrip patch antenna and its characteristics. **(06 Marks)**

b. Determine length ρ of the horn, H – plane aperture and flare angles θ_E and θ_H in (E and H plane) of a pyramidal horn for which E – plane aperture is 10λ. 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)**

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 :
   i) Sleeve antenna
   ii) plasma antenna
   iii) 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 :
   i) optimum working frequency
   ii) 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, Dec.2017/Jan.2018
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 the following with respect to antenna :
   i) Directivity
   ii) Radiation pattern
   iii) Effective aperture
   iv) Antenna field zones. **(08 Marks)**

b. Derive the relation between maximum effective aperture and directivity. **(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 1.5km between them. The electromagnetic wave is travelling with a frequency of 6MHz and the total input power is 25KW. Find the power received by the receiving antenna. **(06 Marks)**

2 a. Derive an expression for the total field and plot the field pattern for two isotropic point sources with same amplitude and equal phase spaced $\lambda/2$ apart. **(08 Marks)**

b. A linear array consists of 4 isotropic point sources. The distance between the adjacent elements is $\lambda/2$. The power is applied with equal magnitudes and a phase difference – dr. Obtain the field pattern and find BWFN (Beam width first Null) and HPBW. **(08 Marks)**

c. What are broadside and End fire arrays. **(04 Marks)**

3 a. A magnetic field strength of $5\mu A/m$ is required at a point on $\theta = \pi/2$, 2km away from an antenna in free space. Neglecting ohmic loss, how much power must the antenna transmit if it is,
   i) A hertzian dipole of length $\lambda/25$?
   ii) A half wave dipole?
   iii) A quarter wave monopole? **(08 Marks)**

b. Derive the radiation resistance of short dipole. **(06 Marks)**

c. Explain basic concept of folded dipole antenna and show how impedance transformation is possible using folded dipole. **(06 Marks)**

4 a. Derive an expression for the far field components of a loop antenna. **(08 Marks)**

b. Show that the radiation resistance of a small loop antenna consisting 'N' turns is given by

$$R_{rad} = 31200\left(\frac{NA}{\lambda^2}\right)^2 \Omega.$$ **(08 Marks)**

c. Write short notes on slot antenna. **(04 Marks)**

PART – B

5 a. Explain with a neat figure the working of a Yagi–uda antenna. Mention the general characteristics and salient features of Yagi – uda antenna. **(10 Marks)**

b. A parabolic dish provides a power gain of 50dB at 10 GHz with 70% efficiency. Find out, i) HPBW ii) BWFN iii) Diameter. **(06 Marks)**

c. Write a note on Lens antenna. **(04 Marks)**

6 a. Write a note on :
i) Ultra wideband antennas
ii) Turnstile antenna. **(08 Marks)**

b. Discuss the design considerations of an antenna used for satellite communications. **(08 Marks)**

c. Discuss briefly about antennas for ground penetrating radar. **(04 Marks)**

7 a. Describe ground wave propagation. **(08 Marks)**

b. Derive an expression for resultant electric field strength (E_R) at a point due to space wave propagation. **(06 Marks)**

c. The transmitting and receiving antennas with heights 50metre and 25metre are used to establish a communication link at 150MHz with 100 watts power of transmission. Determine : i) LOS distance ii) strength of received signal. **(06 Marks)**

8 a. Define Maximum Usable Frequency (f_{MUF}). Derive an expression of f_{MUF} for curved surface of earth. **(08 Marks)**

b. Explain skip distance. Derive an expression for skip distance (D), for flat earth surface. **(06 Marks)**

c. Assume that reflection takes place at a height of 400 km and that the maximum electron density in the ionosphere corresponds to a 0.9 refractive index at 10 MHz. What will be the range for which MUF is 10 MHz? i) for flat earth ii) for curved earth. **(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) $U = U_m \cos^2\theta \sin^3\phi, \quad 0 \le \theta \le \pi, \ 0 \le \phi \le \pi$
ii) $U = U_m \sin^2\theta \sin^3\phi, \quad 0 \le \theta \le \pi, \ 0 \le \phi \le \pi$ **(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 Ω. **(06 Marks)**

b. Write an explanatory note on folded dipole antenna, giving neat figures. **(06 Marks)**

c. A magnetic field strength of 20 μA/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)**

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.

ii) Embedded antenna. **(08 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 Nm = 9×10^6 /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, 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 aperature 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 $0 \le \theta \le \pi$, $0 \le \phi \le \pi$.

ii) $U_m \sin^2\theta \sin^3\phi$; for $0 \le \theta \le \pi/2$, $0 \le \phi \le 2\pi$. **(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_ϕ and H_θ incase of a small loop. **(08 Marks)**

b. The radius of a circular loop antenna is 0.02λ. How many turns of the antenna will give a radiation resistance of 35Ω? **(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°. **(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)**

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, 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 $U = U_m \sin^2\theta \sin^3\phi$; $0 \le \theta \le \pi$; $0 \le \phi \le \pi$. **(05 Marks)**

c. An antenna has a field pattern given by $E(\theta) = \cos\theta \cos 2\theta$ for $0 \le \theta \le 90^\circ$. 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 1Ω. 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)**

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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10EC64

Sixth Semester B.E. Degree Examination, June/July 2017

Antenna 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 term directivity and effective aperture of an antenna. Derive the relation for D in terms of Ae. **(08 Marks)**

b. Define the following parameters of antenna:
i) Beam area
ii) Radiation pattern **(08 Marks)**

c. An antenna has a field pattern given by $E(\theta) = \cos\theta\cos 2\theta$ for $0 \le \theta \le 90°$. Find:
i) The half-power beam width
ii) The beam width between first nulls. **(04 Marks)**

2 a. State and prove the power theorem and explain its application to an isotropic source. **(04 Marks)**

b. The radiation intensity of an antenna is given by $U = U_m \sin^2\theta$ for $0 \le \theta \le \pi/2$ and $0 \le \phi \le 2\pi$. Find the directivity. **(04 Marks)**

c. Explain field and phase pattern. **(05 Marks)**

d. Derive an expression for total field in case of two isotropic points with same amplitude and phase. Plot the relative field pattern when these two isotropic sources are spaced $\lambda/2$ apart. **(07 Marks)**

3 a. Derive the expression for the radiation resistance of short dipole. **(08 Marks)**

b. Show that the radiation resistance of a linear $\lambda/2$ antenna with sinusoidal current distribution is equal to 73Ω. **(08 Marks)**

c. For a short dipole $\lambda/15$ long, find the efficiency, radiation resistance if loss resistance is 1Ω. Find also the effective aperture. **(04 Marks)**

4 a. Derive Far field expressions for small loop antenna. **(08 Marks)**

b. State and explain Babinet's principle. **(06 Marks)**

c. Write notes on patch antenna with applications. **(06 Marks)**

PART – B

5 a. Explain the Yagi-Uda array antenna. **(08 Marks)**

b. Explain the working of log periodic antenna. **(08 Marks)**

c. A 16-turn helical beam antenna has a circumference of λ and turn spacing of $\lambda/4$. What is (i) HPBW, (ii) Axial ratio, (iii) Gain? **(04 Marks)**

6 Write short notes on:

a. Sleeve antenna **(05 Marks)**

b. Antennas for ground penetrating radars (GPR) **(05 Marks)**

c. Ultra wide band antennas **(05 Marks)**

d. Plasma antenna **(05 Marks)**

7 a. Find the approximate formula for the filed strength in VHF propagation and explain how it varies sinusoidally. **(10 Marks)**

b. Explain about the diffraction with two basic models. **(06 Marks)**

c. A VHF communication is to be established at 90 MHz, with the transmitter power of 35 watts. Calculate the LOS communication distance, if the heights of transmitter and receiver antennas are 40 m and 25 m respectively. **(04 Marks)**

8 a. Derive the expression for refractive index of an ionospheric layer. **(10 Marks)**

b. Explain the effects of earth's magnetic field. **(06 Marks)**

c. A HF radio link is established for a range of 2000 km. If the reflection region of the ionosphere is at a height of 200 km and has a critical frequency of 6 MHz. Calculate MUF. **(04 Marks)**

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10EC64

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) $U = U_m \cdot \sin^2\theta \cdot \sin^3\phi$.

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 $0 \le \theta \le \pi$ and $0 \le \phi \le \pi$ 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 exited. **(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 complimentary dipole antenna impedance Z_d. **(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)**

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 100μV/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/m^3. (05 Marks)

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06EC64

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
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 antenna parameters:
i) Radiation resistance ii) Antenna apertures iii) Antenna bandwidth **(12 Marks)**

b. An antenna has field pattern given by $E(\theta) = \cos\theta \cos 2\theta$. Fins the half power beam width. **(04 Marks)**

c. A directional antenna has a maximum electrical dimensions of 50 m and its operating frequency is 100 MHz. A field is measured at 1 km from the antenna. Is it near or far field? **(04 Marks)**

2 a. State and explain power theorem. **(05 Marks)**

b. Explain source with cosine field pattern. **(04 Marks)**

c. Explain non-isotropic but similar point sources and the principle of pattern multiplication. **(07 Marks)**

d. Calculate the directivity in dB for the broad side array as well as end fire array consisting of 8 isotropic elements separated by $\lambda/4$ distance. **(04 Marks)**

3 a. Prove that radiation resistance of the $\lambda/2$ antenna is 73 Ω. **(07 Marks)**

b. Explain folded dipole antenna. **(07 Marks)**

c. Two element array consisting identical radiators carrying equal currents in phase, obtain positions of maxima and minima of the radiation pattern if the distance of separation is $d = x$. **(06 Marks)**

4 a. Derive the radiation resistance of small loop antenna. **(07 Marks)**

b. Derive the expression for impedance of slot antenna. **(07 Marks)**

c. Write notes on horn antenna with applications. **(06 Marks)**

PART – B

5 a. Explain Babinets principle. **(06 Marks)**

b. Derive the impedance for complimentary screen. **(07 Marks)**

c. Write notes on slot antenna with applications. **(07 Marks)**

6 Write short notes on:
a. Yagi-uda array b. Sleeve antennas
c. Antennas for ground penetrating radar (GPR) d. Plasma antenna **(20 Marks)**

7 a. Derive the fundamental equation for free-space propagation and the equation for the electric field strength at the receiving antenna. **(10 Marks)**

b. Derive the expression for line of sight distance. **(06 Marks)**

c. Explain tilting of wave fronts in ground wave propagation. **(04 Marks)**

8 a. Describe structure of ionosphere. **(05 Marks)**

b. Describe mechanism of radio wave bending by the ionosphere. **(05 Marks)**

c. Derive the expression for refractive index of ionosphere assuming there is no collision. **(10 Marks)**

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