148|c

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Reg. No.

Seventh Semester B.E. Degree Examination, February 2002

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All questions carry equal marks.
Any missing data can be suitably assumed.

1. (a) Starting from fundamentals derive the equation for radiation resistance of a Hertzian dipole.

   (b) Briefly explain the following terms w.r.t antenna
   i) HPBW ii) Directivity iii) Effective length iv) Band width **(8 Marks)**

2. (a) A short dipole antenna with hemispherical radiation pattern has average power density.

   $W_{av} = \frac{\hat{r} A_0 Sin^2\theta}{r^2} watts/m^2$ Find

   i) Radiation intensity ii) Maximum radiation intensity iii) Radiated power iv) Directivity **(12 Marks)**

   (b) With the help of mathematical expressions explain the different antenna aperture concepts. **(4 Marks)**

   (c) A half wave dipole is made of copper ($\sigma = 5.7 \times 10^7 S/m$) wire. Determine radiating efficiency at 100 mHz if radius of wire = $3 \times 10^{-4}\lambda$, $R_r = 73\Omega$ for half wave dipole. **(10 Marks)**

3. (a) For the point source with
   i) Sinusoidal and
   ii) Unidirectional cosine squared radiation patterns determine radiated power and directivity. **(6 Marks)**

   (b) Two isotopic point sources of same amplitude and phase are $\lambda/2$ distant apart lies along x-axis symmetric w.r.t origin. Find for field E-pattern, array factor, BWFN, HPBW. **(6 Marks)**

   (c) Briefly explain the concept of pattern multiplication w.r.t. array antennae. **(6 Marks)**

4. (a) Write explanatory note on:
   i) Folded - dipole antenna ii) Yagi-uda antenna **(8 Marks)**

   (b) A dish antenna operating at a frequency of 1.43 aHz has a diameter of 64 metres and is fed by a directional antenna. Calculate HPBW, BWFN and gain w.r.t. $\lambda/2$ dipole with even illumination. **(12 Marks)**

5. (a) Write an explanatory note on matching BALUN. **(8 Marks)**

Contd... 2

(b) Discuss about constructional feature, dimensional considerations, beam width, directivity and applications of horn antenna. (12 Marks)

6. (a) Explain with the help of neat block diagram how antenna impedance is measured using a slotted line. (10 Marks)

(b) Describe any two methods used to measure the gain of an antenna. (10 Marks)

7. (a) How surface wave propagation takes place? Explain. Obtain an equation for the tilt angle (α) of the wave. (10 Marks)

(b) Explain the following terms w.r.t wave propagation

i) Critical frequency ii) MUF iii) Optimum working frequency
iv) Virtual height v) Skip distance (10 Marks)

8. (a) Briefly explain characteristics of different ionized layers in ionospheric propagation. (10 Marks)

(b) What are the various types of fading encountered in radio wave propagation? Explain (10 Marks)

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18 Reg. No.

Seventh Semester B.E. Degree Examination, July/August 2002

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs. [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All questions carry equal marks.
Any missing data can be suitably assumed.

1. (a) Define the following quantities as referred to an antenna.
   i) Radiation pattern.
   ii) Directivity.
   iii) Radiation intensity.
   iv) Radiation resistance.
   v) Effective aperture. (10 Marks)

   (b) Prove that the maximum effective aperture of a short dipole is $0.119\lambda^2$ (5 Marks)

   (c) Determine the directivity of the source described by $U = U_M \, Sin\theta \, Sin^2\phi$, given $O \leq \theta \leq \pi$ *and* $O \leq \phi \leq \pi$. (5 Marks)

2. (a) Derive the expressions for the for field components of a $\lambda/2$ dipole, starting with the expressions for the short dipole. (10 Marks)

   (b) Show that the radiation resistance of a $\lambda/2$ dipole is 73 ohms. (10 Marks)

3. (a) Discuss the effects of earth on radiation patterns of vertical and horizontal dipole antennae. (10 Marks)

   (b) Derive FRII's transmission formula. (5 Marks)

   (c) Find the maximum power received at a distance of 0.75 km over free space 110 MHz circuit consisting of a transmitting antenna of 30 dB gain and a receiving antenna of 25dB gain, if the power input to the transmitting antenna is 120watts. (5 Marks)

4. (a) What is an antenna array? What are the 4-parameters which determine the pattern of an array. (5 Marks)

   (b) Draw the sketch of a helical antenna. Distinguish between the normal mode and the axial mode of operation of helix. (8 Marks)

   (c) An antenna array consists of 4 isotropic antennae spaced $\lambda/2$ and fed with equal currents. Obtain an expression for its array pattern and plot the field pattern. (7 Marks)

5. (a) Discuss the constructional details, features and applications of V antennae and Rhombic antennae. (7 Marks)

   (b) Write an explanatory note on log-periodic antennae. (6 Marks)

Contd.... 2

(c) Describe the procedure and setup for measuring the gain or directivity of a given antenna. (7 Marks)

6. (a) Derive the expression for field strength due to space wave, in terms of the heights of transmitting and receiving antennae and field strength at unit distance. plot the variation of field strength as a function of distance. (10 Marks)

(b) Calculate the radio horizon for a 100 metres transmitting antenna and a receiving antenna of 25 metres. Derive the formula you would use. (10 Marks)

7. (a) Give the structure of ionosphere and explain the mechanism of sky wave propagation. (7 Marks)

(b) Explain the terms (wrt ionospheric propagation).

i) Critical frequency.

ii) Maximum usable frequency.

iii) Skip distance.

iv) Virtual height.

(6 Marks)

(c) Find MUF for a layer with $N_{max} = m10^{12}/m^3$, h=450 km and D=1500 km. Derive the formula used. (7 Marks)

8. Explain the following.

a) Turnstile antenna.

b) Troposcatter propagation.

c) DWT propagation.

d) Huyghen's principle.

(4×5=20 Marks)

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17 Reg. No. | | | | | | | | | | |

Tenth Semester B.E. Degree Examination, January/February 2003

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs. [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All questions carry equal marks.
Any missing data can be suitably assumed.

1. (a) With the help of neat diagrams explain the principle of radiation in antennas. (8 Marks)

   (b) Derive the relationship between beamwidth and directivity of an antenna. (6 Marks)

   (c) Radiation intensity of the major lobe pattern of an antenna is $U = U_0 Cos\theta$, $0 \le \theta \le \frac{\pi}{2}$, $0 \le \phi \le 2\pi$. Find approximate and exact directivity of the antenna. (6 Marks)

2. (a) Briefly explain the following terms w.r.t antenna.
   i) Power gain
   ii) Band width
   iii) Radiation efficiency (9 Marks)

   (b) Find the effective length of a centre fed dipole antenna (Length 'l') having sinusoidal current distribution. (4 Marks)

   (c) State and prove reciprocity theorem as applied to antennas. (7 Marks)

3. (a) Two space crafts are separated by 100 Mega metres. Directivity of each antenna is 1000 operating at 2.5GHz. If craft 'A' receiver requires 20 dB over 1 Pwatts, what transmitter power is required on craft 'B' to achieve this signal level. (6 Marks)

   (b) Synthesize an array having two isotropic point sources of same amplitude but are in phase quadrature separated by a distance of $\lambda/2$ placed symmetric w.r.t. origin. Draw the radiation pattern. (10 Marks)

   (c) Write a note on Hansen Woodyard array. (4 Marks)

4. (a) With an example explain the principle of pattern multiplication. (8 Marks)

   (b) Write explanatory note on :
   i) Parabolic reflectors
   ii) Balun (12 Marks)

5. (a) Explain slotted line method used to measure self impedance of a antenna. (8 Marks)

   (b) Explain important features of
   i) Turnstile antena
   ii) Corner reflector antenna used at VHF and UHF (12 Marks)

Contd... 2

6. (a) Briefly explain surface wave propagation. (6 Marks)

   (b) Derive the equations for optical and radio horizon in space wave propagation. (8 Marks)

   (c) Earth has a conductivity of $5mv$, with relative permittivity 10 at 1 MHz. Find surface wave tilt angle in degrees. (6 Marks)

7. (a) A 85 watt transmitter is operating at 90 MHz over a VHF link. If height of transmitting and receiving antennas are 40 m and 25 m respectively find field strength at the receiving end. (6 Marks)

   (b) Briefly explain any three types of fading in radio wave propagation. (6 Marks)

   (c) What is duct propagation ? Explain. (8 Marks)

8. Write explanatory note on any FOUR.

   a) Babinet's principle

   b) Binomial array

   c) Horn antenna

   d) MUF

   e) Yagi - uda Antenna

(4×5=20 Marks)

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16

USN

Seventh Semester B.E. Degree Examination, June 2008

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs. [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Explain the following as related to antenna systems.
   i) Directivity ii) Beam width iii) Band width
   (b) Find the directivity for the pattern having radiation intensity. (9 Marks)
   $U = U_m Sin^2\Phi \ Sin^2\theta$
   (c) Distinguish between near field and far field of an antenna. (6 Marks)

2. (a) Show that the maximum effective aperture of a $\lambda/2$ dipole is (5 Marks)
   $A_{em} = \frac{3D}{73\pi}\lambda^2$
   (b) What is the maximum power received at a distance 0.5 km over a free space 1 MHz circuit consisting of a transmitting antenna of gain 25 dB and a receiving antenna of gain 20 dB. The gain is with reference to isotropic antenna. The transmiting antenna input power is 150 watts. (6 Marks)
   (c) Obtain the relation between aperture and directivity. (8 Marks)

3. (a) Derive the far-field expressions for a half wave length dipole and plot its radiation pattern. (6 Marks)
   (b) Find the radiation resistance of a Hertzian dipole whose length is $\frac{\lambda}{8}$ (12 Marks)
   (c) The current fed at the centre of a $\frac{\lambda}{2}$ dipole is 2.5 A (RMS). Find the electric field strength in a direction 60^0 from the axis of dipole at the distance 10 km. (3 Marks)

4. (a) Two point sources are spaced half wavelength apart to form an array. Calculate the total field due to this array. The two elements are fed with equal amplitudes and phase difference $\delta = 0$. Sketch the pattern. (5 Marks)
   (b) Distinguish between the broadside and end fire array systems. (7 Marks)
   (c) Obtain the field patterns for a linear uniform array of isotropic antennas, satisfying the following parameters. (5 Marks)
   $n = 5$, $d = \frac{\lambda}{2}$ and $\delta = -d_r$
   Find BWFN and HPBW

5. (a) With a simple analysis show how the field distributes at the aperature of a dielectric lens. (8 Marks)
   (b) A 64 m diameter paraboloid reflector operating at 1450 Mhz has an area factor 0.7. Find the directivity with respect to a $\lambda/2$ dipole. (8 Marks)

Contd.... 2

(c) Determine the cut.off frequency and pass - band of a log-periodic dipole array with a design factor 0.7. The structure consists of 5 dipoles, the least dipole having a dimension 0.6 m (6 Marks)

6. (a) Explain the construction and applications of a turn-stile antenna. (6 Marks)

(b) Write a note on folded dipole. (4 Marks)

(c) Explain any one method of measuring the antenna gain. (10 Marks)

7. (a) Obtain an expression for the space wave field components taking into account a direct wave field components taking into account a direct wave and a reflected wave from earth surface. (8 Marks)

(b) A transmitter radiates 100 watt of power at a frequency 50 MHz, so that a space wave propagation takes place. The transmitting antenna has a gain of 5 and its height is 50 m. The receiving antenna height is 2 m. It is estimated that a field strength of 100 $\mu V/m$ is required to give a satisfactory result. Calculate the distance between transmitter and receiver. (8 Marks)

(c) Estimate the surface wave tilt in degrees over an earth of 12 millimeters conductivity and relative permitivity 20 at a wavelength of 300 m. (4 Marks)

8. (a) Explain the following with reference to ionospheric propagation.

i) Critical frequency

ii) Maximum usable frequency

iii) Skip distance (9 Marks)

(b) Calculate the critical frequency for a medium at which the wave reflects if the maximum electron density is 1.24×10^6 electrons / cm^3 (3 Marks)

(c) Which propagation will aid the following frequencies and why.

i) $120KHz$ ii) $10MHz$ iii) $300MHz$ iv) $30GHz$ (8 Marks)

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Seventh Semester B.E. Degree Examination, January/February 2004

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs.] [Max.Marks : 100

Note: 1. *Answer any FIVE full questions.*
2. *Assume missing data (if any) sensibly.*

1. (a) With the help of Maxwell's equations, explain how radiation and reception of electromagnetic wave take place. (8 Marks)

(b) Define the following terms with respect to antenna.

i) Radiation resistance

ii) Directivity

iii) Effective aperture

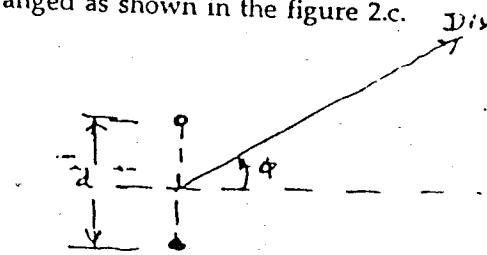
iv) Effective length (6 Marks)

(c) Show that the directivity for a source with a unidirectional pattern given by $U = U_m \cos^n\theta$ is $D = 2(n+1)$. Where U has a value only for $0 \le \theta \le \pi/2$ and $0 \le \Phi \le 2\pi$ and is zero elsewhere. (6 Marks)

2. (a) Derive the expression for the "Array Factor" of an $n-$ element uniform linear array of isotropic point sources with uniform spacing. Discuss the effect of phase difference on the pattern for different numbers of elements. (10 Marks)

(b) Explain the principle of pattern multiplication. (4 Marks)

(c) Obtain the relative $E(\Phi)$ pattern of an array of 2 identical isotropic in - phase joint sources arranged as shown in the figure 2.c. (6 Marks)



Also show that the maxima, nulls and half power points are given by

Maxima $\Phi = sin^{-1}\left[\pm\frac{k\lambda}{d}\right]$ where $k = 0, 1, 2, \ldots$

Nulls $\Phi = sin^{-1}\left[\pm\frac{(2k+1)\lambda}{2d}\right]$

Half power points $\Phi = sin^{-1}\left[\pm\frac{(2k+1)\lambda}{4d}\right]$

3. (a) Starting from the concepts of magnetic vector and electric scalar potentials, derive the expressions for the far-field components of a short dipole. (10 Marks)

(b) Derive the expression for the radiation resistance of a short dipole. (6 Marks)

Contd... 2

(c) Calculate the radiation resistance of a dipole of length $\lambda/5$. (Assume triangular current distribution). (4 Marks)

4. (a) Derive the relationship between the power gain of an antenna and its effective aperture at a given wave length. (7 Marks)

(b) State and prove FRIIS transmission formula. (7 Marks)

(c) Two space crafts A and B are separated by 10^7 metres. Each has an antenna with $D = 1000$ operating at $3GHz$. If craft A's receiver requires a power of 20 dB over $1pW$, what transmitter power is required on craft B to achieve this signal level ? (6 Marks)

5. (a) With the help of a neat diagram explain the working of a Yagi - Uda array. What is the advantage of using a folded dipole ? (7 Marks)

(b) Explain how would you measure the gain of an electromagnetic horn in the laboratory by "Direct comparisson method". (7 Marks)

(c) Calculate the directivity of an antenna which has a half power beam widths of 60^0 and 75^0 in vertical and horizontal planes respectively. Derive the formula used. (6 Marks)

6. (a) Explain with neat sketches the mechanism of ionospheric propagation for HF waves. Derive the expression for the permittivity of the ionized medium as function of electron density and angular frequency. (9 Marks)

(b) Define the terms critical frequency, maximum usable frequency, optimal working frequency and skip distance using suitable diagrams. (6 Marks)

(c) Two points on earth 1000 km apart are to communicate by means of HF signals. Assuming single - hop propagation via ionosphere and the critical frequency is $7\ MHz$, calculate the MUF if the virtual height of the ionization layer is $400km$. (5 Marks)

7. (a) Describe the phenomenon of propagation of higher frequency radio waves through troposphere. Explain the effects of different refractive index profiles on the tropospheric wave used for terrestrial VHF/UHF communications. Use relevant sketches to make your point. (10 Marks)

(b) The antenna height of a TV transmitter is $180m$. Find the distance over which the direct ray converge is possible for a receiving antenna of height $8m$ (assume standard atmosphere). (5 Marks)

(c) Write an explanatory note on "Traposcatter propagation". (5 Marks)

8. Write short notes on :

a) Cassegrain antenna

b) Lens antennas

c) Duct propagation

d) Surface wave propagation. (5 × 4 = 20 Marks)

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(53)

Seventh Semester B.E. Degree Examination, May/June 2004

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs.] [Max:Marks : 100

Note: 1. *Answer any FIVE full questions.*
2. *All questions carry EQUAL marks.*
3. *Any missing data can be suitably assumed.*

1. (a) Show that radiated power of half wave dipole is $\frac{0.609\eta I_m^2}{4\pi}$ with usual notations where I_m is the maximum current and $\eta = 120\pi$. (10 Marks)

   (b) Prove that maximum effective aperture of a short dipole is $0.119\lambda^2$ (5 Marks)

   (c) Derive FRII's transmission formula. (5 Marks)

2. (a) Define the following w.r.t antenna and write their mathematical expression:

   i) Directivity

   ii) Beam efficiency

   iii) HPBW

   iv) Effective Aperture (12 Marks)

   (b) Find radiation resistance of an antenna with unidirectional power pattern given by $U = 8sin^2\theta sin^3\phi$ w/sr where $0^0 \leq \theta \leq 180^0$ and $0^0 \leq \phi \leq 180^0$ if antenna terminal current is $3A$. (8 Marks)

3. (a) Show that total BWFN for an ordinary end fire array is $2\sqrt{BWFN}$ of broadside array. (8 Marks)

   (b) Derive an expression for normalised array pattern of linear array of n isotropic point sources of equal amplitude and spacing. (6 Marks)

   (c) 5 sources have equal amplitude and are spaced $\lambda/4$. Maximum field is to be in line with sources [at $\theta = 0^0$]. Plot the field pattern of array given $\psi = 0$ (6 Marks)

4. (a) Write explanatory notes on:

   i) Yagi - uda - antenna

   ii) Log periodic antenna (10 Marks)

   (b) Explain parabolic reflector antenna highlighting cassegrain feed. Write expressions for HPBW, BWFN and gain. (10 Marks)

5. (a) Write brief notes on:

   i) LF antennas

   ii) HF antennas (10 Marks)

Cont'd...

(b) Explain the method of measuring

i) Gain of an antenna

ii) Impedance of an antenna (10 Marks)

6. (a) Explain with a neat diagram the propagation paths of EM waves for different range of frequencies. (5 Marks)

(b) For a VHF communication link, a 85W transmitter is operating at 90MHz. Determine the distance upto which line of sight communication would be possible, given that the height of the transmitting and receiving antenna are 40m and 25m respectively. Evaluate field strength at the receiving point. (7 Marks)

(c) Explain duct propagation. Explain over what range of frequencies this propagation is observed. (8 Marks)

7. (a) Explain in brief the terms w.r.t ionospheric propagation.

i) critical frequency

ii) MUF

iii) Skip distance

iv) virtual height

v) optimum working frequency. (10 Marks)

(b) If the skip distance for a critical frequency of 1MHz for a layer height of 200m is 10km, what is the MUF? (5 Marks)

(c) Write brief notes on atmospheric effects in space wave propagation. (5 Marks)

8. Write brief notes on any FOUR:

i) Tropospheric scatter

ii) Matching baluns

iii) Medium frequency antennas

iv) Fading of space wave signals

v) Babinet's principle. (4×5=20 Marks)

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EC7T3

USN

Seventh Semester B.E. Degree Examination, January/February 2005

Electronics and Communication Engineering

Antenna and Wave Propagation

Time: 3 hrs. [Max.Marks : 100]

Note: 1. *Answer any FIVE full questions.*
2. *All questions carry equal marks.*
3. *Any missing data can be suitably assumed.*

1. (a) Starting from fundamentals derive the equation for radiation resistance of Hertzian dipole. (8 Marks)

(b) Briefly explain the following terms w.r.t an antenna

i) Radiation efficiency ii) Band width
iii) Physical aperture iv) Gain (12 Marks)

2. (a) State and prove reciprocity theorem as applicable to antennas. (6 Marks)

(b) Derive relationship between maximum effective aperture and directivity of an antenna. (8 Marks)

(c) The normalized electric field of an antenna is $E_n = \sin\theta \sin\phi \ for \ 0 \leq \theta \leq \pi$ and $0 \leq \phi \leq \pi$. Find exact directivity, approximate directivity and dB difference. (6 Marks)

3. (a) Synthesize an array of two isotropic point sources of equal amplitude, separated by $\lambda/2$, symmetric about origin but all in phase quadrature. (10 Marks)

(b) How earth affects vertical radiation pattern of an antenna? Explain. (7 Marks)

(c) Find HPBW & directivity of a linear broad side array of equal strength four isotropic point sources with $d = \lambda/2$. (3 Marks)

4. (a) Write explanatory notes on

i) Folded dipole antenna ii) Matching BALUNS (12 Marks)

(b) Find dB gain, HPBW, BWFN and capture area of a uniform illuminated dish antenna with 6m diameter, dipole fed at 10GHz. Assume antenna aperture efficiency as 0.65. (8 Marks)

5. (a) Find the length 'L', H-plane aperture & flare angles θ_E & θ_H of a pyramidal horn for which E-plane aperture is 10λ. Horn is fed by a rectangular wave guide with TE_{10} mode. Assume $\delta = 0.2\lambda$ in E-plane & $0.375\ \lambda$ in H-plane. Also find E -plane, H-plane beam widths & directivity. (8 Marks)

(b) Explain the principle of measuring the radiation pattern of an antenna. (7 Marks)

(c) In comparison method of gain measurement the power gain of standard horn antenna is 12.5. A large directional AUT is connected to the receiver & it was necessary to introduce attenuator adjusted to 23dB to get the same power output as that of horn antenna. Find the gain of AUT in dB & ratio. (5 Marks)

Contd..... 2

6. (a) Explain the principle of surface wave prorogation. Obtain an equation for tilt angle α of the wave. (12 Marks)

   (b) Calculate the skip distance at a critical frequency of 1MHz for a layer height of 200m if MUF is 25 MHz. (3 Marks)

   (c) What is the value of frequency at which an EMW must be propagated through D layer with an index of refraction of 0.5 & electron density of 3.24×10^{4} electrons/m^3? (5 Marks)

7. (a) Briefly explain characteristics of different ionized layers in ionospheric propagation. (10 Marks)

   (b) Explain different types of fading encountered in radio wave propagation. (10 Marks)

8. Write explanatory notes on any FOUR: (4×5=20 Marks)

   i) Binomial array

   ii) Turnstile antenna

   iii) MUF

   iv) Duct propagation

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NEW SCHEME

EC65

Reg. No.

Sixth Semester B.E. Degree Examination, January/February 2006

Electronics & Communication/Telecommunication Engineering

Antennas and Propagation

Time: 3 hrs.) (Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. All questions carry equal marks.
3. Any missing data can be suitably assumed.

1. (a) Define aperture. Show that maximum effective aperture of a $\lambda/2$ dipole is $0.13\lambda^2$. Also find the directivity. (7 Marks)

(b) Derive Friis transmission formula. (5 Marks)

(c) Prove that directivity for a source with a unidirectional power pattern given by $U = U_m cos^n\theta$ can be expressed as $D_n = 2(n+1)$. U has a value for $0 \leq \theta \leq 90^0$. The patterns are independent of azimuth angle. (8 Marks)

2. (a) Find the relative $E(\phi)$ pattern of an array of two identical isotropic in phase point sources arranged as shown in figure. Also find the expressions for maxima, nulls and half power points.

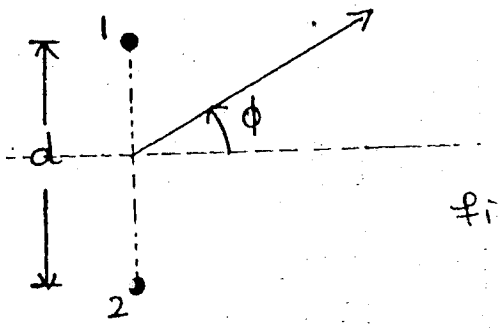

fig Q2 (a)

(8 Marks)

(b) For a Broadside array of n isotropic point sources of equal amplitude and spacing, show that $\phi_0 = arc\ cos\left(\pm\frac{kA}{nd}\right)$, where ϕ_0 gives the null directions. Find null directions for an array of 4 isotropic point sources with $\lambda/2$ spacing. (6 Marks)

(c) State and explain the principle of pattern multiplication. Calculate and plot the field pattern of an array of two nonisotropic dissimilar sources for which the total field is given by

$$E = cos\phi + sin\phi \angle \underline{\psi}$$

Contd.... 2

where $\psi = d\cos\phi + \delta = \frac{\pi}{2}(\cos\phi + 1)$

Take source 1 as reference as shown in figure. (6 Marks)

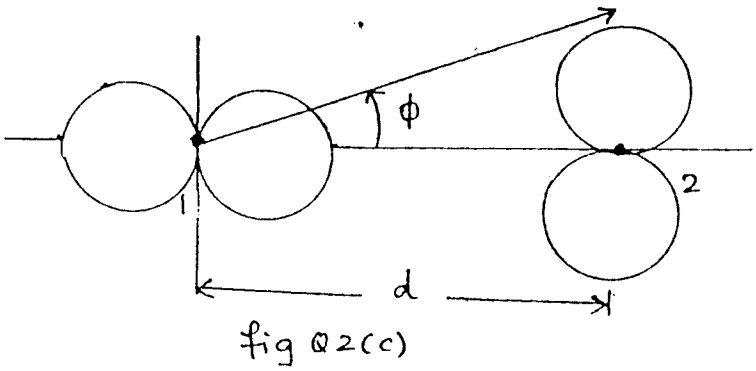

fig Q2(c)

3. (a) Starting from the fundamentals derive the expressions for the far field components of thin linear antenna. (8 Marks)

(b) A dipole antenna of length 5cm is operated at a frequency of $100MHz$ with a terminal current $I_0 = 120mA$ at $t = 1sec$, $\theta = 45^0$ and distance $r = 3m$.
Find i) i) E_θ ii) H_ϕ (6 Marks)

(c) Using Poynting vector integration, show that the radiation resistance of a small loop is equal to $320\pi^4\left(\frac{A}{\lambda^2}\right)^2\ \Omega$. (6 Marks)

4. (a) Describe a helical antenna : Discuss the properties of two modes of operation. Explain how linearly polarised radiation may be obtained using helical antenna. (8 Marks)

(b) Design a Yagi-Uda six element antenna for operation at $500MHz$ with a folded dipole feed. What are the lengths of

i) reflector element

ii) driven element

iii) four director elements ?
What is spacing

iv) between reflector and driven element and

v) between director elements ? (6 Marks)

(c) How is slot antenna excited ? Give some typical applications of slot antenna. (6 Marks)

5. (a) Show that the field intensity ratio in the aperture plane of a cylindrical parabolic reflector is $\sqrt{\frac{1+\cos\theta}{2}}$. (8 Marks)

Contd.... 3

(b) Explain in detail the log periodic antenna What are their advantages? **(8 Marks)**

(c) What is the approximate directivity of a rectangular horn antenna, whose physical aperture is $81\lambda^2$? **(4 Marks)**

6. (a) Show that radius of curvature of path is a function of the rate of change of dielectric constant with height. **(8 Marks)**

(b) Find the approximate formula for the field strength in VHF propagation. **(8 Marks)**

(c) Two aircrafts are flying at altitudes of $3km$ and $6km$ respectively. What is the maximum possible distance along the surface of the earth overwhich they can have effective point to point communication? **(4 Marks)**

7. (a) Obtain the expression for refractive index of the ionosphere in the case of ionospheric propagation. **(8 Marks)**

(b) Define maximum usable frequency (MUF). Find an expression to calculate MUF. **(5 Marks)**

(c) What is meant by critical frequency of ionospheric layer ? Develop an expression for critical frequency.

Calculate electron density required to a return signal at $12MHz$ incident on the bottom of the layer at an angle 26^0 to the normal. **(7 Marks)**

8. Write short notes on :

a) Babinet's principle

b) Skip distance

c) Embedded antenna

d) Plasma antenna **(4×5=20 Marks)**

EC65

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2006
EC/TC
Antenna and Propagation

Time: 3 hrs.] [Max: Marks:100

Note: *1. Answer any FIVE full questions.*
2. Assume any missing data suitably.

1 a. Explain the following parameters of an Antenna:
i) Beam solid angle ii) Directivity
iii) Effective height iv) Half power beam width. **(12 Marks)**
b. Derive Friis transmission formula for an antenna. **(05 Marks)**
c. A radio link has 100 W transmitter connected to an antenna of 2.5 m^2 effective aperture at 5 GHz. The receiving antenna has an effective aperture of 0.5 m^2 and is located at a 15 km LOS distance. Find the power delivered to the receiver. **(03 Marks)**

2 a. State and explain Power Theorem and its applications to an isotropic source. **(05 Marks)**
b. Derive an expression and draw the field pattern for two isotropic point sources of the same amplitude but opposite phase. **(07 Marks)**
c. Show that the width of the principle lobe of a uniform end – fire array is greater than that of a uniform broad-side array of the same space. **(08 Marks)**

3 a. Derive an expression for Radiation-Resistance of a short electric dipole. **(08 Marks)**
b. Considering both general and special cases, derive an expression for Far-Field patterns for a loop antenna. **(08 Marks)**
c. Find the radiation efficiency of a 1 m diameter loop [C = π m] of 10 mm – diameter copper wire at 10 MHz. **(04 Marks)**

4 a. Explain the practical design considerations for the monofilar axial mode Helical Antenna. **(10 Marks)**
b. A 16-turn helical beam antenna has a circumference of λ, and turn spacing of λ/4. What is i) HPBW ii) axial ratio iii) gain and iv) power pattern? **(05 Marks)**
c. Design a Yagi - Uda Six element antenna for operation at 300 MHz with a folded dipole feed. Calculate the length of i) Reflector ii) Driven element iii) Four director element iv) Spacing between reflector and driven element v) Spacing between director element. **(05 Marks)**

5 a. Explain with examples the different types of rectangular and circular horn antennas. What are their advantages over the other antennas? **(10 Marks)**
b. State and explain Rumsey's principle for frequency-independent antenna. **(04 Marks)**
c. Write a brief note on Embedded and Plasma antennas. **(06 Marks)**

6 a. Discuss the antennas used for terrestrial mobile communication system. **(10 Marks)**
b. Explain with suitable expression and diagrams the need of UWB antennas for digital applications. **(10 Marks)**

7 a. Explain with a neat diagram some of the possible propagation paths. **(10 Marks)**
b. Find the approximate formula for the field strength in VHF propagation. **(10 Marks)**

8 a. What is the procedure for experimental determination of critical frequencies and virtual heights? **(08 Marks)**
b. Define and find the expression to calculate maximum usable frequency (MUF). **(04 Marks)**
c. Explain the phenomenon of Faraday Rotation and how measurement of total electron content is done for an ionospheric propagation. **(08 Marks)**

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EC65

USN

(48)

NEW SCHEME

Sixth Semester B.E. Degree Examination, Dec. 06 / Jan. 07
EC / TC
Antenna and Propagation

Time: 3 hrs.] [Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Discuss the following terms as applied to antennas :
   i) Radiation resistance
   ii) Isotropic radiation
   iii) Effective height
   iv) Directivity and gain
   v) Beam width. **(10 Marks)**

b. Distinguish between near field and far field as applied to radiating element. **(05 Marks)**

c. A small dipole antenna carrying a uniform rms current of 10A is having a far zone rms field at a distance 'r' meter in a direction making an angle θ with the conductor given by $E = \frac{200\pi}{r}\sin\theta$ V/m. Find the total radiated power. **(05 Marks)**

2 a. State power pattern theorem and explain. Discuss its applications. **(06 Marks)**

b. Show that the directivity for unidirectional operation is 2(n+1) for an intensity variation of $U = U_m \cos^n\theta$. **(06 Marks)**

c. Calculate the directivity for an intensity variation of $U = U_m \sin^2\theta \sin^3\phi$ $0 \le \theta \le \pi/2$, $0 \le \phi \le 2\pi$. Using :
   i) Exact method
   ii) Approximate method. **(08 Marks)**

3 a. Discuss the fields of short dipole with respect to spherical co-ordinate system. Derive mathematical relations. **(10 Marks)**

b. Calculate the maximum effective aperture of a short dipole. **(04 Marks)**

c. Show that radiation resistance of $\lambda/2$ - antenna is 73 ohms. **(06 Marks)**

4 a. Explain the different types of apertures and their inter-relationships. **(08 Marks)**

b. Explain Hansen and Woodyard array. **(08 Marks)**

c. For an 8 element array with equal spacing of 0.7λ and fed with equal amplitude and phase, find the approximate gain and FNBW. **(04 Marks)**

5 a. Explain Babinet's principle with illustrations. Discuss features of complementary antenna.

b. Write explanatory note on frequency independent antenna.

c. Calculate horn parameters i)length 'L' ii)flare angle 'θ' iii)flare angle 'ϕ' iv)width 'a' if mouth height 'b' is 10λ and the horn is fed by a rectangular waveguide with TE_{10} mode.

Contd.... 2

6 a. Discuss the features of Antenna for Ground Penetrating Radar (GPR). **(06 Marks)**

b. Explain the structure of Ionosphere. **(08 Marks)**

c. Obtain the field at a distance of 60 km from a transmitter of frequency 2 MHz radiating 200 W from a vertical half wave aerial over earth with $\varepsilon = 12$ and $\sigma = 5 \times 10^{-3}$ mho/m (assume attenuation factor K = 0.02). **(06 Marks)**

7 a. Derive simplified formula for VHF propagation. **(06 Marks)**

b. Derive an expression for refractive index in case of Ionosphere. **(08 Marks)**

c. For a VHF communication link, a 85 Watt transmitter is operating at 90 MHz. Determine the distance up to which line of sight communication would be possible given that the height of the transmitting and receiving antenna are 40 m and 25 m respectively. Evaluate the field strength at the receiving point. **(06 Marks)**

8 Write short note on any four :

a. Parabolic reflector

b. Duct multiplication

c. Pattern multiplication

d. Helical antenna

e. Loop antenna

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

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EC65

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2007
EC / TE
Antennas and Propagation

Time: 3 hrs.] [Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. Explain the following as related to antenna systems:
i) Directivity.
ii) Beam width.
iii) Band width. **(09 Marks)**

b. Find the power density at a distance 3 km from an isotropic source if the power density at a distance 2 km is 10 mwatts/sq.units. **(05 Marks)**

c. obtain an expression for maximum effective aperture for $\lambda / 2$ dipole. **(06 Marks)**

2 a. Find the directivity for an intensity variation,

$$U = U_m \sin\theta \sin^2\phi$$

where θ and φ ranges between 0 and π. **(05 Marks)**

b. Two vertical short dipoles are separated by a distance $\lambda / 3$. The power is applied with equal magnitudes having a phase difference $\pi / 3$. Obtain the field pattern and find the beam width. **(07 Marks)**

c. Four isotropic antennas are placed along a straight line separated by a distance $\lambda / 2$. The power is applied with equal magnitudes. The peak should be in a direction 60° from the axis of the array. Find the phase difference between adjacent elements. Complete the pattern and find BWFN and HPBW. **(08 Marks)**

3 a. Starting from magnetic and electric potentials, obtain the far electric fields for a short dipole. **(08 Marks)**

b. A 2-m long vertical wire carries a current of 5 A at 1 MHz. Find the field strength at 30 km in a direction at right angles to the axis of the wire, assuming the wire is situated in free space. **(06 Marks)**

c. A half wave dipole radiating in free space is driven by a current of 0.5 amps at the terminals. Calculate the electric field strength E at a distance 1 km from the antenna at angles 45° and 90°. **(06 Marks)**

4 a. Obtain the field components for small loop antenna. **(08 Marks)**

b. Show how a helical antenna can be used as polarization diversity system. **(06 Marks)**

c. A helical antenna has 10 turns, 100 mm diameter and 70 mm turn spacing. The operating frequency is 1 GHz. What is the directivity and the polarization state. **(06 Marks)**

5 a. A 64 m diameter dish antenna operating at a frequency of 1.43 GHz is fed by a nondirectional antenna. Calculate its
i) HPBW.
ii) BWFN.
iii) Gain with respect to $\lambda/2$ dipole assuming even illumination. **(06 Marks)**

5 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 $\frac{1}{2}$ equals to 0.3 m. (09 Marks)

c. Write a note on corner reflectors. (05 Marks)

6 Write short notes on any three of the following:
a. Log periodic antennas.
b. Pattern multiplication principle.
c. Horn antenna.
d. Yagi-Uda array. (20 Marks)

7 a. Define the following as related to ionospheric propagation:
i) Maximum usable frequency.
ii) Critical frequency.
iii) Virtual height. (06 Marks)

b. Discuss the propagation characteristics of radio waves in the frequency range 200 kHz to 200 MHz. (14 Marks)

8 a. Derive the expressions for conductivity and relative permittivity for ionosphere layers. (08 Marks)

b. A HF radio link is established for a range of 2000 km. If the reflection region of ionosphere is at a height 200 km and has a critical frequency of 6 MHz, calculate MUF. (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)

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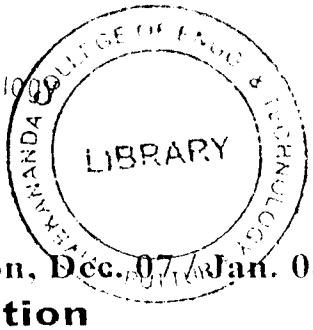

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EC65

Sixth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. Define the terms Normalized field pattern, Beam efficiency, Aperture efficiency, Directivity, Effective height of an antenna. (15 Marks)
b. Write brief notes on – Antenna Field Zones. (05 Marks)

2 a Derive the expression for total field, in case of two isotropic point sources with same amplitude and opposite phase. Plot the relative field pattern when these two isotropic sources are spaced $\frac{\lambda}{2}$ apart. (10 Marks)
b. Find the directivity for the source with sine – squared (Doughnut) power pattern. (05 Marks)
c. Illustrate the principle of pattern multiplication with suitable example. (05 Marks)

3 a. Derive the expression for Array factor in case of linear array of 'n' isotropic point sources of equal amplitude and spacing. (10 Marks)
b. Derive the expression for radiation resistance of short dipole with uniform current. (10 Marks)

4 a. Derive the expression for instantaneous electric field and magnetic field at a large distance 'r' from a loop antenna of radius 'a'. (15 Marks)
b. Compare the far fields of small loop and a short dipole. (05 Marks)

5 a. Give the brief account of design considerations of Log – periodic Array. (10 Marks)
b. State and explain Rumsey's principle. (05 Marks)
c. "Helical antennas are indispensable for space communication applications". Justify the statement in brief. (05 Marks)

6 a. Describe the important features of Pyramidal Horn Antenna. (10 Marks)
b. Write notes on i) Adaptive base station antennas of terristrial mobile communications ii) Whip antennas. (10 Marks)

7 a. Discuss the salient features of ground wave propagation. (10 Marks)
b. Distinguish between E – layer and Sporadic E – layer of ionosphere. (05 Marks)
c. What are the effects of earth's magnetic field on propagation of radio waves through the ionosphere? (05 Marks)

8 a. Explain the following terms in connection with sky wave transmission and indicate briefly the factors on which they depend : i) Maximum usable frequency ii) Critical Frequency iii) Skip distance. (15 Marks)
b. Distinguish between Virtual height and Actual heights of an ionized layer. (05 Marks)

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06EC64

Sixth Semester B.E. Degree Examination, June-July 2009
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define: i) Radiation intensity ii) Power density derive their relation. **(06 Marks)**

b. State and prove reciprocity theorem for antennas. **(06 Marks)**

c. Determine the directivity of the system if the radiation intensity
i) $U = U_m \cos^3\theta$ ii) $U = U_m \sin\theta \sin^2\phi$. **(08 Marks)**

2 a. Derive an expression for maximum effective Aperture, A_{em}. Also show that A_{em} of $\frac{\lambda}{2}$ dipole is $0.13\lambda^2$. **(10 Marks)**

b. Derive a relation that relates total received power and total transmitted power in terms of directivities. **(06 Marks)**

c. If 'P' is power radiated and 'G' is gain of the antenna, then show that $E = \frac{(30PG)^{1/2}}{r}$. **(04 Marks)**

3 a. Derive an expression for array factor of an array of N–isotropic sources. **(08 Marks)**

b. A Linear antenna consists of 4 – isotropic sources. The distance between adjacent elements is $\frac{\lambda}{2}$. The power is applied with equal magnitudes and a phase difference –dr. Obtain the field pattern and find HPBW. **(08 Marks)**

c. Explain the principle of pattern multiplication. **(04 Marks)**

4 a. Derive the expressions for the field components of a short dipole starting with expressions of electric potential and vector magnetic potential. Also determine the far field components. **(14 Marks)**

b. Derive an expression for radiation resistance of a short-dipole. **(06 Marks)**

PART – B

5 a. Derive the expressions for the field strengths E_ϕ and H_θ in case of small loop. **(10 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? **(05 Marks)**

c. Explain the necessity of flaring of walls of waveguide in case of Horn antennas. **(05 Marks)**

6 a. Describe a Helical Antenna. Explain its two modes of operation with relevant expressions. **(12 Marks)**

b. Explain the operation of log-periodic antennas. **(05 Marks)**

c. List the merits and demerits of lens antenna. **(03 Marks)**

7 a. Derive an expression for space wave field intensity and show that it varies sinusoidally. **(10 Marks)**

b. Explain Duct propagation. **(06 Marks)**

c. Find the maximum range of a tropospheric transmission for which transmitting antenna height is 100 ft and receiving antenna height is 50ft. **(04 Marks)**

8 a. Explain the mechanism of Ionospheric propagation. Also derive an expression for the refractive index of an Ionospheric layer. **(10 Marks)**

b. Discuss the effect of Earth's magnetic field on Ionospheric propagation. **(06 Marks)**

c. A high frequency radio link has to be established between two points on the earth 200 km away. The reflection region of the ionosphere is at a height of 200 km and has a critical frequency of 6 MHz. Calculate the MUF for the given path in case of flat earth. **(04 Marks)**

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06EC64

Sixth Semester B.E. Degree Examination, Dec.09-Jan.10
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Assume any missing data suitably.

PART – A

1 a. Define the term antenna aperture. Derive the equation for directivity in terms of aperture. **(06 Marks)**

b. Explain the following terms with respect to antenna :
i) Field zones ii) Effective height. **(08 Marks)**

c. A lossless resonant $\lambda/2$ dipole antenna having an input impedance of 73 Ω is to be connected to a transmission line having characteristic impedance of 50 Ω. The pattern of the antenna is given by $u = u_o \sin^3\theta$. Find the overall gain of the antenna. **(06 Marks)**

2 a. For $\lambda/2$ dipole antenna derive an expression for effective aperture and obtain the value of directivity. **(08 Marks)**

b. State and explain power theorem and its application to point sources. **(04 Marks)**

c. For a source having radiation intensity $u = u_m \sin\theta \sin^2\phi$, find the directivity by
i) Exact method ; ii) Approximate method. **(08 Marks)**

3 a. Prove that the width of main lobe of uniform end-fire array is broader than that for a uniform broad side array. **(08 Marks)**

b. Explain the principle of pattern multiplication. **(04 Marks)**

c. Obtain the field pattern for a linear uniform array of 6 isotropic point sources spaced $\lambda/2$ distance apart. The power is applied with equal amplitude and in phase. Also find HPBW and FNBW. **(08 Marks)**

4 a. Derive far-field equations for a thin linear center fed antenna of length L. **(08 Marks)**

b. A thin linear dipole antenna is $\lambda/12$ long and its loss resistance is 1.2 Ω. Find the radiation resistance and efficiency. **(04 Marks)**

c. Write notes on i) Rhombic antenna ii) Folded dipole antenna. **(08 Marks)**

PART – B

5 a. Considering general case derive the far field equations for loop antenna. **(08 Marks)**

b. Explain Babinet's principle with illustration. **(04 Marks)**

c. Derive the equation for impedance of a slot antenna in terms of the impedance of the complementary dipole antenna. **(08 Marks)**

6 a. Explain the following design parameters of a helical antenna :
   i) Beam width
   ii) Axial ratio
   iii) Impedance. **(06 Marks)**

b. Explain in detail the log-periodic dipole array. **(06 Marks)**

c. Write notes on i) Antennas for ground penetrating radar ; ii) Ultra wide band antennas. **(08 Marks)**

7 a. A free space line of sight microwave link operating at 10 GHz consists of a transmit and a receive antenna each having a gain of 25 dB. The distance between the two antennas is 30 kmt and the power radiated by the transmit antenna is 10 W. Calculate the path loss of the link and the received power. **(06 Marks)**

b. An antenna located at the surface of the earth is used to receive the signals transmitted by another antenna located at a height of 80 mt from the spherical surface of the earth (mean radius = 6370 kmts). Calculate the optical and radio horizon if dN/dh = -39 / kmt. **(06 Marks)**

c. In troporpheric propagation, show that radius of curvature of path is a function of the rate of change of dielectric constant with height and explain the duct propagation of wave. **(08 Marks)**

8 a. For ionospheric layers, derive the expression for conductivity and relative permittivity as a function of electron density and angular frequency. **(08 Marks)**

b. Define the terms
   i) Critical frequency f_c
   ii) Skip distance D_{Skip}
   iii) Maximum usable frequency f_{MUF}.
   Obtain the relation for skip distance in terms of f_c and f_{MUF}. **(08 Marks)**

c. Ionospheric wave is reflected from E layer with virtual height 100 kmt and from F layer with virtual height 300 kmt. Determine the single loop distance for each layer. **(04 Marks)**

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06EC64

Sixth Semester B.E. Degree Examination, May/June 2010
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following with respect to antenna:
i) Isotropic radiator
ii) Directivity
iii) Radiation pattern
iv) Polarization. **(10 Marks)**

b. Antenna of gain G radiates Wt. Watts. Show that the free space intensity E at a distance of r metres is given by $E = \frac{\sqrt{30wt.G}}{r}$ v/m. **(05 Marks)**

c. Derive an expression for antenna efficiency in terms of radiation resistance. **(05 Marks)**

2 a. Find the directivity and beam width of the following :
i) $U = U_m \sin\phi \cos^2\theta$ ii) $U = U_m \cos\phi \sin^2\theta$. **(10 Marks)**

b. State and prove the power theorem. **(05 Marks)**

c. Prove that $D = 2(n+1)$ for a unidirectional pattern given by $U = U_m \cos^n\theta$. **(05 Marks)**

3 a. Derive an expression for field intensity for two isotropic point sources with equal amplitude and equal phase. **(10 Marks)**

b. Draw the polar diagram of a broadside array with number of elements = 5 and spacing = $\lambda/2$. **(10 Marks)**

4 a. Derive an expression for radiation resistance of a short electric dipole. **(10 Marks)**

b. Write short notes on :
i) Folded dipole antenna ; ii) Thin linear antenna. **(10 Marks)**

PART – B

5 a. Discuss the features of a loop antenna. Derive an expression for far field components of a loop antenna. **(10 Marks)**

b. Write notes on : i) Horn antenna ; ii) Slot antenna. **(10 Marks)**

6 a. Discuss the features of an helical antenna. Give the construction details of the helical antenna. **(10 Marks)**

b. What are parabolic reflectors? Where these antennas are used? **(05 Marks)**

c. Draw the construction details of an embedded antenna. **(05 Marks)**

7 a. Discuss the different forms of radio wave propagation. **(10 Marks)**

b. Derive an expression for wave tilt of surface wave. **(10 Marks)**

8 a. Explain different layers of ionosphere in detail. **(10 Marks)**

b. Define the following with respect to wave propagation :
i) Critical frequency ; ii) MUF ; iii) Virtual height ; iv) Skip distance. **(10 Marks)**

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