NEW SCHEME

EC65

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Sixth Semester B.E. Degree Examination, July/August 2005

Electronics and Communication Engineering

Antenna & Propagation

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

Note: *Answer any FIVE full questions.*

1. (a) Explain the following terms as referred to a radiation element so as to highlight the effectiveness.

   i) Beam area ii) Beam efficiency iii) Effective aperture iv) Directivity **(12 Marks)**

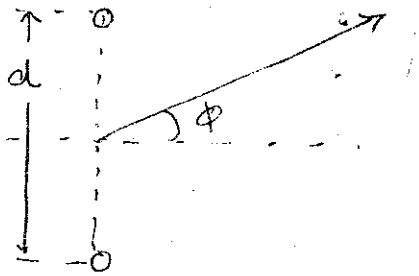
   (b) Calculate the maximum power received at a distance of 0.5km over a free space 1 GHz circuit consisting of a transmitting antenna with 25 dB gain and a receiving antenna gain of 20 dB. Assume the transmitting antenna input is 150 watts. **(8 Marks)**

2. (a) State and explain the power pattern theorem. **(4 Marks)**

   (b) Explain field and phase patterns. **(6 Marks)**

   (c) Show that the relative $E(\Phi)$ pattern of an array of two identical isotropic point sources arranged as shown in the fig. is given by $E(\Phi) = cos\left[\left(\frac{dr}{2}\right)\ sin\phi\right]$ where $dr = \frac{2\pi d}{\lambda}$

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



   Maxima : $\Phi = sin^{-1}\left[+\frac{k\lambda}{d}\right]$

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

   Half power points : $\Phi = sin^{-1}\left[\pm\frac{2k+1}{4d}\ \lambda\right]$ **(10 Marks)**

3. (a) Explain the term linear array and bring out the properties of broad-side and end-fire arrays. Sketch the directional pattern for these arrays. **(6 Marks)**

   (b) Using the principle of pattern multiplication show that a linear array with binomial amplitude distribution has a pattern with no minor lobes. **(8 Marks)**

Contd.... 2

(c) Show that the HPBW of a long uniform broad side array is given by $50.8^0/(L/\lambda)$ (6 Marks)

4. (a) Show that the electric field pattern of a thin linear antenna of length $L = \lambda/2$ is given by

$$E = \frac{cos[\pi/2 \cdot cos\theta]}{sin\theta}$$ (3 Marks)

(b) Show that the radiation resistance of a small loop antenna consisting of (n) terms is given by

$$R_r = 31.200 \left(n \cdot \frac{A}{\lambda^2}\right)^2 \ \Omega$$ (6 Marks)

(c) Calculate the maximum effective aperture of a thin loop antenna 0.1λ in diameter with a uniform in-phase current distribution. (6 Marks)

5. (a) Explain the important design considerations for the monofilar axial mode helical antenna. (12 Marks)

(b) A right handed monofilar helical antenna has 10 turns, $10mm$ dia and $70mm$ turn spacing. Calculate the far field pattern at $f = 1GHz$ and HPBW, gain. (8 Marks)

6. (a) Write a brief note on the following types of antenna

i) Slot antenna ii) Log periodic antennas (10 Marks)

(b) The normalized field pattern $E(\Phi)$ for a rectangular aperture is given by

$$E(\Phi) = \frac{2\lambda}{\pi D} \cdot \cdot \frac{J_1\left[\frac{\pi D}{\lambda} \cdot sin\Phi\right]}{sin\Phi}$$

Starting from the above equation obtain the expressions for the beam width between first nulls (BWFN) for circular aperture and for rectangular aperture. (10 Marks)

7. (a) Discuss briefly the design considerations of an antenna used for satellite communication. (10 Marks)

(b) Explain the phenomenon of ground wave propagtion over an imperfect earth. (10 Marks)

8. (a) Explain the term critical frequency with reference to ionospheric propagation and obtain an expression for the same. (6 Marks)

(b) Explain a method to determine the critical frequency and the virtual height of an ionospheric layer. (8 Marks)

(c) Calculate the maximum usable frequency for ionospheric propagation assuming the maximum electron density is (5×10^6) electrons/c.c and the signals are reflected by the F-layer at a height of 140 km. (Assume the radius of earth as 3500 km.) (6 Marks)

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EC65

NEW SCHEME

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.

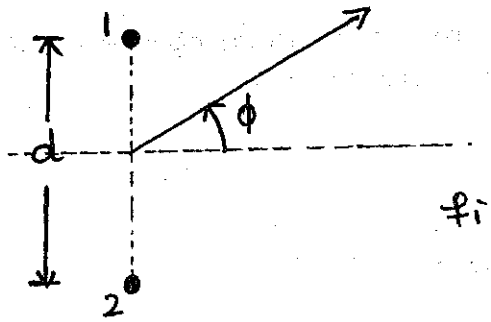

fig Q2(a)

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

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

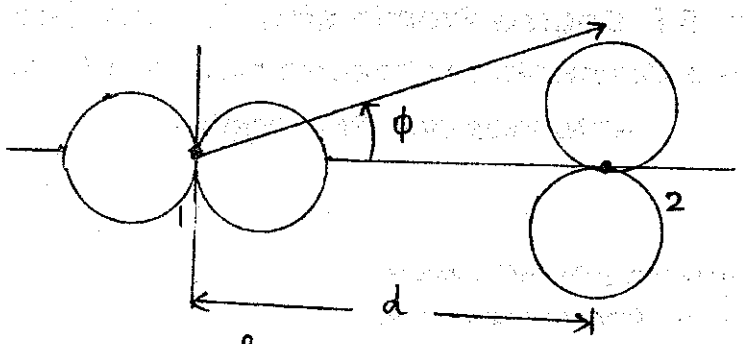

fig Q2(c)

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)**

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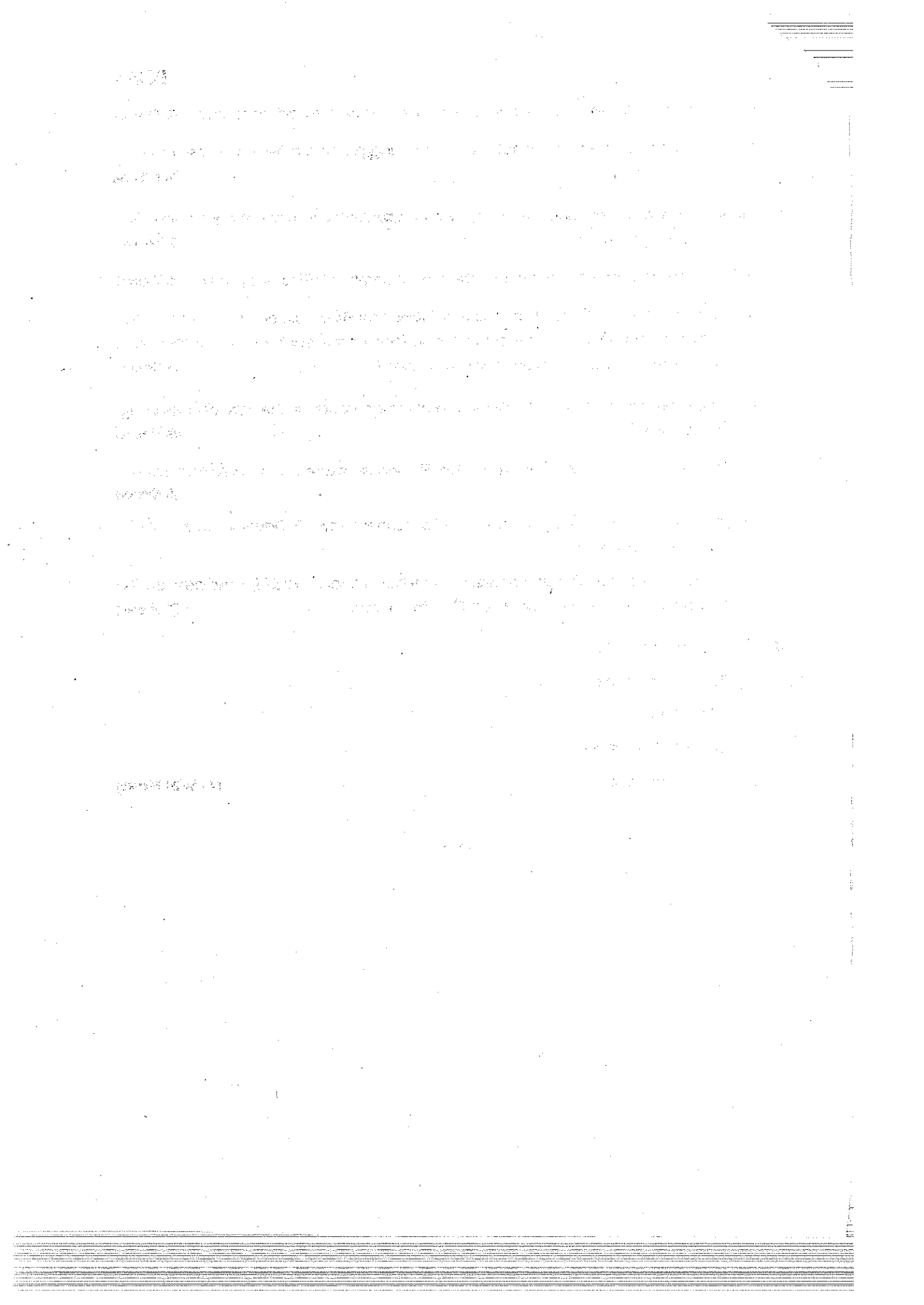

EC65

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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 $\lambda/4$. 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

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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

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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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EC65

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

e: 3 hrs. Max. Marks:100

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

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)**

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)**

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)**

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)**

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)**

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)**

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)**

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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EC65

Sixth Semester B.E. Degree Examination, June/July 08
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

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

1 a. Explain the following terms as related to antenna systems:
i) Directivity ii) Half power beam width iii) Beam efficiency. **(09 Marks)**

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

c. A radio link has 150 watts transmitter connected to an antenna of 2 m^2 aperture at 2 GHZ. The receiving antenna has an aperture of 1.5 m^2 and is located at 10 km. Find the power delivered to the receiver. **(05 Marks)**

2 a. Find the total power radiated and directivity for an isotropic point source with unidirectional cosine squared power pattern. Also show the pattern. **(06 Marks)**

b. Derive an expression and draw the field pattern for an array two isotropic point sources with equal amplitude and opposite phase. **(06 Marks)**

c. Four isotropic point sources separated by $\lambda/2$ are placed along a straight line in a broadside fashion. Draw the field pattern. Also find BWFN and HPBW. **(08 Marks)**

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

b. A dipole antenna of length 5 cm is operated at a frequency of 100 MHz with terminal current, I_o = 120 mA. At time t = 1sec, $\theta = 45^0$ and r = 3m, find i) Er ii) E_θ iii) $H\varphi$ **(08 Marks)**

c. With a neat figure, write the far – field equations for a thin linear antenna. **(04 Marks)**

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

b. Derive the expression for radiation resistance of small loop antenna. **(08 Marks)**

c. Find the radiation efficiency of a 1m dia loop (c = π m) of 10 mm diameter copper wire at i) 1 MHz ii) 10 MHz. **(04 Marks)**

5 a. Explain the practical design considerations for the monofilar axial mode Helical antenna **(10 Marks)**

b. Determine
i) The length L. aperture a_H and half angles in E and H planes for a pyramidal e.m horn for which the aperture $a_E = 8\lambda$. The horn is fed with a rectangular waveguide with TE_{10} mode.
Take $\delta = \frac{\lambda}{10}$ in the E – plane and $\delta = \frac{\lambda}{4}$ in the H – plane.
ii) What is directivity? iii) What is the aperture efficiency? **(10 Marks)**

6 Write short notes on the following:
a. Plasma antennas
b. Corner reflector antennas
c. Complementary antennas
d. Antennas for GPR systems **(20 Marks)**

7 a. Discuss the salient features of Ground wave propagation. **(10 Marks)**

b. Derive the expression for resultant field strength at a point due to space wave propogation. **(10 Marks)**

8 a. Define the following terms as related to ionospheric propagation:
i) MUF ii) Critical frequency iii) Virtual height iv) Skip distance. **(08 Marks)**

b. In an ionospheric wave propagation the angle of incidence made at a particular layer, at a height of 200 km is 45^0, with critical frequency 6 MHz. Calculate the skip distance. **(06 Marks)**

c. Calculate the wave tilt in degrees of the surface wave over an earth of 6 millimeters conductivity and relative permittivity of 12 at 2 MHz. **(06 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 Ma
   b. Explain in detail the log-periodic dipole array. (06 Ma
   c. Write notes on i) Antennas for ground penetrating radar ; ii) Ultra wide band antennas. (08 Ma

7 a. A free space line of sight microwave link operating at 10 GHz consists of a transmit an receive antenna each having a gain of 25 dB. The distance between the two antenna 30 kmt and the power radiated by the transmit antenna is 10 W. Calculate the path loss the link and the received power. (06 Mai
   b. An antenna located at the surface of the earth is used to receive the signals transmitted another antenna located at a height of 80 mt from the spherical surface of the earth (m radius = 6370 kmts). Calculate the optical and radio horizon if dN/dh = -39 / kmt. (06 Mai
   c. In troporpheric propagation, show that radius of curvature of path is a function of the rate change of dielectric constant with height and explain the duct propagation of wave. (08 Mai

8 a. For ionospheric layers, derive the expression for conductivity and relative permittivity a function of electron density and angular frequency. (08 Mai
   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 Mai
   c. Ionospheric wave is reflected from E layer with virtual height 100 kmt and from F layer w virtual height 300 kmt. Determine the single loop distance for each layer. (04 Mai

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2002 SCHEME

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EC65

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

Time: 3 hrs. Max. Marks:100

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

1 a. Explain basic principle of radiation using basic radiation equation. **(04 Marks)**

b. Explain the following terms with respect to an antenna:
   i) Radiation pattern
   ii) Effective height
   iii) Directivity
   iv) Beam area
   v) Radiation Intensity. **(10 Marks)**

c. Two space crafts A and B are separated by a distance 100×10^6m each has an antenna with D=1000, operating at 2.5GHZ. If craft 'A's receiver required 20dB over 1 Pico watt, what transmitter power is required on craft 'B' to achieve this signal power. **(06 Marks)**

2 a. Find the directivity for a pattern under unidirectional operation with radial component of the average Poynting Vector $S = S_m \sin^2\theta \sin^3\phi$. **(06 Marks)**

b. Explain the principle of pattern multiplication with an example. **(06 Marks)**

c. For linear uniform array of N-isotropic point sources, derive an equation for resultant field and obtain the equation for FWBW for Broadside operation. **(08 Marks)**

3 a. Calculate the radiation resistance of $\lambda/2$ dipole antenna. **(04 Marks)**

b. Derive an expression for the far field components of thin linear antenna. **(08 Marks)**

c. Derive an expression for the far field patterns of loop antenna for general case and extend it for small loop. **(08 Marks)**

4 a. Explain the main design parameters of Monofilar axial mode helical antenna. **(10 Marks)**

b. Obtain relation for relative phase velocity of Axial mode helical antenna for the case of ordinary end fire operation. **(05 Marks)**

c. Design Yagi-uda six element antenna for operation at 400 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 the corner reflector antenna and mention its application. **(06 Marks)**

b. Calculate BWFN and gain of a 2m paraboloid reflector operating at 6 GHZ. **(04 Marks)**

c. Explain different types of Horn antenna and mention its application. Write design equation for rectangular horn antenna. **(10 Marks)**

6 a. What is surface wave tilting obtain an equation for tilt angle of the wave? **(08 Marks)**

b. For normal refraction of tropospheric waves, derive the relation between the radius of curvature of the path and the change of dielectric constant with height. Obtain the modified earth's radius of curvature. **(08 Marks)**

c. The antenna of a TV transmitter is located at a height of 152mts above ground level. Calculate the distance upto which the line of right communication is possible if the height of receiving antenna is to be 9 mts. **(04 Marks)**

7 a. Explain the mechanism by which the radio waves are returned to earth in ionospheric propagation. **(06 Marks)**

b. Calculate the value of the skip distance given that the height of the ionospheric layer is 50kmt, MUF is 29 MHZ and its critical frequency is 4 MHZ. Derive the formula used. **(06 Marks)**

c. In Radio wave propagation, what is meant by signal fading? Explain various types of signal fading. **(08 Marks)**

8 Write short notes on :

a. Cross field effect

b. Bare Station Antennas for terrestrial mobile communication

c. Embedded and Plasma Antenna

d. Faraday rotation. **(20 Marks)**

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