Antenna Theory & propagation (EC-604A)

Question Paper Details					
Course	Stream	Semester	Subject	Paper Code	Chapter
B.TECH	Electronics & Communication Engg. (ECE)	6th	Antenna Theory & Propagation	EC-604A	Module 1: Review of Maxwell's equation & Antenna Characteristics

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MCQ type (marks 1)

1. Aperture efficiency of antenna is
   a. Ratio of g_p and g_d
   b. Maximum effective area to physical area
   c. Effective area to physical area
   d. physical area to effective area
2. In far field the angular field distribution is independent of
   a. Transmitter power
   b. Distance from the antenna
   c. Antenna type
   d. Angular region
3. Fresnel region exists when
   a. $R \leq 0.62\sqrt{\frac{D^3}{\lambda}}$
   b. $R \geq 0.62\sqrt{\frac{D^3}{\lambda}}$ and $R < \frac{2D^2}{\lambda}$
   c. $R \geq \frac{2D^2}{\lambda}$
   d. $R \geq 0.62\sqrt{\frac{D^3}{\lambda}}$
4. For frequency independent antenna band width is
   a. 0
   b. Infinite
   c. Finite
   d. Moderate
5. The magnetic field inside a perfect conductor is
   a. Zero
   b. Uniform
   c. Non uniform
   d. Reduced exponentially
6. The E- field inside a perfect conductor is
   a. Uniform
   b. Non –uniform
   c. Reduced exponentially
   d. 0

7. Linear polarization can be obtained only if the wave consists of _____
   a. E_x
   b. E_y
   c. Both E_x &E_y & in phase
   d. Both E_x &E_y & out of phase
8. Determine the electric field intensity at a distance of 10 km from an antenna having a directive gain of 5 dB and radiating a total power of 20 kW
   a. 0.1732 V/m
   b. 0.346 V/m
   c. 0.195 V/m
   d. 0.398 V/m
9. If there exists 2 orthogonal linear components which are in time phase polarization is
   a. Linear
   b. Circular
   c. Ellipse
   d. Ellipsoid
10. Which property/ies of antenna is/are likely to be evidenced in accordance to Reciprocity theorem?
    a. Equality of impedances
    b. Equality of directional patterns
    c. Equality of effective lengths
    d. All of the above
11. The radiation field of an antenna at a distance "r" varies as
    a. $\frac{1}{r}$
    b. $\frac{1}{r^2}$
    c. $\frac{1}{r^3}$
12. An electric field on a place is described by its potential

$$V = 20(r^{-1} + r^{-2})$$

    The field is due to
    a) A monopole
    b) A Dipole
    c) Both A & B
    d) A quadruple
13. The radiation pattern of an antenna is $cos^4\theta$. The directivity of an antenna
    a) 10dB
    b) 12.6dB
    c) 11.5 dB
    d) 18dB

Short Question (Marks 2)

1. The field amplitude due to half wave dipole at 10km is 0.1 V/m. It operates in 100MHz. Find dipole length and radiated power.
2. Find the maximum effective area of an antenna at 2GHz when the directivity is 100.
3. Find the radiated power of an antenna if 10 Amp current exists and its radiation resistance 32 ohm.
4. Find radiation efficiency of Hertzian dipole of 0.03λ at frequency of 100MHz, if loss resistance is 0.01ohm.
5. What is the major application of using concept of magnetic vector potential?
6. Antenna has maximum radiation intensity of 2 W/Sr. if the antenna input power is 1 W, then find out the directivity. (Assume antenna efficiency is 90%)
7. What is antenna directivity?
8. Why choice of polarization is one of major issues in antenna Tx/Rx designing?
9. State antenna duality principle.

Subjective Question (Marks 3)

1. The radiation intensity of a certain antenna is given by

$$U = \begin{cases} 4\sin\theta\sin\phi; & 0 \le \theta \le \pi, \quad 0 \le \phi \le \pi \\ 0 \quad ; & \text{elsewhere} \end{cases}$$

Find out the directivity of the antenna.

2. What are HPBW and FNBW of antenna?
3. Write down different kind of losses in antenna system.
4. What is radiation resistance of antenna? What is its physical impact on antenna characteristics?
5. If radiation resistance of a circular loop of one turn is 0.01Ω, what is the radiation resistance of 5 turn?
6. For an antenna radiating in free space, the electric field at a distance of 1 km is found to be 12 V/m. Given that intrinsic impedance of the free space is $120\pi\Omega$, Find the magnitude of average power density due to this antenna at a distance of 2 km from the antenna (in nW/m2) .
7. If power pattern of an antenna is $p(\theta) = \cos 2\theta$, then find out its HPBW & FNBW.

Broad Question (Marks 5)

1. State Maxwell equation in integral and differential form. Discuss their significance.
2. What is half wave dipole? Assuming a sinusoidal current distribution over length derive an expression for vector potential A at large distance from this dipole.
3. Why all antenna measurement is preferably done in far field? Discuss different nature of near field zone of any antenna.
4. What is antenna gain? How is it related with directive gain and power gain? If it is found an antenna having 4dBi gain, what does it interpret?
5. What are differences between antenna beamwidth and bandwidth. What is FB ratio of an antenna? Explain the significance of "effective area" of antenna. How is it related with antenna gain?
6. What are E-Plane and H-plane in antenna pattern graph? Using reciprocity mode show that the radiation pattern is same in both transmit and receive mode.

Question Paper Details					
Course	Stream	Semester	Subject	Paper Code	Chapter
B.TECH	Electronics & Communication Engg. (ECE)	6th	Antenna Theory & Propagation	EC-604A	Module 2: Characteristics of Dipole, monopole and Antenna array

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MCQ type (marks 1)

1. Broad side arrays are
   a. Omni directional
   b. Directional
   c. Point sources
   d. Isotropic
2. If the elements of a binomial array are separated by λ/4, how many shape patterns are generated with no minor lobes?
   a. 2
   b. 4
   c. 8
   d. 16
3. What kind of beamwidth is/are produced by Chebyshev arrays for given side lobe level (SLL)?
   a. Widest
   b. Narrowest
   c. Both a and b
   d. None of the above
4. If a linear uniform array consists of 9 isotropic elements separated by λ/4, what would be the directivity of a broadside array in dB?
   a. 6.53 dB
   b. 7.99 dB
   c. 8.55 dB
   d. 9.02 dB
5. An antenna consists of 4 identical Hertzian dipoles uniformly located along the *z* axis and polarized in '*z*' direction. The spacing between the dipoles is The group pattern function is (Assume initial phase difference between the dipoles is zero degrees)

a) $4\cos(\frac{\pi}{4}cos\theta)\cos(\frac{\pi}{2}cos\theta)$

b) $4\cos(\frac{\pi}{4}cos\theta)\cos(\frac{\pi}{8}cos\theta)$

c) $4\cos(\frac{\pi}{4}cos\theta)\sin(\frac{\pi}{2}cos\theta)$

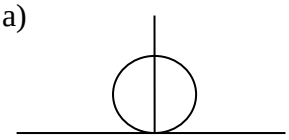
d) $4\cos(\frac{\pi}{4}cos\theta)\sin(\frac{\pi}{8}cos\theta)$

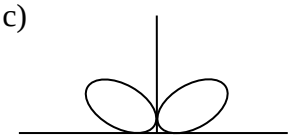
6. The electric field E and the magnetic field H of a short dipole antenna satisfy the condition
   (a) The r component of E is equal to zero
   (b)Both r and θ components of H are equal to zero
   (c) The θ component of E dominates the r component in the far – field region
   (d)The θ and $\emptyset$ components of H are of the same order of magnitude in the near – field region.

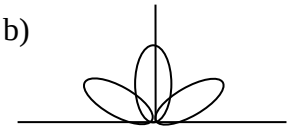
7. Gain of a half-wave dipole antenna over isotropic.
   2.15 dB
   1.76 dB
   1 dB
   0 dB
8. Which of the following is the property of Microwave antennas?
   a. Wider beam angles than RF antennas
   b. larger captive areas than RF antennas
   c. smaller physical lengths than RF antennas
   d. All of the above
9. Match List I (Type of Antenna) with List II (Example) and select the correct answer using the codes.

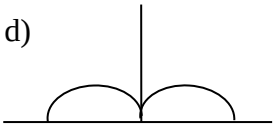
List I	List II
A. Aperture antenna	1. Helical antenna
B. Circularly polarized antenna	2. Point source
C. Frequency independent antenna	3. Log periodic antenna
D. Isotropic antenna	4. Microstrip antenna

10. A $\frac{\lambda}{2}$ dipole is kept horizontally at a height of $\frac{\lambda}{2}$ above a perfectly conducting plane. The radiation pattern in the plane of dipole looks approximately

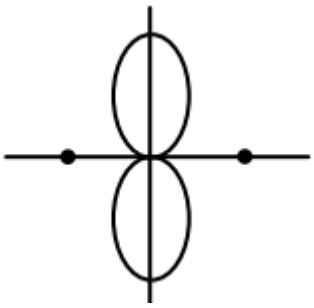
a) 

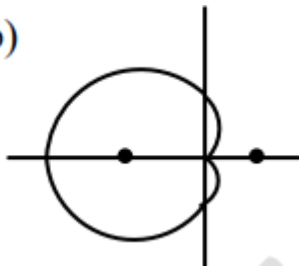
c) 

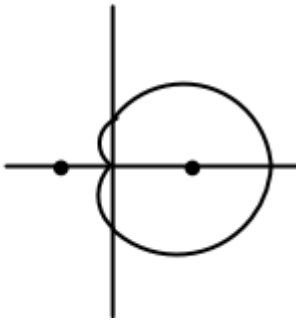
b) 

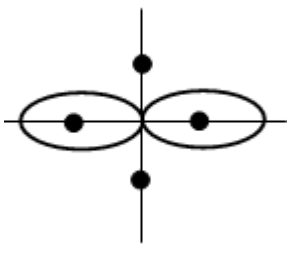
d) 

11. Two identical and parallel dipole antennas are kept apart by a distance of $\lambda/4$ in the H – plane. They are fed with equal currents but the right most antennas have phase shift of $+90^{o}$. The radiation pattern is given as(2)

(a) 

(b) 

(c) 



12. For a dipole antenna
    (a) The radiation intensity is maximum along the normal to the dipole axis
    (b)The current distribution along its length is uniform irrespective of the length
    (c) The effective length equals its physical length
    (d)The input impedance is independent of the location of the feed – point
13. An antenna when radiating, has a highly directional radiation pattern. When the antenna is receiving its radiation pattern
    (a) Is more directive
    (b) Is less directive
    (c) Is the same
    (d) Exhibits no directivity all
14. By how many times is an input impedance of a folded dipole at resonance greater than that of an isolated dipole with same length as one of its sides?
    a. 2
    b. 3
    c. 4
    d. 6
15. If diameter of a $\frac{\lambda}{2}$ dipole antenna is increased from $\frac{\lambda}{100}$to $\frac{\lambda}{50}$, then its
    a) Bandwidth increases
    b) Bandwidth decreases
    c) Gain increases
    d) Gain decreases

Short Question (Marks 2)

1. What is the advantage of Dolph-Tschebyscheff distribution?
2. What is the pattern multiplication factor in array?
3. What is effect of ground on vertical antenna?
4. What is antenna temperature?
5. Consider a dipole antenna in free space which has a uniform sinusoidal current distribution. If the length of the dipole is 0.02 λ then find the value of current (peak) required to radiate a total power of 300 mW.
6. What do you mean by array factor?
7. What are the basic differences between parasitic and driven elements in an array.

Subjective Question (Marks 3)

1. In Uniform linear array, 4 isotropic radiating elements are placed $\frac{\lambda}{4}$ apart. Find out the progressive phase shift required for forming the main beam at 60° off the end fire.
2. Define Broadside and End-fire array of antenna.
3. Draw radiation pattern of Marconi (quarter wave monopole) antenna.
4. What is the effect of length on power of linear antenna?
5. Briefly explain how the broadside array radiation pattern comes about.

Broad Question (Marks 5)

1. Show that, for N-element array show that the first minor lobe is 13·46 dB down from the major lobe.
2. Find the expression for the relative field strength pattern of a four-element broadside array with $\frac{\lambda}{2}$spacing.
3. Discuss Binomial array synthesis procedure in short.

4. Find the radiation resistance of a half wave dipole with uniform current distribution.
5. Sketch current pattern as with horizontal and vertical field radiation pattern of a centre fed dipole for following lengths
   a) $\frac{\lambda}{2}$ b) $3\frac{\lambda}{2}$ c) 2λ
6. Define antenna array. Show that the resultant field of an array consisting N elements equally spaced 'd' in a direction making at angle θ , carrying equal current and in phase is given by

$$F = F_0 \frac{\sin(\frac{N\varphi}{2})}{N sin\varphi/2}$$

Question Paper Details					
Course	Stream	Semester	Subject	Paper Code	Chapter
B.TECH	Electronics & Communication Engg. (ECE)	6th	Antenna Theory & Propagation	EC-604A	Module 3: Characteristics of practical antennas (TWT, Loop, Helical, Yagi-Uda, Horn, Microstrip, Parabolic)

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MCQ type (marks 1)

1. Which among the following is not a disadvantage of rhombic antenna?
   a. Requirement of large space
   b. Reduced transmission efficiency
   c. Maximum radiated power along main axis
   d. Wastage of power in terminating resistor
2. Which conversion mechanism is performed by parabolic reflector antenna?
   a. Plane to spherical wave
   b. Spherical to plane wave
   c. Both a and b
   d. None of the above
3. Which is a non-resonant antenna?
   (a) Rhombic antenna
   (b) Folded dipole
   (c) end-fire array
   (d) yagi-uda antenna
4. The antenna most commonly used for TV broadcasting in the UHF band is
   a) turnstile antenna
   b) dipole antenna
   c) yagi antenna
   d) rhombic antenna
5. For an 8 ft. parabolic dish operating at 4GHz, the minimum distance required for far field measurement is closest to
   a) 7.5 cm
   b) 15 cm
   c) 15m
   d) 150 m
6. A log periodic antenna is a
   a) Frequency independent antenna
   b) Frequency dependent antenna
   c) Directional antenna
   d) None of these.
7. Antenna commonly used for microwave links is
   a) loop antenna
   b) log periodic antenna
   c) paraboloidal dishes
   d) rhombic antenna.

8. Radiation resistance of a two wire folded dipole
   a) 73 ohm
   b) 292 ohm
   c) 100 ohm
   d) 50 ohm
9. Use of directors in Yagi antenna
   a) Reflects back radiation
   b) Increases directivity
   c) Minimizes Losses
   d) None of these
10. Top loading with antenna is sometimes used for
   a) Effective length
   b) Bandwidth
   c) Beamwidth
   d) Input capacitance

Short Question (Marks 2)

1. How horn antenna is fed?
2. What are different types of antenna in HF?
3. What is E-Plain & H-Plain horn?
4. List different types of TWT antennas.
5. Differentiate between director and reflector in an array.
6. Why parabolic antennas are good for setting microwave link?
7. State two important features of loop antenna.
8. What are uses of folded dipole?
9. What are frequency independent antennas?

Subjective Question (Marks 3)

1. Discuss merits and demerits of rhombic antenna.
2. What is Cassegrain type feed of a parabolic antenna?
3. Find out the beamwidth between first null and power gain of a 2 m parabolic reflector operating at 6000MHz.
4. A parabolic antenna having a circular mouth is to have a power gain of 1000 at λ= 15cm. Find diameter of mouth and HPBW of the antenna.
5. Explain why electrically short antennas have low efficiency.
6. Give basic idea about direction finding antenna (RDF).

Broad Question (Marks 5)

1. Discuss different types of mode in a rectangular microstrip antenna? What will be the dominant mode of a rectangular microstrip antenna if fed along length of patch?
2. What is the effect of height and effective dielectric constant on Q factor of microstrip antenna?
3. Draw different kinds of feed systems for parabolic dish.
4. Describe axial or beam mode propagation of helical antenna. Write down the reason of significant use of them in satellite communication.
5. With proper symbols and assumption derive the relation between f over D ratio for parabolic antenna.
6. Explain the design aspects of Yagi-uda antenna. Explain function of each part.
7. Describe the current distribution and radiation pattern of folded dipole.

Question Paper Details					
Course	Stream	Semester	Subject	Paper Code	Chapter
B.TECH	Electronics & Communication Engg. (ECE)	6th	Antenna Theory & Propagation	EC-604A	Module 4: Method of Propagation, Medium effect on radio wave propagation.

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MCQ type (marks 1)

1. If the maximum electron density for F-layer in ionosphere is 4×10^6 electrons/cm^3, then what will be the critical frequency of EM wave for F-layer?
   a) 4 MHz
   b) 9 MHz
   c) 18 MHz
   d) 25 MHz
2. How is the effect of selective fading reduced?
   A. By high carrier reception
   B. By low carrier reception
   C. By single side band system
   D. By double side band system
   a. A & C
   b. B & D
   c. A & D
   d. B & C
3. The ground wave field strength is
   a) Inversely proportional to distance
   b) Inversely proportional to the square of distance
   c) Directly proportional to distance
   d) Directly proportional to the square distance.
4. Which layer has the atmospheric conditions exactly opposite to that of standard atmosphere?
   a. Depression layer
   b. Regression layer
   c. Inversion layer
   d. Invasion layer
5. Which mode of propagation is adopted in HF antennas?
   a. Ionospheric
   b. Ground wave
   c. Tropospheric
   d. All of the above
6. Faraday rotation is negligible
   a) Above 1GHz
   b) Below 1GHz
   c) At 100 MHz
   d) None of these
7. When microwave signal follows curvature of earth is known as

a) Faraday Effect
b) Ducting
c) Troposphere Scatter
d) Ionospheric reflection

8. Helical antennas are often used for satellite tracking because
   a) Ducting
   b) Troposphere
   c) Ionospheric Propagation
   d) Faraday effect

Short Question (Marks 2)

1. What is radio wave fading?
2. Why does ionospheric layer height fluctuate between day and night?
3. What is Line of Sight (LOS) propagation?
4. What are different layers in ionosphere? Which layers get disappear at night?
5. A HF radio link has to be established between two points on earth 2000 km away. If reflection region of the ionosphere is at a height of 200 km, and has critical frequency 6 MHz, find out MUF for this case.
6. Determine the MUF of an ionosphere layer at 60^{O} incidence and with 8MHz critical frequency.
7. To mitigate Faraday Effect what precautions should be taken at antenna receiver?

Subjective Question (Marks 3)

1. In a communication link two identical antennas at 10 GHz are used for propagation of 40 dB. If the transmitted power is 1 W, find the received power, if the range of the link is 30 km.
2. What is meant by critical frequency? How can it be measured? What information does it convey regarding Ionosphere?
3. Determine the critical freq. of an ionosphere layer is 10MHz. What is the maximum launching angle from the horizon for which 20 MHz will be from the layer?
4. At what frequency a wave must propagate for the D region to have an index of refraction 0·6? Given N = 500 electron / c.c. for D region.
5. Calculate the value of frequency at which an EM wave must be propagated through the D-region with refractive index 0.5 and 'e'density $3.24x10^4$ e/m^3.
6. What is the effect of earth radius on ground wave propagation?

Broad Question (Marks 5)

1. Derive link budget formula/Friss transmission formula.
2. Write Short note on
   a) Skip distance.
   b) Sky wave propagation
3. Define MUF and derive an expression for the same in case of a thin ionospheric layer over a plane earth.
4. Establish index of a layer of the ionosphere $n = \sqrt{1 - \frac{81N}{f^2}}$
5. Define ground wave propagation. What are its limitations? Why only vertically polarized wave is used for this kind of propagation?
6. List major reasons for fading. How fading can be minimized?
7. Describe the significance of tropospheric propagation in microwave communication.
8. Explain how tropospheric ducts are formed and how can they be used for microwave propagation.