

**ANTENNA AND RADIATING SYSTEMS  
(ECEN 5101)**

**Time Allotted : 2½ hrs**

**Full Marks : 60**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 4 (four) from Group B to E, taking one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A**

1. Answer any twelve:

**12 × 1 = 12**

*Choose the correct alternative for the following*

- (i) What is the overall efficiency of a lossless antenna with reflection coefficient 0.15?  
(a) 0.997                      (b) 0.779                      (c) 0.669                      (d) 0.977.
- (ii) If the operating frequency increases, powers received by the receiving antenna \_\_\_\_\_.  
(a) will decrease    (b) will increase  
(c) is independent of frequency    (d) is not predictable.
- (iii) If the distance between the transmitting and receiving antenna is decreased by a factor 2 while other factors remain same, then the new power received by the antenna \_\_\_\_\_  
(a) increases by factor 2    (b) decreases by factor 2  
(c) increases by factor 4    (d) decreases by factor 4.
- (iv) What is the pitch angle of the helical antenna to become a loop antenna?  
(a) 90                                      (b) 0                                      (c) 45                                      (d) 60.
- (v) Which of the following statement about antenna array is false?  
(a) Field pattern is the product of individual elements in array  
(b) Field pattern is the sum of individual elements in array  
(c) Resultant field is the vector superposition of the fields from individual elements in array  
(d) High directivity can be achieved for long distance communications.
- (vi) If the aperture antenna is tapered only in H-plane then which of the following is true compared to uniform non-tapered aperture antenna?  
(a) Principle patterns in E-plane and H-plane are same in both cases  
(b) Principle patterns in E-plane and H-plane are different in both cases  
(c) Principle patterns in E-plane is same and H-plane is different  
(d) Principle patterns in E-plane is different and H-plane is same.

- (vii) Which of the following wave conversion mechanism is performed in a parabolic reflector antenna?  
 (a) Plane to spherical  
 (b) Spherical to plane  
 (c) Performs both plane to spherical and spherical to plane  
 (d) Elliptic polarization.
- (viii) Find the skip distance when the angle of incidence is  $20^\circ$  and virtual height is 50km?  
 (a) 13.22m            (b) 13.22km            (c) 36.33km            (d) 36.33m.
- (ix) Duct propagation is due to which layer?  
 (a) Temperature Inversion layer            (b) Higher atmospheric layer  
 (c) Ionospheric layer            (d) Surface water.
- (x) On which of the following factors does the LOS distance depends?  
 (a) Height of receiving antenna alone  
 (b) Height of transmitting antenna alone  
 (c) Only on height of transmitting and receiving antenna  
 (d) On height of transmitting and receiving antenna and effective earth's radius factor  $k$ .

*Fill in the blanks with the correct word*

- (xi) Power radiated by half-wave dipole with maximum current amplitude 10A is \_\_\_\_\_.
- (xii) The Axial ratio of the helical antenna with 3 turns is \_\_\_\_\_.
- (xiii) The array factor of 8- isotropic elements of broadside array separated by a  $\lambda/4$  is given by \_\_\_\_\_.
- (xiv) Multiplying the normalized field with the normalized array factor gives \_\_\_\_\_.
- (xv) To obtain maximum beam pattern, the primary radiator is placed \_\_\_\_\_ in a reflector antenna.

### Group - B

2. (a) Define the following terms. (i) Radiation Resistance (ii) Bandwidth (iii) Beam Efficiency. [[CO1](/LOCQ)]
- (b) A dipole having a length of 3 cm is operated at 1 GHz. The efficiency factor  $K=0.6$ . Calculate the radiation resistance, antenna gain and effective aperture. [[CO1](Apply/IOCQ)]  
**6 + 6 = 12**
3. (a) Demonstrate the Thevenin equivalent circuit of transmitting and receiving antenna with neat diagrams. [[CO1](Remember/LOCQ)]
- (b) A loss less  $\lambda/2$  antenna with input impedance of  $73\Omega$  is to be connected to a line whose characteristic impedance is  $50\Omega$ . Assuming that the pattern of antenna is given by  $U = B_0 \sin^3\theta$ . Find the overall maximum gain. [[CO1](Apply/IOCQ)]  
**6 + 6 = 12**

## Group - C

4. (a) "A horn antenna may be regarded as a flared out waveguide" — Justify. [[CO2](Analyze/IOCQ)]  
(b) Apply the principle of equality of path length to design a Pyramidal Horn Antenna, illustrate the design with appropriate diagram. [[CO2](Create/HOCQ)]  
**5 + 7 = 12**
5. (a) What is broad side array and its radiation pattern? [[CO2](Remember/LOCQ)]  
(b) A broad side array operating at 10cm wavelength consists of 4 half wave dipole spaced 50 cm each element carries radio frequency current in the same phase and magnitude 0.25A. Calculate the radiated power, half power beamwidth of major lobe. [[CO2](Analyze/IOCQ)]  
**5 + 7 = 12**

## Group - D

6. (a) A parabolic dish provides a power gain of 50 dB at 10 GHz with 70% efficiency. Find out (i) HPBW (ii) BWFN. [[CO2](Analyse/IOCQ)]  
(b) Categorize the different types of UWB antennas in terms of impedance bandwidth. [[CO2](Remember/LOCQ)]  
**6 + 6 = 12**
7. (a) Recognize the various micro-strip antennas and draw its radiation pattern. [[CO2](Understand/HOCQ)]  
(b) Recall the transmission line model of rectangular patch antenna. [[CO2](Remember/LOCQ)]  
**6 + 6 = 12**

## Group - E

8. (a) What is EMC? Discuss the issues related to EMC in detail. [[CO4](Remember/LOCQ)]  
(b) Summarize FCC and CISPR Conducted Emission (CE) and Radiated Emission (RE) standards. [[CO4](Remember/LOCQ)]  
**6 + 6 = 12**
9. (a) Explain the relation between MUF and skip distance. [[CO5](Understand/LOCQ)]  
(b) Explain Multi hop propagation. [[CO5](Remember/LOCQ)]  
(c) For a flat earth assume that at 400 km reflection takes place. The maximum density of ionosphere corresponds to a refractive index of 0.9 at 10 MHz. Calculate range for which maximum usable frequency is 10 MHz. [[CO6](Apply/IOCQ)]  
**3 + 3 + 6 = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	48.96	37.50	13.54

