ANTENNA AND RADIATING SYSTEMS
(ECE5101)

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) Radiation resistance of a half-wave dipole is _____
(a) 36.56Ω (b) 18.28Ω
(c) 73.12Ω (d) 40.24Ω

(ii) 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

(iii) Which of the following statements is false regarding a broadside array?
(a) The maximum radiation is normal to the axis of the array
(b) Must have same amplitude excitation but different phase excitation among different elements
(c) The spacing between elements must not equal to the integral multiples of λ
(d) The phase excitation difference must be equal to zero

(iv) What is the necessary condition for a helical antenna to operate in the axial mode?
(a) $\pi D << \lambda$ (b) $\pi D \approx \lambda$
(c) $\pi D \approx n\lambda$ (d) $\pi D=0$

(v) HPBW of E-plane horn with aperture dimension 10 λ in degrees is ____
(a) 56 (b) 67
(c) 5.6 (d) 6.7

(vi) 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

(vii) In which of the following type of antenna a patch is created during fabrication?
(a) Microstrip antenna (b) Horn antenna
(c) Wire antenna (d) Lens antenna

(viii) How long the waves due to duct propagation travel following the earth curvature?
(a) 1000km (b) 50m
(c) 15m (d) 5000km

(ix) Pattern multiplication is the multiplication of single array radiation pattern with ___
(a) Array Factor (b) Beamwidth
(c) Total Field (d) Directivity

(x) The height at a point above the earth's surface at which the wave bends down to the earth is called _____
(a) Actual height
(b) Virtual height
(c) Skip distance
(d) Distance of separation between transmitter and antenna

Fill in the blanks with the correct word

(xi) The Directive gain is _____ on input power to antenna and ____ on power due to ohmic losses.

(xii) If the HPBW is 30° then FNBW is approximately _____

(xiii) The normalized array factor of a two element array antenna is given by _____

(xiv) The maximum possible frequency for which the wave is reflected back for a given distance of propagation in the ionosphere layer is called as_____

(xv) During ground wave propagation earth behaves like a _____

Group - B

2. (a) Formulate the wave equation using Maxwells equation for electromagnetic wave in free space. Design an antenna with omnidirectional amplitude pattern with a half-power beamwidth of 90°. *[(CO1)(Apply/IOCQ)]*

(b) Express its radiation intensity by $U = \sin^n \theta$. Determine the value of n and attempt to identify elements that exhibit such a pattern. Determine the directivity of the antenna. *[(CO1)(Create/HOCQ)]*

5 + 7 = 12

3. (a) Derive the power radiated by the short dipole? *[(CO1)(Remember/LOCQ)]*

(b) Draw the 3D pattern of a directional antenna with maximum in z- direction at $\theta = 0°$. *[(CO1)(Remember/LOCQ)]*

(c) Sketch the regions around an antenna and explain reactive near field region in detail. *[(CO1)(Understand/LOCQ)]*

(d) Identify how the radiation power density and radiation intensity related to antennas. *[(CO1)(Apply/IOCQ)]*

2 + 2 + 3 + 5 = 12

Group - C

4. (a) Compare the role of centralized control in traditional and distributed databases. *[(CO2)(Analyse/IOCQ)]*

   (b) Verify that the value and utility of an antenna array determine the received or transmitted power as a function of the arrival angle. Enumerate the performance of a phased array antenna. *[(CO2)(Create/HOCQ)]*

4 + 8 = 12

5. (a) Explain about the reciprocity with respect to antenna measurements. *[(CO3)(Remember /LOCQ)]*

   (b) Write short notes on coordination system for antenna measurement. *[(CO3)(Remember/LOCQ)]*

   (c) Describe near and far fields with respect to antenna measurements. *[(CO3)(Understand/LOCQ)]*

   (d) Explain sources of Error in Antenna measurement. *[(CO3)(Understand/IOCQ)]*

3 + 3 + 3 + 3 = 12

Group - D

6. (a) Validate why an antenna using a paraboloid reflector is likely to be a highly directive receiving antenna? *[(CO2)(Evaluate/HOCQ)]*

   (b) Assess the different feeding methods of Parabolic reflector. Under what conditions this method of feed is unsatisfactory? *[(CO2)(Analyze/IOCQ)]*

6 + 6 = 12

7. (a) With a neat diagram explain the radiation mechanism of a patch antenna. What are the excitation techniques. *[(CO2)(Remember/LOCQ)]*

   (b) Design a rectangular microstrip antenna using a substrate (assume) with dielectric constant of 2.2, h=0.1588 cm (0.0625 inches) so as to resonate at 10GHz. *[(CO2)(Analyse/IOCQ)]*

5 + 7 = 12

Group - E

8. (a) Explain Maximum usable frequency with its expression. *[(CO5)(Remember/LOCQ)]*

   (b) Determine the maximum usable frequency for a critical frequency of 20 MHz and an angle of incidence of 350. *[(CO5)(Analyze/IOCQ)]*

6 + 6 = 12

9. (a) Explain characteristics of different ionized layers in ionosphereric propagation. *[(CO5)(Understand/LOCQ)]*

   (b) Describe how the layers D, E, and F are formed and how they effect of propagation of radio wave. *[(CO5)(Remember/LOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	40.62	37.5	21.87