Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (ECE-COMM)/SEM-2/MCE-205D/2012

2012

ADVANCED ANTENNA AND WAVE PROPAGATION

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : 10 × 1 = 10

   i) Omnidirectional radiation pattern is emitting radiation in

   a) 90° b) 270°

   c) 180° d) 360°

   ii) Wire antenna includes

   a) Dipole b) Monopole

   c) Loops d) All of these.

   iii) Directivity is

   a) $\frac{4\pi U(\theta,\phi)}{P_{total}}$ b) P_{total}

   c) $4\pi U(\theta,\varphi)$ d) none of these.

   iv) Folded dipole is used for

   a) VHF b) UHF

   c) None of these d) Both (a) and (b)

v) Corrugation is done in

a) Horn antenna b) Wire antenna

c) Spiral antenna d) None of these.

vi) Pyramidal horn has flaring in

a) *E* plane b) *H* plane

c) both (a) and (b) d) none of these.

vii) Different types of feed include

a) Cassegrain feed b) Horn feed

c) Dipole feed d) All of these.

viii) In broadside array, direction of maxima is along

a) array axis

b) perpendicular to array axis

c) none of these

d) both (a) and (b).

ix) Line of sight is given as

a) $\sqrt{2r}\left(\sqrt{h_t}+\sqrt{h_r}\right)$, b) $\dfrac{\sqrt{2r}}{\left(\sqrt{h_t}+\sqrt{h_r}\right)}$

c) $\dfrac{\left(\sqrt{h_t}+\sqrt{h_r}\right)}{\sqrt{2r}}$ d) $\dfrac{\left(\sqrt{h_t}+\sqrt{h_r}\right)}{2}$.

x) Refractive index μ is given by

a) $\sqrt{\varepsilon_r}$ b) $\dfrac{1}{\sqrt{\varepsilon_r}}$

c) ε_r d) $\dfrac{1}{\varepsilon_r}$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Calculate the aperture efficiency and directivity of an antenna having radiation resistance 72 Ω, loop resistance 8 Ω and power gain 16.
3. The frequency of an antenna is 5 GHz. Calculate the gain of the antenna having circular aperture of diameter 3 m.
4. Calculate the power gain of a test antenna whose input power is 100 mW and input power of reference is 400 MW.
5. The effective antenna temperature of a target at the input terminals of the antenna is 150 K. Assuming that the antenna is maintained at a thermal temperature of 300 K and has thermal efficiency of 99% and it is connected to a receiver through an X-band (8·2-12·4 GHz) rectangular waveguide of 10 m (loss of waveguide = 0·13 dB/m) and at a temperature of 300 K, find the effective antenna temperature at the receiver terminals.
6. Calculate the power gain of a horn antenna of square aperture having the dimension of each side as 3λ.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) A satellite at a distance of 40,000 km from a point on the earth's surface radiates a power of 10 W from an antenna with a gain of 17 dB in the direction of the observer. Find the flux density at the receiving point, and the power received by an antenna at this point with an effective area of 10 m^2 .

b) If the above satellite operates at a frequency of 11 GHz, and the receiving antenna has a gain of 52.3 dB, find the receiving power.

8. What will be the value of directivity when $U = U_m \sin\theta \sin^3\phi$, where θ varies from 0 to π and ϕ varies from 0 to π.

9. a) Explain the design equations of Pyramidal horn antenna.

b) A pyramidal horn antenna having *E*-plane aperture $a_E = 10\lambda$, path length difference $\delta = 0 \cdot 2\lambda$ in the E-plane and $0 \cdot 32\lambda$ in the *H*-plane. Calculate the

(i) horn length

(ii) *H*-plane aperture

(iii) flare angles θ_E and θ_H

(iv) directivity.

10. a) Calculate critical frequency, if maximum electric density of ionosphere layer is $2 \cdot 77 \times 10^3 e/m^3$.

b) Find out the skip distance assuming earth to be flat for ionosphere at frequency 10 MHz and critical frequency 4·358 with height 400 km.

c) Calculate MUF of transmission between two stations of 500 km if electron density is 10^{12} electron per cubic meter and height = 240 km.

11. a) Write down the necessary equations for finding out the length and width of a micro-strip rectangular patch antenna.

b) Design a rectangular microstrip antenna using a substrate (RT/duroid 5880) with dielectric constant of 2·2, h = 0·1588 cm (0·0625 inches) so as to resonate at 10 GHz.