Name : ....

Roll No. : ....

Invigilator's Signature : ....

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

(Short Answer Type Questions)

Answer of the following to the point. $5 \times 2 = 10$

1. Define Gain and Directivity.
2. Define with diagram right handed circular polarized waves.
3. The radiation intensity of the main lobe of an aperture antenna in an infinite ground plane (XY) is given by $U(\theta, \varphi) = \sin\theta$. Determine the beam solid angle.
4. What is the importance of G/T ?
5. Distinguish between diffraction and scattering.

GROUP – B

(Long Answer Type Questions)

Answer any *four* of the following. $4 \times 15 = 60$

6. a) The radiation intensity of an antenna is given by $U(\theta) = \cos^4 \theta$, $(0 \leq \theta \leq 90°, 0° \leq \varphi \leq 360°)$. Find the (a) half-power beam width HPBW, (b) first-null beam width FNBW. $7\frac{1}{2}$

   b) For an infinitesimal dipole excited by a constant rf current I, determine the Radiation Intensity U, maximum value of U, Directivity, and the maximum Effective Aperture. $7\frac{1}{2}$

7. a) An omnidirectional antenna has uniform radiation in $\theta = 90°$ (horizontal) plane and fall to zero outside that plane. The pattern in constant in the $\varphi = 0$ (vertical) plane in the range $60° < \theta < 120°$. Find the Directivity. $7\frac{1}{2}$

   b) The mean radius of a small circular loop of constant current is $\lambda/10$. Find the radiation resistance and the ratio of its maximum effective aperture and physical area of the loop. $7\frac{1}{2}$

8. a) Design a 4 element linear binomial array on y-axis for uniform inter-element spacing of half wavelength. Plot the array pattern. Find FNBW. 8

b) A 3 element Dolph-Chebyshev array possesses a sidelobe level – 20 dB. The array has falf-wavelength spacing and the beam is steered towards broadside. Find the excitation coefficients, and the normalized array factor. 7

9. a) A 10 $\lambda x 5\lambda$ Uniform rectangular aperture is symmetrically located at the origin on *xy*-plane. Find the HPBW in two principal planes, the directivity, and the gain. $7\frac{1}{2}$

b) A parabolic reflector has dia = 10m, $\frac{f}{d} = 0.5$, f = 3GHz,

feedpatternGf $(\theta') = 6\cos^2\theta'$. Find

i) Aperture efficiency

ii) Directivity

for maximum phase error $\Delta\phi_{max} = \frac{\pi}{2}$ radian. $7\frac{1}{2}$

10. Design a 50-200MHz LPDA for gain corresponds to scale factor 0.8 and space factor 0.15.

11. a) Design a rectangular microstrip antenna for 1.8 GHz with RT-duroid 5880 FR4 substrate having $\varepsilon_r = 4.4$, loss tangent = 0.001 and h = 1.6 mm. 10

b) In gain measurement of a horn antenna at 10 GHz, the TX and RX horns are indentical and placed at 5 m apart. The output of test horn is connected to an attenuator of 10 dB. Find the gain of the horn. 5

12. a) A radio link has a 100 watt transmitted power connected to an antenna of 2 m^2 effective aperture at 10GHz. The receiving antenna has an effective aperture of 0.5 m^2 and is located at a 30 km LOS distance from the transmitting antenna. Assuming lossless, matched antennas, find the power delivered to the receiver. 10

b) A plane wave at 20 MHz is transmitted to ionosphere and reflected from a height of 500 km from the flat earth. If the refractive index corresponding to maximum electron density is 0.5, determine the critical frequency. 5