Total number of printed pages: **Programme (UG) 6th Semester/UECE615A**

2024

Antennas and Wave Propagation

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1	(a)	Describe the different types of radiation patterns.	4
	(b)	What does beam area mean for a radiation pattern of an antenna?	4
	(c)	Derive the expression of the directivity of an antenna in terms of beam area?	6
	(d)	An antenna has normalized field pattern given by $E_n = cos^3\theta$ where θ is the polar angle in spherical polar co-ordinates and it varies from 0 to π. Find HPBW and directivity.	6
2	(a)	What does input impedance of an antenna mean?	2
	(b)	Deducing the necessary equations show that power supplied by the generator to a radiating antenna is the summation of power radiation through radiation resistance, power dissipated as heat in loss resistance of the antenna and power dissipated in the internal resistance of the generator.	8
	(c)	What are radiation intensity and radiation power density? Derive their relationship.	3+3
	(d)	An antenna has a loss resistance of 5Ω, power gain 20, and directivity 22. Find radiation resistance	4
3	(a)	What are the different types of antenna polarization? Discuss each of them.	1+7
	(b)	What is the axial ratio? what is its value for different types of polarization?	2+2
	(c)	Deduce the expression of array factor for N element uniform array	4

	(d)	Obtain the pattern of two isotropic point sources with identical amplitude and in phase currents and spaced one-half wavelength apart	4
4	(a)	What is loop antenna? Why is it so important?	2+2
	(b)	Derive the expressions for the field in far-field region and radiation resistance of a square loop antenna.	16
5	(a)	Derive the expressions for the fields in the far field zone of a finite length infinitesimally thin dipole with current distribution $I_e(z') = I_0 \sin\left[k\left(\frac{l}{2} - z'\right)\right] \quad for\ 0 \le z' \le \frac{l}{2}$ $I_e(z') = I_0 \sin\left[k\left(\frac{l}{2} + z'\right)\right] \quad for\ -\frac{l}{2} \le z' \le 0$ Also derive the expression for the radiation resistance.	15
	(b)	Using the above derivation find the radiation resistance for a half wave dipole	5
6	(a)	Define the broad side and end fire array of antenna.	4
	(b)	Deriving the necessary equations obtain the phase difference needed between the elements of an array to achieve broadside and end fire radiation pattern.	2+2
	(c)	Prove that to avoid grating lobes the maximum spacing between the array elements for broadside will be $d \le \lambda$ and for end fire will be $d \le \frac{\lambda}{2}$	5
	(d)	Prove that for large broadside array ($L \gg d$) the directivity of the array becomes$D_0 \approx \frac{2L}{\lambda}$.	7
7	(a)	What are the advantages and disadvantages of microstrip patch antenna?	4
	(b)	How does microstrip antenna radiate?	4
	(c)	What is fringe field? How does it modify the length of the antenna?	3+2
	(d)	What are the different types feeding techniques used? Compare these methods in terms of spurious feed radiation, reliability, fabrication, impedance matching and bandwidth	2+5