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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (R, S) / S7 (PT) (R,S) Examination November 2024 (2019 Scheme)

Course Code: ECT401

Course Name: MICROWAVES AND ANTENNAS

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks. Marks

1		What is aperture efficiency of an antenna? Find the effective aperture of a hypothetical, idealized isotropic antenna with Directivity D = 1.	(3)
2		Explain about the antenna field zones.	(3)
3		Derive the expression for apex angle of a log periodic antenna.	(3)
4		With a neat diagram explain the Cassegrain feed method for a parabolic antenna.	(3)
5		Explain the principle of pattern multiplication with an example of resultant pattern of four isotropic elements spaced at $\lambda/2$.	(3)
6		What is the concept of phased arrays? Give any two types of phased arrays.	(3)
7		Calculate the lowest resonant frequency of a rectangular cavity resonator with dimensions a = 2 cm ,b = 1cm and d = 3 cm.	(3)
8		What is a re-entrant cavity in microwave engineering, and what are the different types.	(3)
9		What are the different modes in Gunn diode?	(3)
10		Derive the S matrix of a two- port network.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	Explain and derive the mathematical relationship between gain and directivity for an ideal, lossless antenna, and interpret what this relationship implies about the antenna's radiation characteristics.	(7)
	b)	State and prove Reciprocity theorem.	(7)

OR

12	a)	Derive Helmholtz theorem of a vector field.	(6)
	b)	Derive the Radiation Resistance of a half wave dipole antenna.	(8)

Module II

13 a) Differentiate between axial mode and normal mode of a helical antenna and write down the design equations. (7)

b) With necessary diagrams explain the working and feed techniques of a microstrip antenna. (7)

OR

14 a) Explain the working principle of a horn antenna and discuss how the shape of the horn affects its performance. Mention the types of horn antennas commonly used in communication systems. (7)

b) Why Log Periodic antenna is called as Frequency Independent antenna? Draw the structural geometry of a log periodic antenna array and explain its design steps. (7)

Module III

15 a) Derive the expression for the array factor of a broad side array of N isotropic point sources and also the expression for major lobe, minor lobe and null of the array and plot the same for N=4 and d= $\lambda/2$. (9)

b) Compare broadside and end fire arrays. (5)

OR

16 a) Using the Dolph-Chebyshev technique, determine the weights for a 4-element array with $\lambda/2$ spacing between elements. Ensure that the side lobe level is 19.1 dB below the main lobe. (8)

b) What are grating lobes? How can it be minimised? (6)

Module IV

17 a) Using a structural diagram and an Applegate diagram, explain the working of a reflex klystron. (9)

b) What are slow wave structures? Explain its types. (5)

OR

18 a) Show that magnitude of the velocity fluctuation of the electron beam in a TWT is directly proportional to the magnitude of the axial electric field. (9)

b) An X-band pulsed cylindrical magnetron has a Magnetic flux density Bo = 0.336 Wb/m2, cathode cylinder radius a = 5 cm, vane edge to centre radius b = 10 cm, find i) The cyclotron angular frequency and ii) The cutoff voltage for a fixed Bo. Given that the charge to mass ratio of electron = $1.759 * 10^{11}$ C/Kg. (5)

Module V

19	a)	With the help of a structure explain the working of a two hole directional coupler.	(4)
	b)	An input power of 10 mW is applied to the port 1 of a 20 dB directional coupler. Determine the coupled power at port 4.	(3)
	c)	Explain the working of a Ferrite isolator. What is its S matrix?	(7)

OR

20	a)	With neat sketches explain the working of magic Tee. Derive its S matrix	(8)
	b)	Draw the J-E characteristics of a Gunn diode and explain the different regions.	(6)

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