Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Examination December 2022 (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		Differentiate between Gain and Directivity of an antenna.	(3)
2		Derive expression for effective aperture of an antenna.	(3)
3		Explain the principle of operation of a Horn Antenna.	(3)
4		Explain the working of an Inverted – F antenna.	(3)
5		Explain the principle of Pattern Multiplication.	(3)
6		Explain the concept of phased arrays.	(3)
7		Derive expressions for the resonant frequency of a rectangular cavity resonator.	(3)
8		Derive expressions for the efficiency of a Reflex Klystron	(3)
9		List the important properties of Scattering parameters.	(3)
10		What do you mean by Gunn Effect?	(3)

PART B

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

Module I

11	a)	With the help of a neat figure explain about the antenna field zones.	(6)
	b)	Derive expressions for the Radiation Resistance and Directivity of a short dipole antenna.	(8)

OR

12	a)	State and prove Reciprocity Theorem.	(7)
	b)	Derive Helmholtz Equation in terms of Vector Magnetic Potential.	(7)

Module II

13	a)	Explain the axial mode and normal mode of operation of a helical antenna.	(6)
	b)	Design a rectangular patch antenna using a substrate with a dielectric constant of 10.5, h = 0.126 cm so as to resonate at 1.65 Ghz .	(8)

OR

14	a)	Explain the steps involved in the design of a Log Periodic Dipole Array.	(7)

b) With the help of neat sketches explain the working principle of parabolic dish antenna. What are the typical feed antennas used with Dish antennas ? (7)

Module III

15 a) Derive expression for the total field radiated by two isotropic point sources fed with current of same amplitude and phase. Also find the directions of maxima and minima. (7)

b) Derive expressions for the array factor of a linear array of n-isotropic point sources of equal amplitude and spacing. Derive the conditions for using this array as an end fire array. (7)

OR

16 a) Explain the difference between broadside array and end fire array (4)

b) Design a 7 element Dolph-Chebyshev array with a spacing of d = $\lambda/2$. The pattern is to be optimum with a side lobe of 22 db down the main lobe maximum. (10)

Module IV

17 a) With the help of a neat diagram explain the working of a Reflex Klystron. (7)

b) A cylindrical magnetron has the following operating parameters : V_o = 25KV, I_o = 28A, B_o = 0.332 Wb/m^2 , a = 5 cm , b = 10 cm. Find (7)

a) Cutoff voltage for a fixed B_o,

b) Cut of magnetic Flux Density for a fixed V_o

OR

18 a) Derive expressions for the Hull cut off Magnetic Field and Voltage of a magnetron. (7)

b) With diagram explain the amplification process in a travelling wave tube (7)

Module V

19 a) Explain the important properties of Magic Tee. Derive its Scattering parameters (7)

b) Explain the different modes of operation of Gunn Diode. (7)

OR

20 a) Explain the working of two hole directional coupler. Derive its Scattering parameters. (7)

b) With the help of neat sketches explain the working of a circulator. (7)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree (S, FE) Examination May 2023 (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		Define the term 'Beam solid angle'. Also derive the relation between beam solid angle and directivity	(3)
2		List the different types of antennas based on the radiation pattern	(3)
3		Compare different feeding method of parabolic dish antenna.	(3)
4		Why Log Periodic antenna is called as Frequency Independent antenna, explain?	(3)
5		Explain (i) Pattern Multiplication (ii) Grating lobes	(3)
6		Find the FNBW of linear array of 4 isotropic point sources with n=4, d=λ/2 and δ=0?	(3)
7		Explain the working of a cavity resonator. Give a practical use of cavity resonator.	(3)
8		With the help of an example , explain the significance of slow wave structures used in microwave circuits	(3)
9		Explain with figure , the working of ferrite isolator	(3)
10		Write a short note on Phase shifter.	(3)

PART B

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

Module I

11	a)	Derive the expressions for the Radiation resistance and Directivity of a short dipole antenna	(10)
	b)	The radiation resistance of a short dipole of length 0.1 times the wavelength is 8 ohms. Calculate the radiation resistance when the length of dipole is reduced by a factor of ½	(4)

OR

12 a) A lossless half wave dipole antenna with input impedance of 73Ω is connected to a 50Ω transmission line (Let$U = B_0 sin^3(\theta)$). Find Gain and overall efficiency. (7)

b) State and prove Helmholtz theorem (7)

Module II

13 a) Explain the design steps of a rectangular microstrip antenna (8)

b) Distinguish between the normal and axial modes of radiation from a helical Antenna (6)

OR

14 a) Explain the working of horn antenna .Write down the expression for directivity, gain and HPBW (7)

b) Explain the working principle of parabolic dish antenna. Write down the expression for directivity, gain and HPBW (7)

Module III

15 a) Explain Chebyshev array and write down the procedure for finding the expression array factor (10)

b) Derive the expression for Array factor of an array of odd numbers of isotropic elements is positioned symmetrically along the z-axis. Assume that the non-uniform amplitude excitation is symmetrical about the origin (4)

OR

16 a) Design a Broadside Array and plot its radiation pattern. (7)

b) Show that for an array of two isotropic point sources with identical amplitude and phase, have a broadside radiation pattern (7)

Module IV

17 a) With the help of neat diagrams explain the working of an magnetron. (7)

b) With neat diagram describe the constructional features and working principle of a Travelling Wave Tube (7)

OR

18 a) Show that the axial electric field of TWT varies with convection current. (7)

b) A reflex klystron operates under the following conditions: (7)

Cathode voltage , Vo=600V

Rsh = l5Kohm

Oscillating frequency , fr= 9 GHz ,

Distance between Rentrant cavity and Repeller , L =1 mm

Given J(1.832) = 0.582 The tube is oscillating at fr at the peak of the n = 2 mode or 1 3/4 mode. Assume that the transit time through the gap and beam loading can be neglected

(i) Find the value of the repeller voltage Vr.

(ii) Find the direct current necessary to give a microwave gap voltage of 200 V.

(iii) What is the electronic efficiency under this condition?

Module V

19	a)	Explain the features of magic tee and derive its s- matrix	(7)
	b)	With a schematic diagram describe the operation of a four-port circulator. Obtain the S matrix of a perfectly matched, lossless four port circulator	(7)

OR

20	a)	Explain the working of a microwave amplifiers using MESFET	(7)
	b)	Explain the working principle of a 2 hole directional coupler and derive its S matrix	(7)

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