GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
RF & MICROWAVE ENGINEERING
EC603

TIME ALLOTTED: 3 HR **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)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

			Marks	CO No.
1.	(i)	Distance between successive maxima and minima of standing wave is a) $\lambda/2$ b) λ c) $3\lambda/2$ d) $\lambda/4$	1	CO2
	(ii)	In a Strip line the dominant mode of propagation is a) TE b) TM c) TEM d) none of these	1	CO4
	(iii)	The dominant mode of propagation in a rectangular waveguide is a) TE_{11} b) TE_{10} c) TE_{12} d) TM_{11}	1	CO2
	(iv)	The cut-off frequency of TM10 mode is $f_c = c/2a$ where c = velocity of light, a = waveguide dimension a) True b) False	1	CO2
	(v)	Which of the following modes are characterized by $Ez = Hz = 0$? a) TE b) TM c) TEM d) none of these	1	CO2
	(vi)	Microwave Frequency range and their application: a) PN junction diode b) IMPATT diode c) TRAPATT diode d) BARITT diode	1	CO1

(vii)	Microwave semiconductor devices are basically a) positive resistance device b) negative resistance device c) zero resistance device d) none of these	1	CO1
(viii)	A microwave circulator is a multiport waveguide junction by which the wave can flow only from the n-th port to ($n + 1$) th port in one direction a) True b) False	1	CO3
(ix)	The Frequency band of Ku band is: a) 12-18 GHz b) 18-27 GHz c) 27-40 GHz d) 40-300 GHz	1	CO1
(x)	The cavity magnetron uses strapping to a) prevent mode jumping b) improve the phase focusing effect c) ensure bunching d) prevent cathode back-heating	1	CO5
(xi)	For the transferred electron effect to occur the separation of energy between the lower and upper valley must be a) much larger than the thermal energy at room temperature b) much lower than the thermal energy at room temperature c) equal to the thermal energy at room temperature d) none of these	1	CO5
(xii)	The device used to get the measurement of S parameters of n- port micro wave network is: a) CRO b) Network analyzer c) Circulator d) Attenuator	1	CO3

GROUP – B
(Short Answer Type Questions)

(Answer any *three* of the following) **3 x 5 = 15**

		Marks	CO No.
2.	A TE_{11} mode is propagating through a circular waveguide. The radius a of the guide is 5 cm and the guide contain air as dielectric medium. Determine a) The cut-off frequency b) The wavelength in the guide for an operating frequency of 3GHz. Given $X_{11} = K_c$. $\alpha = 1.841$ where k_c is the cut - off wave number.	5	CO2
3.	Compare the performance of rectangular waveguide and circular waveguide.	3	CO2
	Define the term "dominant mode" and "degenerate mode" as applied to waveguide.	2	CO2
4.	What is an E - plane Tee? Define its S-matrix.	5	CO3

5.		What is meant by π mode operation in a magnetron containing eight cavity resonators?	5	CO4
6.		Explain Transit Time and Mode Number of a Reflex Klystron with suitable diagram.	5	CO4

GROUP – C
(Long Answer Type Questions)

(Answer any *three* of the following) **3 x 15 = 45**

			Marks	CO No.
7.	a)	What are the advantages and disadvantages of a micro strip line?	3	CO4
	b)	Show the electric and magnetic field line configurations in microstrip lines for Quasi TEM mode.	4	CO4
	c)	A microstrip line is composed of zero thickness copper conductors on a substrate having ε_r=8.4, tan δ= 0.0005 and thickness 2.4mm. If the line width is 1 mm, and operated at 10 GHz, calculate a) the characteristics impedance, b) the attenuation due to conductor loss and dielectric loss.	8	CO4
8.	a)	Consider a lossless two-port network. i) If the network is reciprocal, show that 2 11 2 S21 =1− S . ii) If the network is nonreciprocal, show that it is impossible to have unidirectional transmission, where, S12=0 and S21≠0.	5	CO3
	b)	From the properties of a Directional coupler derive the *S* matrix of the ideal Directional coupler.	5	CO3
	c)	Give the differences between E-plane and H-plane Tee with the help of suitable diagrams.	5	CO3
9.	a)	Make a classification of different types of magnetrons.	5	CO5
	b)	What do you mean by slot line? Explain with the help of a suitable diagram.	5	CO5
	c)	An *X* band pulsed cylindrical magnetron has the following operating parameters: Anode Voltage V_0 = 26 kV, Beam Current I_0 = 27A, Magnetic flux density $B_0 = 0{\cdot}336$ Wb/m^2 , Radius of cathode cylinder a = 5 cm, Radius from the centre of the cathode to the edge of the anode b = 10 cm. Compute (i) The cyclotron angular frequency (ii) The cut-off voltage for a fixed B_0 (iii) The cut-off magnetic flux density for a fixed V_0.	5	CO5
10.	a)	Explain with experimental set-up the measurement technique of high VSWR >20.	7	CO5
	b)	Describe the construction and operation of a GaAs Gunn diode using energy band diagram. Explain the Gunn mode of operation.	8	CO5
11.		Write short notes on any **three** of the following:	3×5=15	
	a)	VSWR	5	CO1
	b)	Frequency Measurement Technique	5	CO1
	c)	IMPATT diode oscillator	5	CO2
	d)	Helix-TWT	5	CO2
	e)	Magic Tee	5	CO3