

GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2020-2021

RF & MICROWAVE ENGINEERING

EC701

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

(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)	A hollow waveguide behaves as a) Low Pass Filter b) Band Pass Filter c) High Pass Filter d) All Pass Filters	1	CO2
1(ii)	The dominant mode of propagation in a rectangular waveguide is a) TE ₁₁ b) TE ₁₀ c) TE ₁₂ d) TM ₁₁	1	CO2
1(iii)	The cut-off frequency of TE ₁₀ mode is $f_c = c/2a$ where c = velocity of light, a = waveguide dimension a) True b) False	1	CO2
1(iv)	Which of the following modes are characterized by $E_z = 0$ and $H_z = 0$? a) TE b) TM c) TEM d) none of these	1	CO2
1(v)	Electromagnetic cavity resonators as energy store devices are used in a) klystron b) directional coupler c) circulator d) magic tee	1	CO4
1(vi)	Microwave semiconductor devices are basically a) positive resistance device b) negative resistance device c) zero resistance device d) none of these	1	CO1

1(vii)	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
1(viii)	An example of Transferred electron device is a) Tunnel Diode b) MESFET c) Gun Diode d) IMPATT Diode	1	CO5
1(ix)	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
1(x)	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
1(xi)	In a Strip line the dominant mode of propagation is a) TE b) TM c) TEM d) none of these	1	CO4

GROUP – B

(Short Answer Type Questions)

(Answer any *three* of the following)

3 x 5 = 15

		Marks	CO No.
2.	Derive the zero property of S matrix.	5	CO3
3.	What is meant by π mode operation in a magnetron containing eight cavity resonators?	5	CO4
4.	A TE_{11} mode is propagating through a circular waveguide. The radius a of the guide is 5 cm and the guide contains 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
5.	Describe the operation of four-port microwave circulator.	5	CO3
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) Describe an ideal Directional coupler with the help of a suitable diagram. Define 'Coupling factor' and 'Directivity' in the context of a coupler.	5	CO3
	b) From the properties of a Directional coupler derive the S matrix of the ideal Directional coupler.	5	CO3
	c) Describe the working principle of a Faraday rotation isolator with the help of a suitable diagram.	5	CO3
8.	a) Make a classification of different types of magnetrons.	5	CO5
	b) Draw the diagram of a cylindrical magnetron and derive the hull cut-off magnetic field equation and the corresponding cut-off voltage.	5	CO5
	c) An X band pulsed cylindrical magnetron has the following operating parameters: Anode Voltage $V_0 = 26$ kV, Beam Current $I_0 = 27$ A, Magnetic flux density $B_0 = 0.336$ 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
9.	a) What are the advantages and disadvantages of microstrip 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 $\epsilon_r=8.4$, $\tan \delta= 0.0005$ 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
10.	a) Explain with experimental set-up the measurement technique of high VSWR >20.	7	CO5
	b) Define quality factor Q for a rectangular cavity and derive the expression for the unloaded Q for dominant TE_{101} mode.	8	CO5
11.	Write short notes on any three of the following	3×5	
	a) Tunnel Diode	5	CO1
	b) IMPATT diode oscillator	5	CO1
	c) TWT amplifier	5	CO3
	d) Precision waveguide phase shifter	5	CO3