

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**  
(MID SEMESTER EXAMINATION MO/2023)

CLASS: B.Tech  
BRANCH: ECE

SEMESTER : VII  
SESSION : MO/2023

SUBJECT: EC401R1 MICROWAVE THEORY AND TECHNIQUES

TIME: 02 Hours

FULL MARKS: 25

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

		CO	BL
Q.1(a)	Differentiate between the TEM and Non-TEM lines giving suitable examples.	[2] CO1, CO2	2
Q.1(b)	Show that for a single port network the reflection coefficient is given as $S_{11} = \frac{Z_{11} - 1}{Z_{11} + 1}$	[3] CO1, CO2	3
Q.2(a)	Differentiate between intrinsic impedance and wave impedance.	[2] CO1, CO2	2
Q.2(b)	Given for a two-port network: $[S] = \begin{bmatrix} 0.15\angle 0^\circ & 0.85\angle 45^\circ \\ 0.85\angle 45^\circ & 0.2\angle 0^\circ \end{bmatrix}$ ; Determine (i) if the network is reciprocal and lossless. (ii) the reflection coefficient at port 1 if port 2 is terminated with a matched load.	[3] CO1, CO2, CO5	3
Q.3(a)	Derive [S] matrix for an E-plane waveguide power divider.	[2] CO1, CO2, CO5	5
Q.3(b)	Prove that a physical realization of a 3-port network is not possible if it is required to be lossless, reciprocal, and matched at all the ports.	[3] CO1, CO2, CO5	4
Q.4(a)	What are properties of Quadrature Hybrid coupler? Write the S-matrix for Quadrature (90°) Hybrid coupler.	[2] CO1, CO2, CO4, CO5	1
Q.4(b)	A directional coupler has the scattering matrix given below. Determine the directivity, coupling, isolation, and return loss at the input port when the other ports are terminated in matched loads. $[S] = \begin{bmatrix} .05\angle 30^\circ & .96\angle 0^\circ & .1\angle 90^\circ & .05\angle 90^\circ \\ .96\angle 0^\circ & .05\angle 30^\circ & .05\angle 90^\circ & .1\angle 90^\circ \\ .1\angle 90^\circ & .05\angle 90^\circ & .04\angle 30^\circ & .96\angle 0^\circ \\ .05\angle 90^\circ & .1\angle 90^\circ & .96\angle 0^\circ & .05\angle 30^\circ \end{bmatrix}$	[3] CO1, CO2, CO4, CO5	3
Q.5(a)	Describe the limitations of a conventional tube at microwave frequencies?	[2] CO1, CO3	2
Q.5(b)	Illustrate the velocity modulation of a two cavity Klystron with the help of a suitable diagram.	[3] CO1, CO3	4

:::19/09/2023 M:::