CLASS: BTECH   SEMESTER : VII
BRANCH: ECE   SESSION : MO/2024

SUBJECT: EC401 MICROWAVE THEORY AND TECHNIQUES
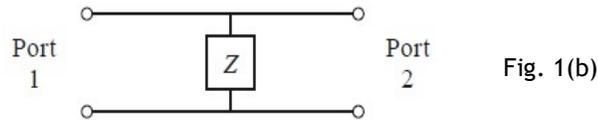TIME: 3 Hours   FULL MARKS: 50

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	A two-port network is known to have the following scattering matrix	[5]	1	III

$$[S] = \begin{bmatrix} 0.15\angle 0^0 & 0.85\angle -45^0 \\ 0.85\angle 45^0 & 0.2\angle 0^0 \end{bmatrix}$$

If port 2 is terminated with a short circuit. What is the return loss seen at port 1

Q.1(b)   Determine the $[S]$ matrix for the circuit shown in Fig. Q1(b)   [5]   1   V

Fig. 1(b)

Q.2(a)   Design a microstrip lossless T-junction power divider with a $30\,\Omega$ source impedance to give   [5]   2   VI
a $3:1$ power split. Design quarter-wave matching transformers to convert the impedances
of the output lines to $30\,\Omega$. Determine the $[S]$ matrix for this circuit, using a $30\,\Omega$
characteristic impedance.

Q.2(b)   Using the even and odd mode analysis, determine the $[S]$ matrix for the quadrature 90^0 [5]   2   V
hybrid coupler.

Q.3(a)   Discuss the three limitations of conventional vacuum tubes over the microwave tubes.   [5]   3   II
Q.3(b)   With the help of applegate diagram and schematic layout diagram, explain the working   [5]   3   I
principle of two cavity Klystron amplifier.

Q.4(a)   Derive the expression of transfer function of low-pass filter and calculate its group delay.   [5]   4   VI
Q.4(b)   Design an N = 3 Chebyshev bandpass filter with a 3 dB passband ripple for a communication   [5]   4   VI
link. The center frequency is at 2.4 GHz and the filter has to meet a bandwidth
requirement of 20%. The filter has to be inserted into a 50 Ω characteristics line
impedance. Find the various inductive and capacitive elements and draw the circuit
diagram. The coefficients for the standard 3 dB Chebyshev normalized low pass filter
prototype are $g_0 = g_4 = 1$, $g_1 = g_3 = 3.3487$, $g_2 = 0.7117$.

Q.5(a)   A small AC (microwave) magnetic field, $\bar{H}$ is applied to the magnetically saturated ferrite   [5]   5   III
material biased by $\hat{Z}$-directed DC magnetic field, $\bar{H}_0 = \hat{Z}H_0$. For this situation, derive the
equations of motion for the forced precession of the magnetic dipoles and tensor
permeability $[\mu]$ matrix.

Q.5(b)   Explain the working principle of Nonreciprocal Faraday rotation phase shifter   [5]   5   II