ANNA UNIVERSITY CHENNAI-25 CONTROLLER OF EXAMINATIONS (UD) ADDITIONAL

REG.No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2024

Electronics and Communication Engineering
Fourth Semester

EC5401 - TRANSMISSION LINES AND WAVEGUIDES

(Regulation 2019)

(Smith Chart is Permitted)

Time:3hrs Max.Marks:100

CO1	Ability to apply Transmission Line concepts and obtain general solution
CO2	Ability to analyze the impedance concepts
CO3	Ability to apply filter basics and design element filters
CO4	Ability to analyze the behavior of guiding structures
CO5	Ability to apply reflection and coupling concepts to coplanar waveguide

BL–Bloom'sTaxonomyLevels
(L1-Remembering,L2-Understanding,L3-Applying,L4-Analysing,L5-Evaluating,L6-Creating)

(Answer all Questions)

PART – A (10 x 2 = 20 Marks)

Q.No	Questions	Marks	CO	BL
1	A transmission line has the following primary constants: R = 23 Ω km^{-1}, G = 4 mS km^{-1}, L = 125 μH km^{-1} and C = 48 nF km^{-1}. Calculate the characteristic impedance Z_0, of the line at a frequency of 10 MHz.	2	1	2
2	What is Inductive loading and infinite line.	2	1	1
3	Find the length of the transmission line if its input impedance is 200 Ω and the load impedance is 200 Ω. Assume the operating frequency is 150 MHz.	2	2	2
4	A transmission line has a characteristic impedance (Z_0) of 90 Ω. Its electrical length is λ/4 and it is terminated by a load impedance (Z_L) of 20 Ω. Calculate the input impedance (Z_{in}) presented by the line.	2	2	2
5	What are the limitations of constant – k filter? How it is overcome by m derived filter?	2	3	1
6	Determine the characteristics impedance of a symmetrical π network with Z_1 = 75 Ω and Z_2 = 50 Ω.	2	3	2
7	Justify why TEM, TM_{01} and TM_{10} modes does not exist in a rectangular waveguide?	2	4	2
8	Is wave propagation in parallel plane dispersive? Justify your answer?	2	4	2
9	What are the applications of Time domain reflectometer.	2	5	1
10	How cross talk occurs in coupled lines? How does it affect the system performance?	2	5	2

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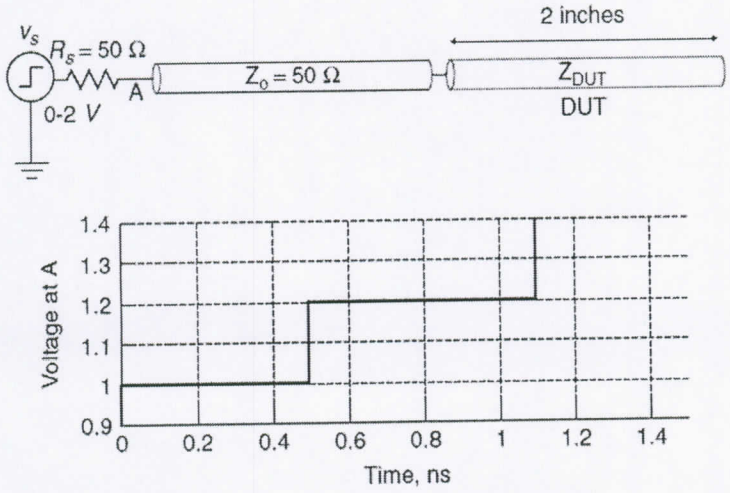
PART – B (5 x 13 = 65 Marks)

Q.No	Questions	Marks	CO	BL
11(a) (i)	Derive the transmission line equation and obtain the general solution for voltage V and current I on the line.	9	1	2
(ii)	Calculate the voltage reflection coefficient for the case where $Z_L = (80 - j10)\ \Omega$ and $Z_0 = 50\ \Omega$.	4	1	2
	OR			
11(b) (i)	For a uniformly loaded telephone cable, show that the attenuation constant and phase velocity are independent of frequency.	9	1	2
(ii)	Mention the properties of 'S' parameters.	4	1	2
12(a) (i)	Derive the expression for voltage and current on dissipation less line and find input impedance.	9	2	2
(ii)	A 75 Ω line is left unterminated with an open circuit at one end and its electrical length is λ/5. Calculate its input impedance at the other end.	4	2	4
	OR			
12(b) (i)	Write short notes on λ/8, λ/4 & λ/2 lines. (3 x 3 =9)	9	2	2
(ii)	A transmission line with characteristic impedance of 50 Ω is terminated with a load impedance of (100+j50)Ω. Find its reflection coefficient and input impedance if the line length is 0.4 λ using **SMITH CHART**.	4	2	4
13(a)(i)	Design constant K high pass filter of T and π type to meet the following specifications: f_c=12 KHz and R = 400Ω.	9	3	3
(ii)	Sketch the basic circuit for the T and π type band pass filter.	4	3	2
	OR			
13(b) (i)	Design an m-derived T type low pass filter connected to a load of 450 Ω. The filter should have a cutoff frequency of 5 kHz and peak attenuation at 4 KHz.	9	3	3
(ii)	Design a T-pad attenuator to give an attenuation of 60 dB and to work in a line of 400 Ω impedance.	4	3	2
14(a) (i)	Starting from Maxwell's equation obtain the expressions for various components of Electric and Magnetic field strengths. Assuming waves are propagating between parallel planes.	9	4	2
(ii)	Infinitely long, parallel conducting planes are separated by a distance of 1.5 cm. Find cut off frequency.	4	4	3
	OR			
14(b) (i)	Obtain the expression for the field components of the transmission of TM and TE waves in circular wave guide.	9	4	2
(ii)	Find the resonant frequency of the lowest mode of an air filled rectangular cavity of dimensions 5cm x 3cm x 2.5cm.	4	4	3

15(a) (i)	Draw and explain the geometry and field configuration of Strip line and derive the expressions for its design equations.	9	5	2
(ii)	Find the width for a 50 Ω copper Strip line conductor, with b = 0.32cm and ε_r = 2.20. If the dielectric loss tangent is 0.001 and the operating frequency is 10GHz. Calculate the attenuation in dB/λ. Assume a conductor thickness of t = 0.01mm.	4	5	3
	OR			
15(b) (i)	Sketch the generic time-domain reflectometry measurement setup. Explain how to measure the characteristic impedance of a transmission line using TDR ?	9	5	2
(ii)	Calculate the equivalent *L* and *C* per unit length of the 2-inch transmission line measured with TDR profile shown in Figure 15. b. ii.  Figure 15. b. ii.	4	5	3

PART - C (1 x 15 = 15 Marks)

Q.No	Questions	Marks	CO	BL
16.(i)	A 50 Ω transmission line is connected to a series load impedance Z_L = (40 – j80) Ω. Find the position and length of a short circuited single stub required to match the line.	9	2	3
(ii)	Two microstrip lines are printed on the same dielectric substrate. One line has a wider centre strip than the other. Which line has the lower characteristic impedance? Assume that there is no coupling between the two lines.	4	4	2
(iii)	State the conditions for determining cut-off frequency in a lumped filter network.	2	3	2