Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End term Examinations – December 2025

Date: 19 / 12/ 2025 **Time:** 01:00pm –04:00pm

School: SoE	**Program: B. Tech**	
Course Code: ECE3009	**Course Name: Transmission Lines and Waveguide**	
Semester: V	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Marks	**15-20**	**20-25**	**20-25**	**15-20**	**15-20**	**15-20**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	The phase velocity of a signal whose frequency is 100MHz on a transmission line is $v_p = 2 * 104$km/s. Find its wave-length.	**2 Marks**	**L1**	**CO1**
2.	How many conductors does a transmission line have?	**2 Marks**	**L1**	**CO1**
3.	What is the value of α for a loss-less transmission line?	**2 Marks**	**L2**	**CO2**
4.	What is the expression for Z0 of a transmission line in terms of R, L, G, C and ω?	**2 Marks**	**L2**	**CO2**
5.	What should be the direction of rotation on a Smith chart to reach from load to generator?	**2 Marks**	**L2**	**CO3**
6.	What is the equivalent fraction of wavelength for a full rotation (of 360◦) on a Smith chart?	**2 Marks**	**L2**	**CO3**
7.	What is a rectangular waveguide generally made up of?	**2 Marks**	**L2**	**CO4**
8.	Which of these modes have the lowest cut-off frequency- TE10, TE21, TE3	**2 Marks**	**L2**	**CO4**
9.	What kind of a filter is a waveguide?	**2 Marks**	**L2**	**CO5**
10.	What are advantages of optical fiber cable.	**2 Marks**	**L2**	**CO6**

Part B

Answer the Questions. **4Qx 20M = 80M**

11.	**a.**	A lossy cable operating at a frequency of 1 GHz has the following parameters: resistance R = 2.5 ohm/m, inductance L = 10 microH/m, capacitance C = 1 pF/m, and conductance G = 0. Determine the attenuation constant of this transmission line**.**	08 Marks	**L3**	**CO 1**
	b.	Illustrate the equivalent circuit of a transmission line and derive the expression for its characteristic impedance.	12 Marks	L3	CO 1
		Or			
12.	a.	A 30-meter lossless transmission line has a characteristic impedance (Z0) of 50 Ω and operates at 2 MHz. The line is terminated with a load impedance (ZL) of 60+j40 Ω. Calculate the following: a. The reflection coefficient (Γ). b. The voltage standing wave ratio (VSWR).	10 Marks	L3	CO 3
	b.	How are the voltage standing wave ratio (VSWR) and the reflection coefficient related? Explain the physical meaning and importance of this relationship.	10 Marks	L3	CO 2

13.	**a.**	For a transmission line with a characteristic impedance (Z0) of 75 Ω, the load impedance (ZL) is (100+j150) Ω. If the line's length is 1.2λ, find the following: a. Normalized load impedance. b. Standing wave ratio. c. Magnitude of the reflection coefficient. d. Phase angle of the reflection coefficient	10 Marks	**L3**	CO3
	b.	Describe the various types of losses that occur in a transmission line. How do these losses correlate with the operating frequency?	10 Marks	L3	CO3
		Or			
14.	a.	A transmission line has the following constants: R=10.4 ohms, L=3.66 mH, C=0.00835 mF, and G=0.08 micro mhos. a. Determine the characteristic impedance (Z0). b. Calculate the attenuation constant (α), phase constant (β), and phase velocity (Vp) at an angular frequency (ω) of 5000 radians per second.	08 Marks	L2	CO2
	b.	A transmission line with a characteristic impedance of 50 Ω is terminated by a load impedance of (100−j80) Ω. Using a Smith chart, find the following: I. Reflection coefficient. II. Standing wave ratio. III. Input impedance of the line at a distance of λ/8 from the load.	12 Marks	L2	CO3

15.	**a.**	What are the different modes of propagation supported by a rectangular waveguide? Explain them with their corresponding equations.	**10 Marks**	**L3**	**CO 4**
	b.	A rectangular waveguide with dimensions a = 2.5 cm and b = 1 cm operates below 15.1 GHz. The waveguide is filled with a medium where σ=0, ϵr=4ϵ0, and μr=1. How many TE and TM modes can be transmitted? Calculate the cutoff wavelengths for these modes.	10 Marks	L2	CO 4
		Or			
16.	a.	State the field equations for TE and TM modes in a rectangular waveguide using Maxwell's equations	10 Marks	L2	CO 5

	b.	A rectangular waveguide with dimensions a = 2 cm and b = 1 cm is filled with a material having μ_r=1 and ϵ_r=81. The waveguide operates at 3 GHz. Find all the possible propagating modes and their corresponding cut-off frequencies	10 Marks	L2	CO 4

17.	**a.**	Explain the working principle of a rectangular resonant cavity.	12 Marks	**L2**	**CO5**
	b.	An air-filled circular waveguide has a radius 2.5 cm and is excited in the dominant mode at a frequency (f) of 12 GHz. Determine: (i) Cut off frequency (fc) (ii) Guide wavelength (iii) Intrinsic wave Impedance	08 Marks	L3	CO6
		Or			
18.	a.	Derive the condition for total internal reflection and mode number.	12 Marks	L3	CO6
	b.	Derive the expression for its resonant frequency in TE and TM modes. Calculate the resonant frequency for a cavity of dimensions a=5 cm,b=3 cm,c=2 cm for the TE_{101} mode.	08 Marks	L3	CO5