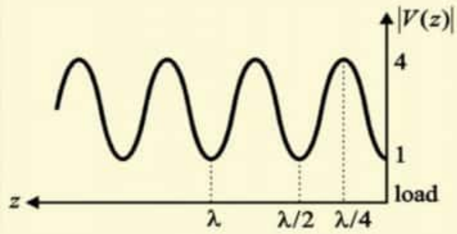
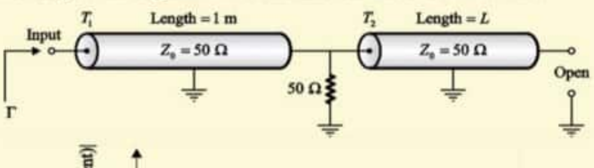
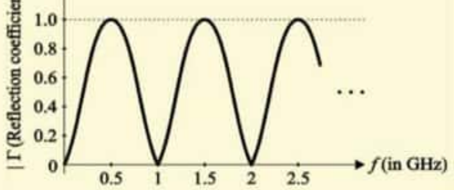
Department of Electrical Engineering
Assignment
Date: 17/04/2020

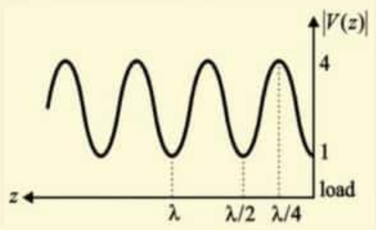
Course Details

Course Title: Antennas & Wave Propagation **Module:** 8th semester
Instructor: Sir Dr Nayeem Kakar **Total Marks:** 30

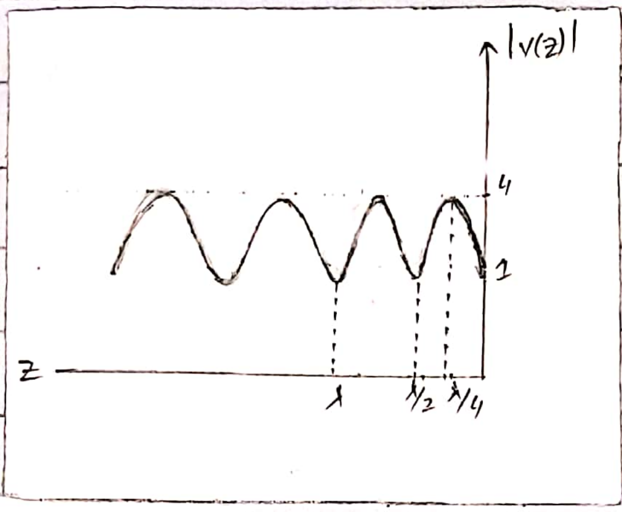
Student Details

Name: SAQIB ALI **Student ID:** 13041

Q1.	(a)	Voltage standing wave pattern in a lossless transmission line with charac impedance 50 Ω and resistive load is shown in the figure.  **Qu.** The value of the load resistance is (A) 50 Ω (B) 200 Ω (C) 12.5 Ω (D) 0	Marks 6 CLO 2
	(b)	Draw & Explain Equivalent circuit model of a Transmission line	Marks 4 CLO 1
Q2.	(a)	A microwave circuit consisting of lossless transmission lines T_1 and T_2 is shown in the figure. The plot shows the magnitude of the input reflection coefficient Γ as a function of frequency f. The phase velocity of the signal in the transmission lines is 2×10^8 m/s.   The length L (in meters) of T_2 is ________. **[Set - 02]**	Marks 6 CLO 2

	(b)	Derive transmission line equation and describe what it says	Marks 4 CLO 1
Q3.	(a)	Voltage standing wave pattern in a lossless transmission line with characteristic impedance 50 Ω and resistive load is shown in the figure.  **Qu.** The reflection coefficient is given by (A) − 0.6 (B) – 1 (C) 0.6 (D) 0.2	Marks 4 CLO 2
	(b)	Explain two Impedance Matching techniques in detail?	Marks 6 CLO 2

Question No 1: Voltage Standing wave pattern in a lossless transmission line with characteristics impedance $50\,\Omega$ and resistive load as show in figure.



Solution:

Given Data

$Z_o = 50\,\Omega$

$V_{max} = 4$

$V_{min} = 1$

Required data

$Z_i = ?$

S. Wave radio = ?

As we know that

S. wave ratio = V_{max} / V_{min}.

puting values.

S. wave ratio = 4/1

S. wave ratio = 4.

Now find Z_i

S. wave ratio = Z_0 / Z_L

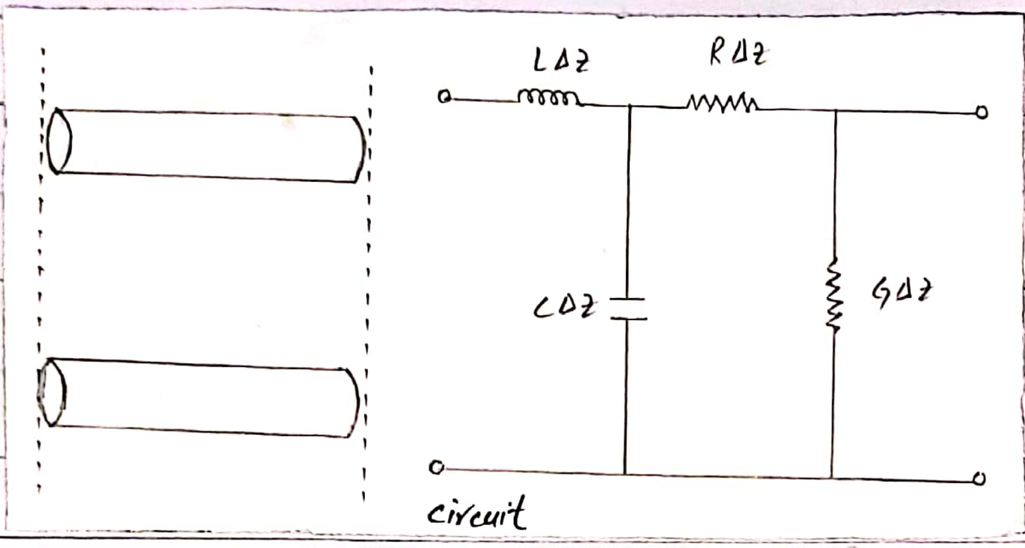
Z_L = Z_0 / S. wave ratio

Puting value

$Z_L = 50/4$.

$Z_L = 12.5\ \Omega$

Question No 1 (b) :- Draw and explain Equivalent circuit model of transmisstion line.



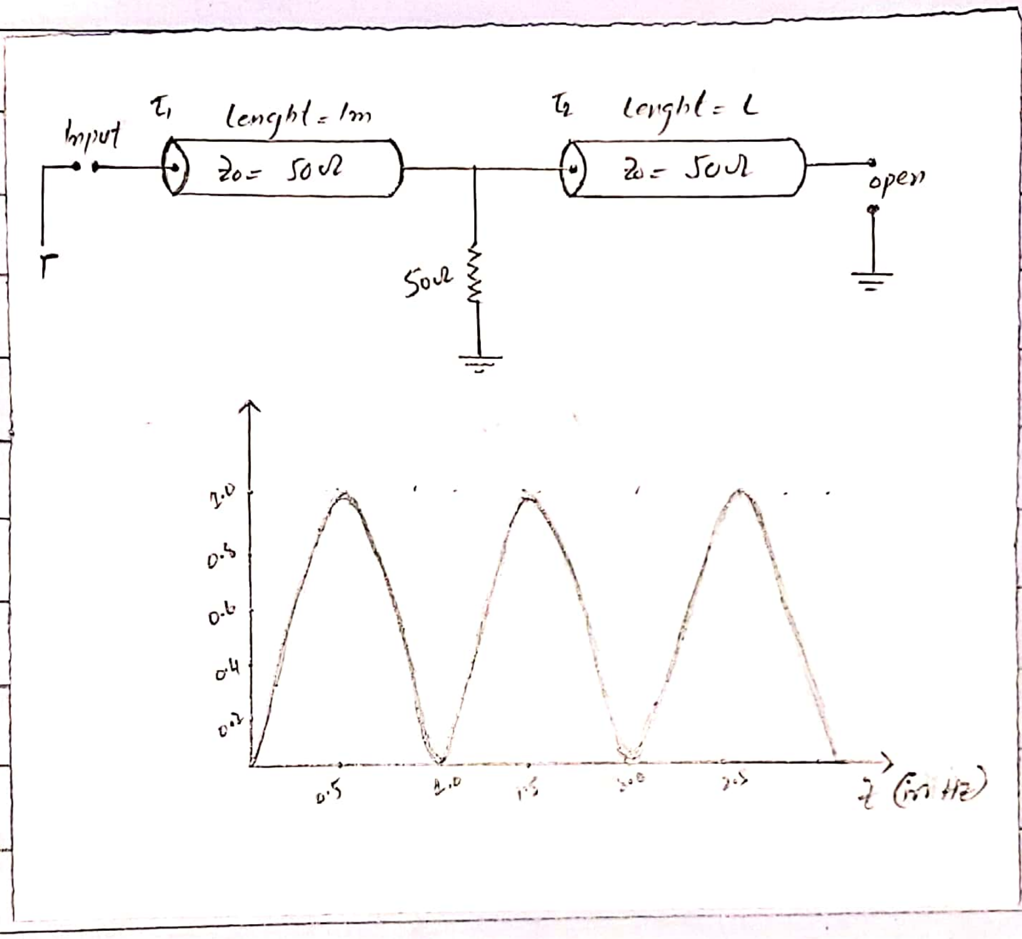
We Know that a constant parameter of the transmission line is our RLGC the only variable parameter changing are voltage and current that varies on the position (z- axis) with respected to time "t". We have the designed the characteries "distributed" circuit Model.

Suppose an infinite line of length ~~Delta~~ Δz by ampere's law whenever in a ~~closed~~ closed conductor current changing at produces an effect of that causing magnetic flux

Now when current are changing with respect to time "t" it directly effect on megenetic flux and voltage variation in the conductor along with electromotive force induced and attempts to drive the current oppositely (lenz low) ($V = L\, di/dt$) at the same time the two adjacent oppositely infinitesimal line conductor (upper and lower line) adoped the behaviour infinitesimal line conductor and capacitor which is model as a shunt capacitor as shown in figure.

In the present of imperfect conductor and faulty insulating materials voltage drop and current leakage occurs in the line. The model daigram clearly designed by series resistor and ~~Shu~~ shunt capacitor.

Question No 28-(a):- A microwave circuit ~~analysis~~ consisting of lossless transmission line T_1 and T_2 is show in figure



Solution:-

As we know that

$$\Gamma = Z_L - Z_0 / Z_L + Z_0$$

We know the frequency is 1 GHz.

Z_4 = 50Ω , ~~Z_0~~ =

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$z_b = jz_0 \cot \beta L$

$z_{eq} = z_a \parallel z_b = 50\Omega$

$z_b = \alpha$

So

$z_b = -jz_0 \cot 2\pi/\lambda \cdot L$

putting value of z_0

$z_b = -j\,50 \cot 2\pi/\lambda \cdot L$

$\cot 2\pi/\lambda \cdot L = \alpha$

$L = \lambda/2$

So $\cot 2\pi/\lambda \cdot \lambda/2 = \alpha$

Now

$L = \lambda/2$

$v_p = 2 \times 10^8$

$v_p = \omega/\beta$

$\omega/\beta = 2 \times 10^8$

At $f = 1$ GHz.

$\lambda = 2 \times 10^8 / 1 \times 10^9$

$\lambda = 0.2$ m.

Now

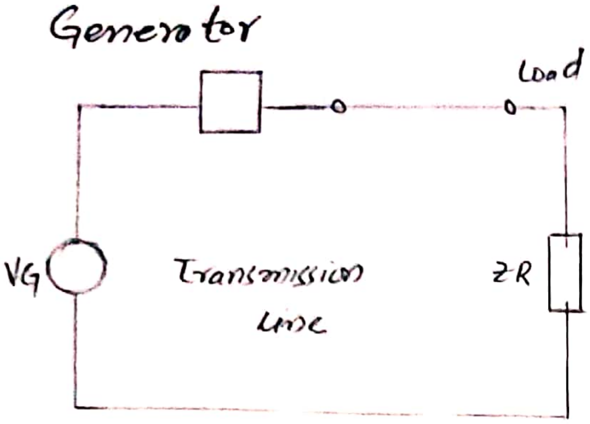
$$L = \lambda/2$$
$$= 0.2/2$$
$$L = 0.1\,m \quad \text{Ans}$$

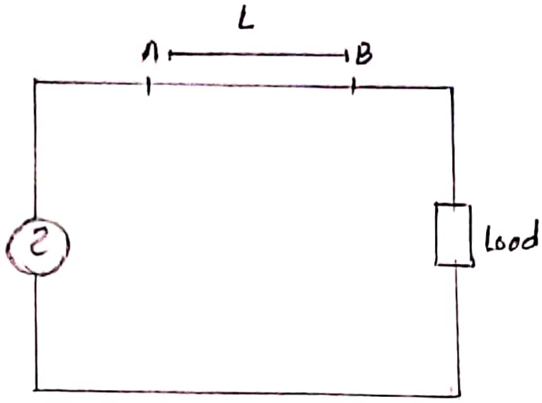
Question No 2 (b) :-

Derive transmission line equation and describe what it says?

Transmission line equation :-

The design of transformation line is depending on many factors. The most distinctive quality of Electrical Engineering problem involve the transmission of electrical power from the generation station to the consumer end. The most common way of transmitting Electrical power are parallel wire and coaxial cable.





transit time effect :-

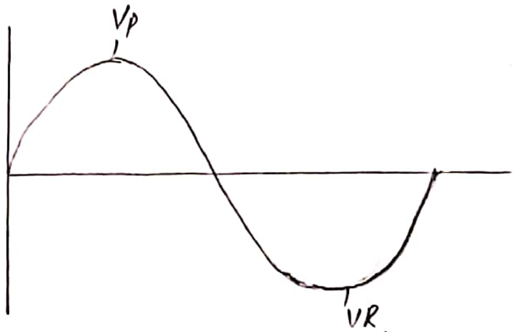
$T \gg t_r$

$T \gg \frac{l}{v}$

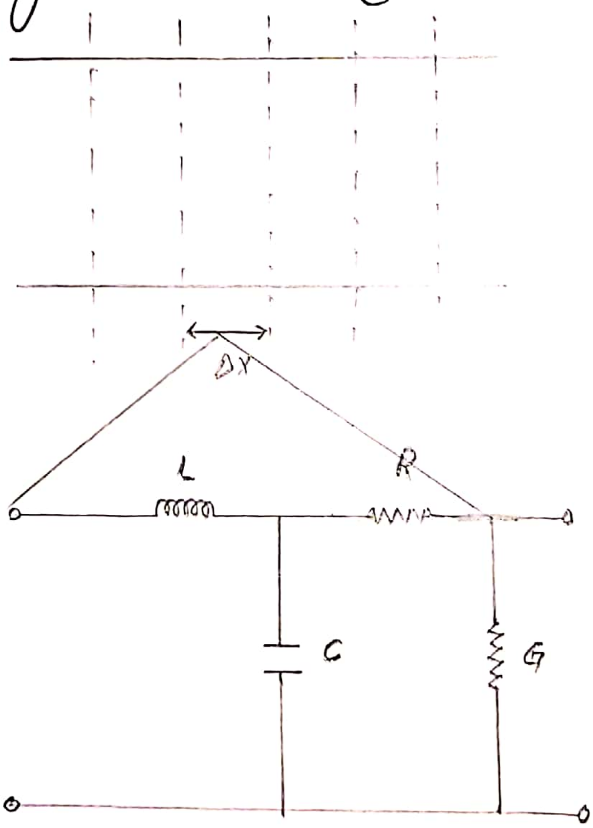
$\frac{1}{f} \gg l/v$

$v/f \gg l$

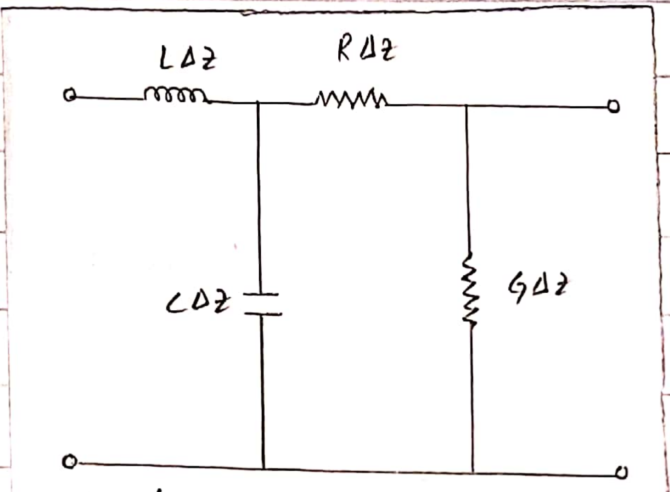
$\lambda \gg l$



Primary constant of transmission line :-



Transmission line equation :-



circuit

· Solution :-

$$\Delta I = -(G\Delta x + j\omega C\Delta x)V$$

$$\lim_{x \to 0} \Delta I/\Delta x = -(G + j\omega C)V$$

$$dI/dx = -(G + j\omega C)V \quad \text{——— (i)}$$

$$\Delta V = -(R\Delta x + j\omega L\Delta x)I$$

$$\lim_{\Delta x \to 0} \Delta V/\Delta x = -(R + j\omega L)I$$

$$dV/dx = -(R + j\omega L)I \quad \text{——— (ii)}$$

Take derivative

$$d^2V/dx^2 = -(R + j\omega L)\, dI/dx$$

$$d^2V/dx^2 = (R + j\omega L)(G + j\omega C)V$$

We know that

$$(R+j\omega L)(G+j\omega C)=\gamma^2$$

$$d^2V/dx^2 = \gamma_V^2$$

$$V(x,t) = (V^+ e^{-\gamma x} + V^- e^{+\gamma x})\, e^{j\omega t}$$

$$= V^+ e^{-j\beta x} e^{j\omega t} + V^- e^{j\beta x} e^{j\omega t}$$

$$= V^+ e^{+j(\omega t-\beta x)} + V^- e^{j(\omega t+\beta x)}$$

We know that

$$\vec{E} = E_o e^{-\alpha z} \cos(\omega t - \beta z)\, \hat{x}$$

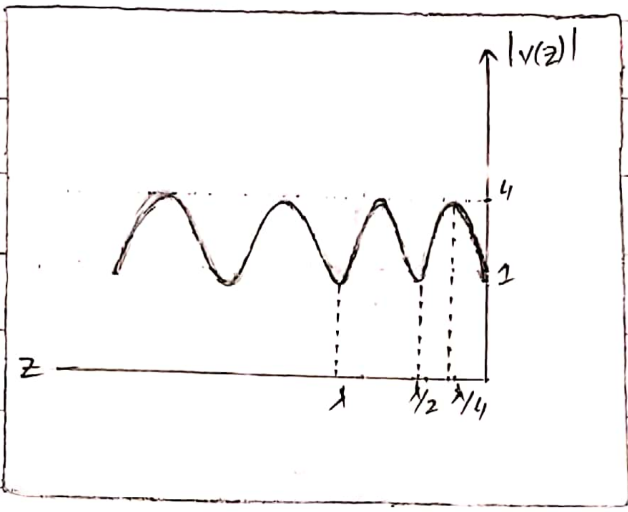
$$\vec{E} = E_o \cos(\omega t - \beta z)\, \hat{x}$$

$$V(x,t) = V^+ \cos(\omega t - \beta x) + V^- \cos(\omega t + \beta x)$$

$V^+\cos(\omega t - \beta x)$ → Travelling $+x$ direction

$V^-\cos(\omega t + \beta x)$ → Travalling $-x$ direction

Question No 3 (a) :- Voltage standing wave pattern is a lossless transmission line with characteristics impedance 50 Ω and resistive load is show in figure.



Solution :-

Data

$Z_0 = 50\,\Omega$

$Z_L = 12.5\,\Omega$

Required

Reflective co-efficient = ?

So

$\Gamma = Z_L - Z_0 / Z_L + Z_0$ ——— (i)

$\Gamma = 12.5 - 50 / 12.5 + 50$

$\Gamma = -37.5 / 62.5 \Rightarrow$ **-0.6 Ans**

Question No 3 (b) :- Explain two impedence matching techniques in detail ?

Impedence matching technique :-

Transmission line section can be used for the purpose of impedence matching. Impedence matching is the one of the important aspects of high frequencey circuit analysis. To aviod reflections and for maximum power transfer the circuits have to be impedence matched.

There are various impedance matching techniques which are discussed in the following.

(A) Single-Stub Matching :-

A stub is a short circuited section of a transmission line connected in parallel to the main transmission line. A stub of appropriate lenght is placed at some distance from the load such that ~~the~~ the impedence seen beyond the stub is equal to the characteristic impedence. Conceptually this can.

be achieved by adding a stub to the main line such that the reflected wave form the short circuit end of the stub and the reflected wave from the load on the main line completely cancel each other at point "B" to give no net reflected wave beyond point "B" toword the generator.

Advantage :-

The single stub matching technique is superior to the quarter wave lenght transformer as it make use of only one type of transmission line for the main line as well as the stub. This technique also in principle is capable of matching any complex load to the characteristic impedence/admittance the single stub matching fixed impedence at microwave frequencies.

(B) Quarter Wave lenght Transformers.

This technique is generally used for matching a resistive load to a transmission line.

(i) Single section for matching two resistive load

(ii) Multiple section for matching two transmission lines with unequal characteristic impedances

(iii) Binomial design for all cases are identical in principle as all require matching b/w two purely resistive impedances.

Two resistive impedence can be matched by a section of a transmission line which is quarter-wavelenght long and has characteristic impedence equal to the geometric mean of the two resistances.

The quarter wavelenght transfer is commonly used at the junction of two transmission lines of unequal characteristic impedence.