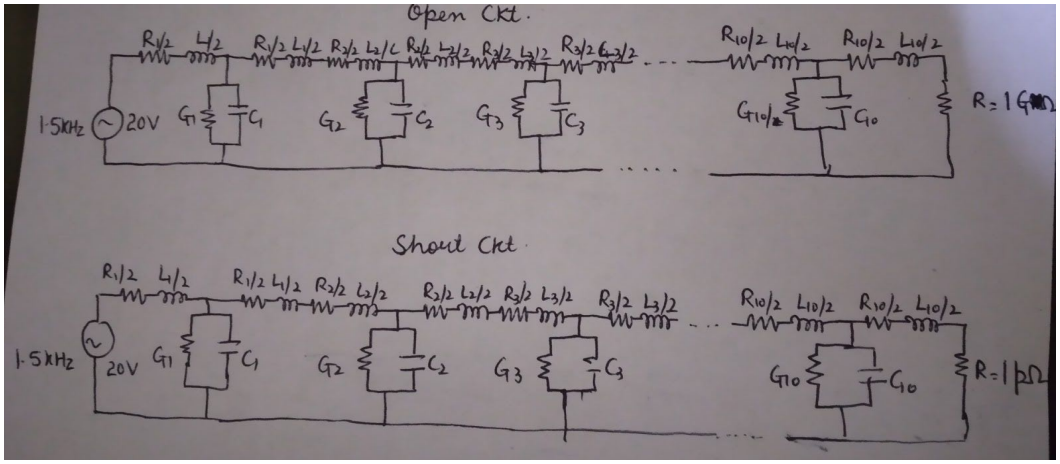
# Engineering Electromagnetics Lab
# Experiment 1

**OBJECTIVE** - To determine the characteristic impedance of lumped constant delay lines using PSPICE AD.

**SOFTWARES USED** - PSPICE AD

**Circuit Diagram:**

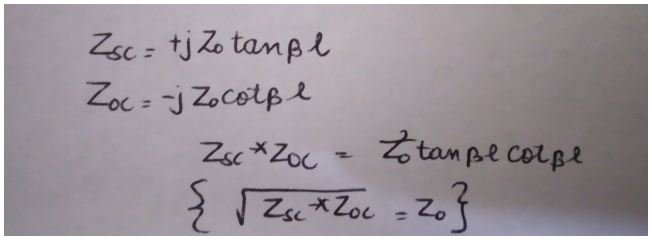



**Formula used:**

$$Zo = \sqrt{Z(OC) * Z(SC)}$$

$$Zo = \sqrt{\frac{Rdz+jwLdz}{Gdz+jwCdz}}$$

The characteristic impedance is the geometric mean of the short and open circuit impedance because, for symmetrical networks, impedances measured at any pair of terminals with other pair of terminals either open circuit or short circuit are of the same value.




## PSPICE Code for 10 T-section transmission line :

```
*Transmission Line 10 section with open ckt
V1 1 0 sin(0 20v 1.5khz)
R1 1 2 5
L1 2 3 2m
C1 3 0 0.47u
```

R2 3 0 1e4
R3 3 4 5
L2 4 5 2m
R4 5 6 5
L3 6 7  2m
C2 7 0 0.47u
R5 7 0 1e4
R6 7 8 5
L4 8 9 2m
R7 9 10 5
L5 10 11 2m
C3 11 0 0.47u
R8 11 0 1e4
R9 11 12 5
L6 12 13 2m
R10 13 14 5
L7 14 15 2m
C4 15 0 0.47u
R11 15 0 1e4
R12 15 16 5
L8 16 17 2m
R13 17 18 5
L9 18 19 2m
C5 19 0 0.47u
R14 19 0 1e4
R15 19 20 5
L10 20 21 2m
R16 21 22 5
L11 22 23 2m
C6 23 0 0.47u
R17 23 0 1e4
R18 23 24 5
L12 24 25 2m
R19 25 26 5
L13 26 27 2m
C7 27 0 0.47u
R20 27 0 1e4
R21 27 28 5
L14 28 29 2m
R22 29 30 5
L15 30 31 2m
C8 31 0 0.47u
R23 31 0 1e4
R24 31 32 5

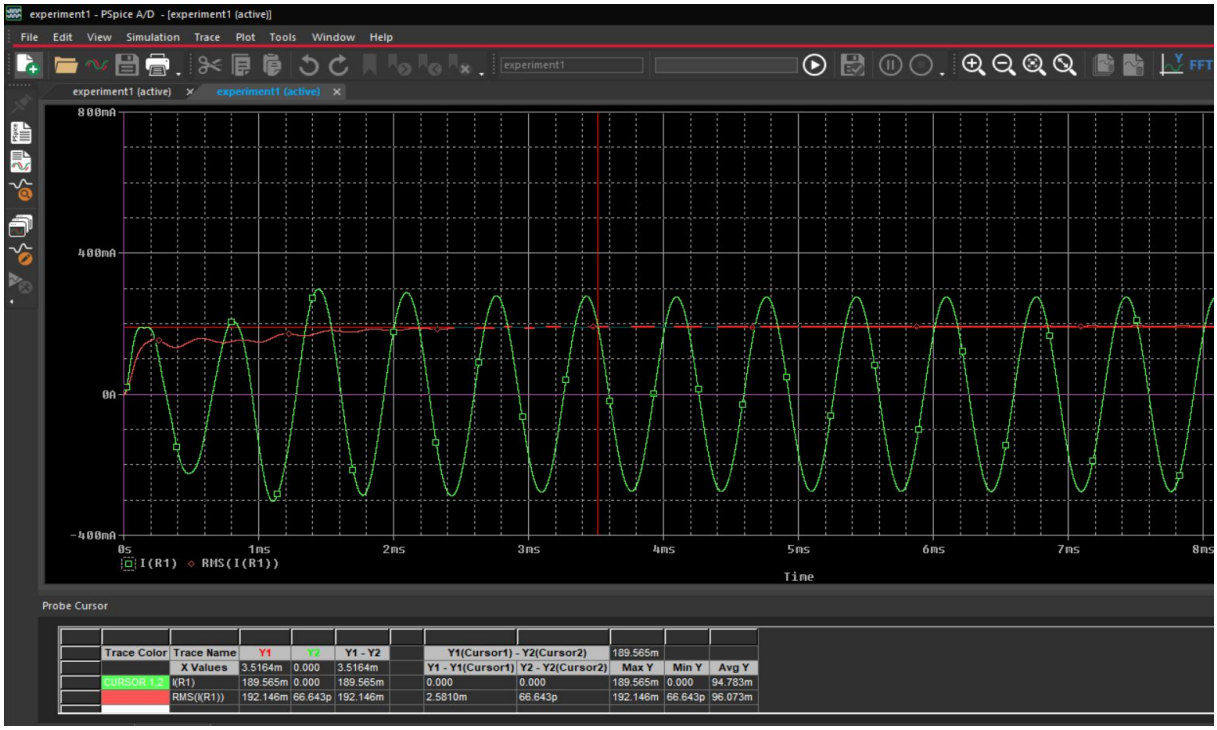
```
L16 32 33 2m
R25 33 34 5
L17 34 35 2m
C9 35 0 0.47u
R26 35 0 1e4
R27 35 36 5
L18 36 37 2m
R28 37 38 5
L19 38 39 2m
C10 39 0 0.47u
R29 39 0 1e4
R30 39 40 5
L20 40 41 2m
R36 41 0 1g
.tran 0 10ms [0 100ns]
.probe

*Transmission Line 10 section with short ckt
V1 1 0 sin(0 20v 1.5khz)
R1 1 2 5
L1 2 3 2m
C1 3 0 0.47u
R2 3 0 1e4
R3 3 4 5
L2 4 5 2m
R4 5 6 5
L3 6 7  2m
C2 7 0 0.47u
R5 7 0 1e4
R6 7 8 5
L4 8 9 2m
R7 9 10 5
L5 10 11 2m
C3 11 0 0.47u
R8 11 0 1e4
R9 11 12 5
L6 12 13 2m
R10 13 14 5
L7 14 15 2m
C4 15 0 0.47u
R11 15 0 1e4
R12 15 16 5
L8 16 17 2m
R13 17 18 5
```

```
L9 18 19 2m
C5 19 0 0.47u
R14 19 0 1e4
R15 19 20 5
L10 20 21 2m
R16 21 22 5
L11 22 23 2m
C6 23 0 0.47u
R17 23 0 1e4
R18 23 24 5
L12 24 25 2m
R19 25 26 5
L13 26 27 2m
C7 27 0 0.47u
R20 27 0 1e4
R21 27 28 5
L14 28 29 2m
R22 29 30 5
L15 30 31 2m
C8 31 0 0.47u
R23 31 0 1e4
R24 31 32 5
L16 32 33 2m
R25 33 34 5
L17 34 35 2m
C9 35 0 0.47u
R26 35 0 1e4
R27 35 36 5
L18 36 37 2m
R28 37 38 5
L19 38 39 2m
C10 39 0 0.47u
R29 39 0 1e4
R30 39 40 5
L20 40 41 2m
R36 41 0 1p
.tran 0 10ms [0 100ns]
.probe
```

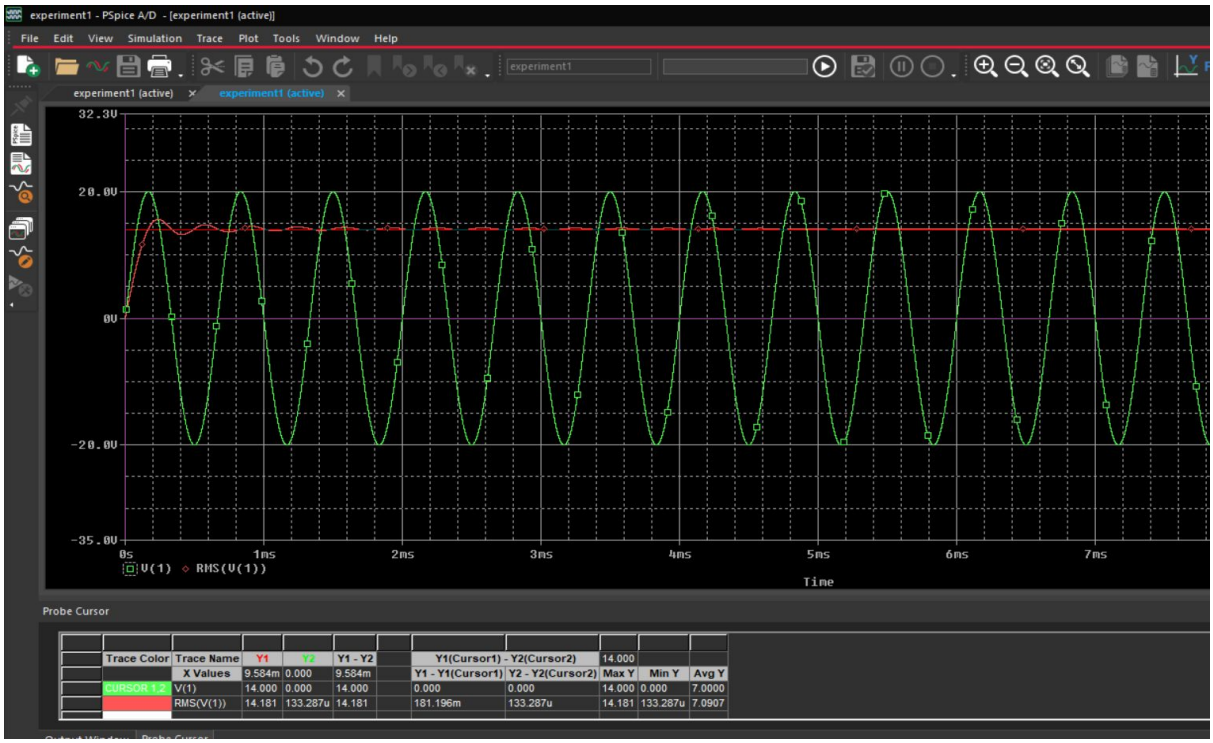
# OBSERVATIONS AND SIMULATION DATA

## Open Circuit:

## Current RMS value=192.146mA

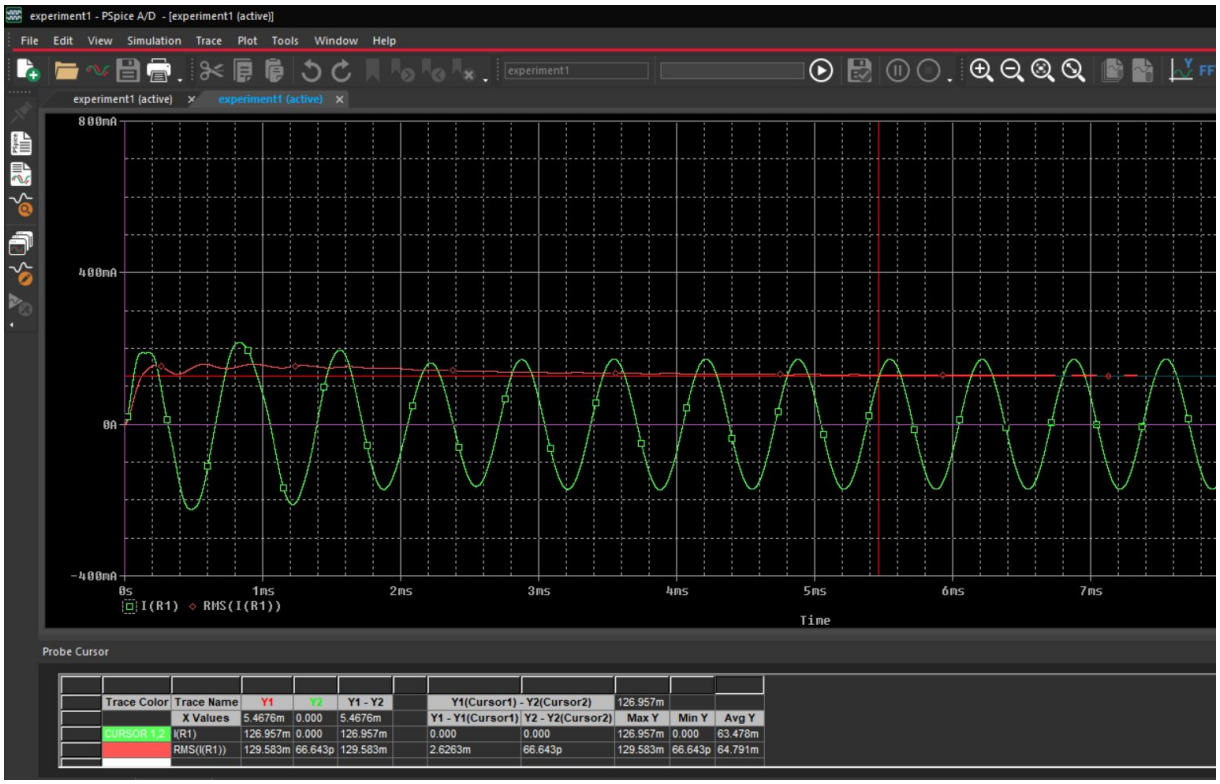



## Voltage RMS value=14.181V



## Short Circuit

### Current RMS value=129.583mA




### Voltage RMS value=14.129V

**CALCULATIONS**

Rdz = 10 Ω
Gdz = 10 Ω −1
Cdz = 0.47 μF
Ldz = 4 mH
f = 1500 Hz
Vin=20V
No. of T-sections = 10

Z(OC)= $\frac{V(OC)}{I(OC)} = \frac{14.181\ V}{192.146\ mA}$ = 73.80Ω

Z(SC)= $\frac{V(SC)}{I(SC)} = \frac{14.129\ V}{129.583\ mA}$ = 109.03Ω

Experimental Value of Zo = $\sqrt{Z(OC) * Z(SC)}$ =89.70Ω

Theoretical Value of Zo= $\sqrt{\frac{Rdz+jwLdz}{Gdz+jwCdz}}$ =93.37Ω

Thus the theoretical value and the experimental value are really close with an error of just 3.90 percent.

Submitted by
Preetesh Verma
2018eeb1171