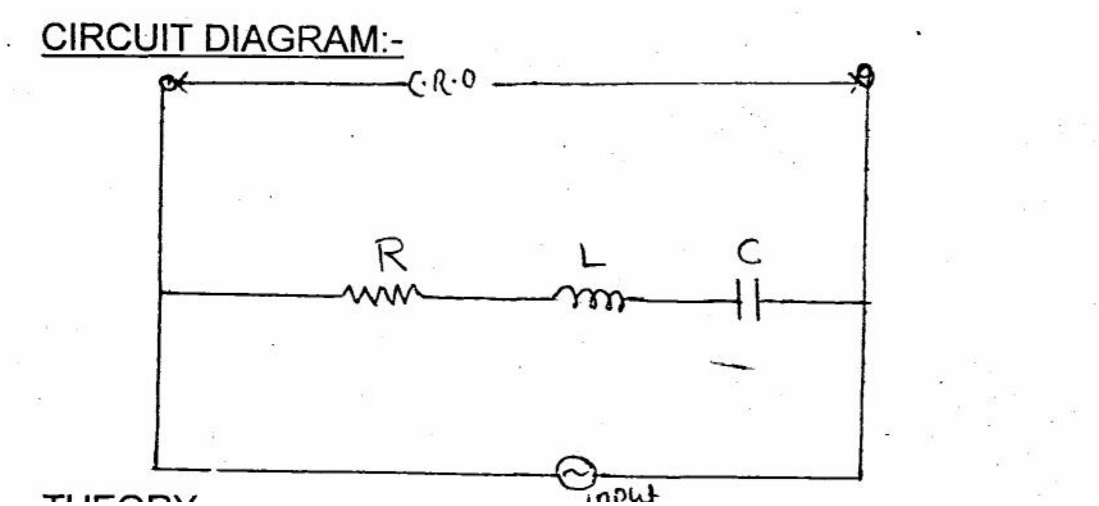
EXPERIMENT : 1

AIM :To find the resonance frequency & band width inseries RLC circuit.

APPARATUS :

CRO, Function Generator, Connecting wires, Kit etc.



Theory

The value of X_L =2πfl and X_C = 2πfc can be changed by changing the applied frequency. The increase in freq. increases X_L and decreases X_C and vice versa. To obtain series resonance,the value of freq. is find out fr so that X_L=X_C ,where fr is resonance freq.

At series resonance:

$$X_L=X_C$$

$$2\pi frl=2\pi fcC$$

$$fr = 1/2\pi (LC)^{1/2}$$

OBJECT:-

(a) At series resçnance XL=XC, therefore impedence across the ckt. is minimum and equal to resistance.

(b) Due to minimum impedence current is maximum.

(c) Power is max.

PROCEDURE:- -

1) First of all an input voltage is setup on signal generator on CRC

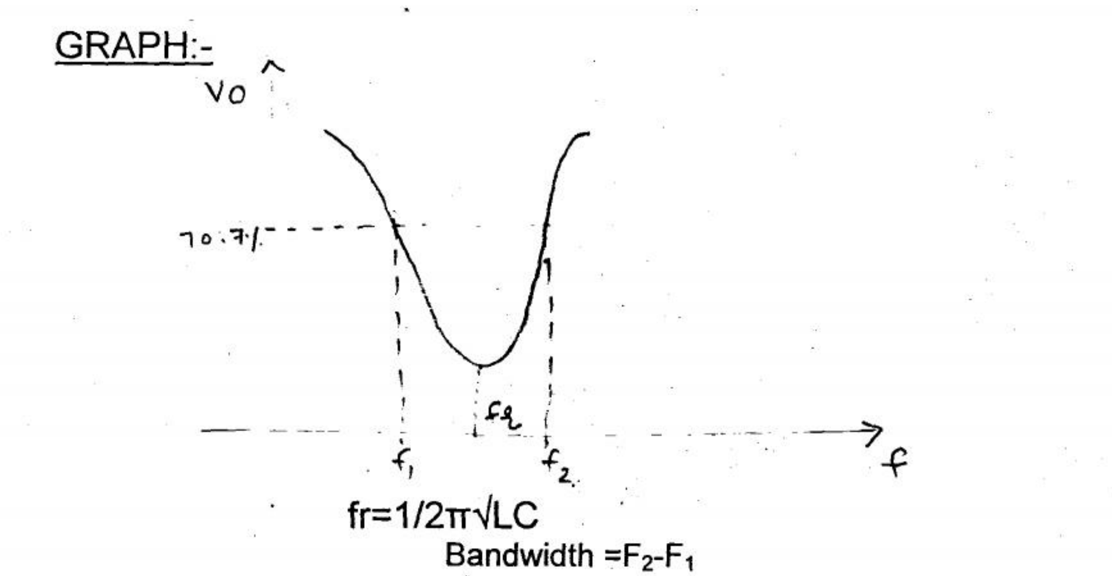
2)'The given value of resistance, inductance,& capictance are selected on the kit.

3) The LCR series ckt. is now connected with input voltage on CRC.

4) Now a particular value of frequency is showii on signal generator and the amplitude of output vbltage is noted from CRC keeping the input voltage const.
5) Now for different values of frequency the output voltage is noted. -
6) The value of frequency for which the ratio of output voltage to input voltage is small is noted 1which is the value of resonance frequency.

OBSERVATION TABLE:-

Frequency (hz)	Voltage(in volts)



CALCULATIONS:-

Experimental value of the resonance frequencyAnd bandwidth is calculated.

PRECAUTIONS

(1 All the connections should be tight.
(2) Voltage should be constant.

RESULT: Resonance frequency of R L C series ckt. is given by

- Theoritical:- 7.1 Khz
- Practical :- 7.1 Khz
- References : NFTL by A. Chakarabarti & Network Analysis by Umesh Sinha
- QUIZ: -

(1) Define resonance?
(2) What is frequency ; time period & phase difference.
(3) Explain formula for resonant frequency
(4) Define bandwidth.
(5) What is 0 factor?
(6) What is formula for resonant frequency?

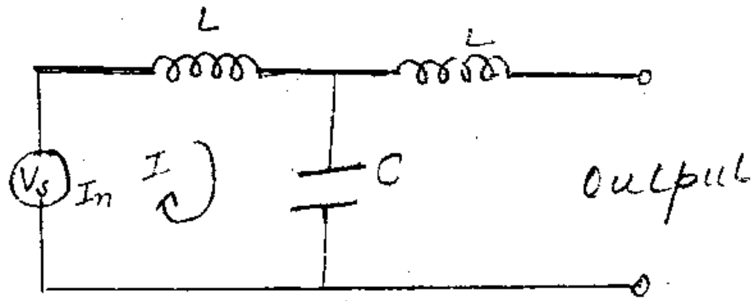
REFRENCES:

N.F.T.L By A. Chakrabarti & Network Analysis By Umesh Sinha.

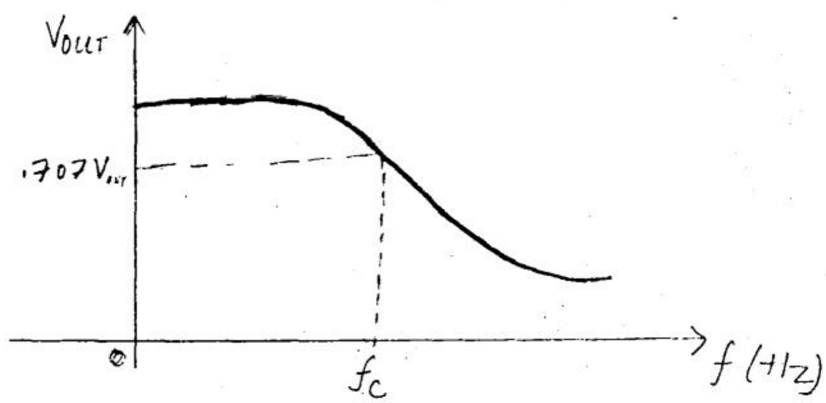
EXPERIMENT NO.- 2

AIM: To study and verify the frequency response curve of a low pass filter and find out frequency.
Apparatus: CRO, Function Generator, Connecting leads
Theory:
Working of low pass filter: It is evident **from** below figure that with increase in frequency of the signal at the input side, the shunt capacitive reactance decreases This will allow more current to be returning back .to the source through low impedence path.

Circuit Diagram:



Graph:



At a higher frequency the entire i/p current returns to the source through the shunt branch which becomes practically a shunt circuit link at this frequency.
Thus it is obvious that the low pass section can only allow passage of signal through it, till signal frequency is at lower magnitude.
Also at a high frequency, the inductive reactance in the series arm also increase to a very high value rendering the blockage of the input signal . In practice LPF operation is said to be satisfactory for increasing frequency till the voltage gain is 70.7%.

In T type

Total series impedence

$$Z_1 = jwl \quad \text{-----------------} \quad (1)$$

Total shunt impedence

$$Z_2 = 1/jwc = -j/wc \quad \text{-------------}(2)$$

Multiplying both equation 1& 2

$Z_1 Z_2 = jwl\,(-j/wc) = L/C = Ro^2$

Again $\frac{Z_1}{4Z_2} - \frac{\omega^2 LC}{4}$ ---- (iv)

But from two port network

$$Z_{OT} = \sqrt{Z_1 Z_2 \left(1+\frac{Z_1}{4Z_2}\right)} \quad (v)$$

Substituting the value of $Z_1 Z_2$ & $\frac{Z_1}{4Z_2}$ from eq (iii) respectively eq. (5) gives

$$Z_{OT} = \sqrt{\frac{L}{C}}\sqrt{1-\frac{\omega^2 LC}{4}} = R_0\sqrt{1-\frac{\omega^2 LC}{4}} = R_0 \sqrt{\text{[illegible]}}$$

$$Z_{OT} = R_0\sqrt{1-\frac{\omega^2}{\omega_c^2}}$$

[illegible] $= \sqrt{1-\left(\frac{f}{f_c}\right)^2}$

Thus it is evident from above that

$Z_{OT} = R_0\,(1-LC\omega^2/4)^{1/2}$ IS REAL IF $LC\omega^2/4<1$ and imaginary if $LC\omega^2/4>1$ that is ZOT indicates the characteristics impedence of the pass band when $LC\omega^2/4<1$ (as Z_{OT} remains real) and Z_{OT} becomes the characteristics impedence for the stop band if $LC\omega^2/4>1$ as Z_{OT} becomes imaginary.

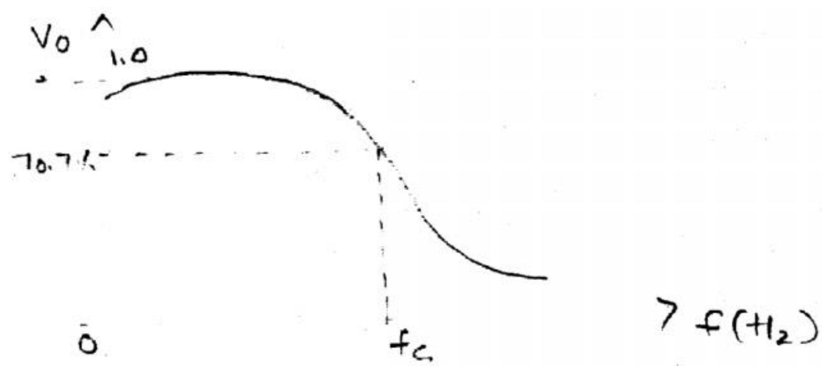
Obviously the cut off frequency will be at a particular condition when $LC\omega^2/4=1$ that is $\omega C=2/(LC)^{1/2}$ or

$$f_c=1/\pi(LC)^{1/2}$$

OBSERVATION TABLE:

S.NO	f	V_0

GRAPH:



PROCEDURE: 1) First of all an input voltage is set up on the signal generator and CR0.
2) The given value of L and C are selected.
3) The LPF is now connected with input voltage on CR0.
4) Now a particular frequency is shown on signal generator and the amplitude of output voltage is noted from CR0 keeping the input voltage constant.
5) Now at different frequencies the output voltage is noted.
6) We observe that at higher frequencies the LPF has poor response that is LPF allows only the passage of lower frequency

CALCULATIONS:

$$f_c= 1/\pi(LC)^{1/2}$$

RESULT

The low pass filter will allow passage of signal through it ,till signal frequency is at lower magnitude.

PRECAUTIONS: 1) All the connections should be tight and clean. 2) Voltage should be constant.

REFERENCES: 1) NFTL by A. Chakrabarti

2) Network Analysis by Umesh Sinha

QUESTIONS:

1) In LPF give value of fc.

2) In LPF pass band lies between

3) Depending upon relation between arm impedences in series arm impedence Z1 and shunt arm impedence Z2 filters are classified as k filter and give the name of second type.

4) What is ideal filter?

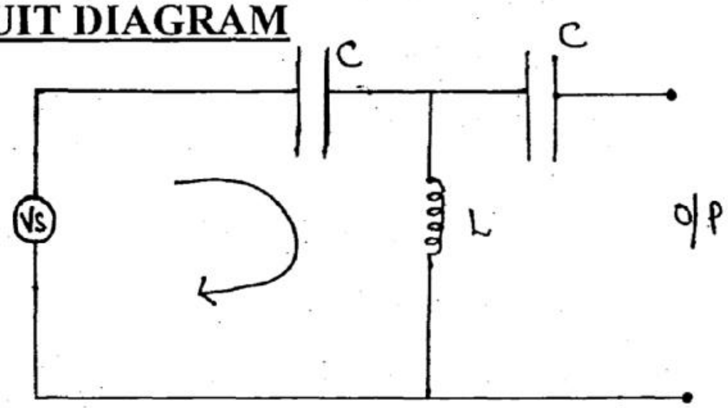
5) The frequency that separates the pass band and alternation band is known as

6) The predominant primary constituents of a telephone cable are

EXPERIMENT 3

AIM:-To study and verify the frequency response curve –of a High Pass Filter and find out cut- off frequency.
APPARATUS:-C R.O., function generator, high pass filter, Connecting leads.
THEORY:- A filter which passes all the frequencies above cut off. frequencies is called high pass filter. With enhancement of frequencies, capacitive, reactance in the series arm decrease while the inductive reactance in the shunt arm- increases. Thus the section allows the passage of higher order frequencies blocking the lower order frequencies. At lower frequencies the series capacitance behaves as a very high reactance while the shunt path offers low reactance .. Pass band is $fc \rightarrow \infty$, and attenuation band in flam 0 to fc.

CIRCUIT DIAGRAM



In the above figure.
Series impedance $Z1=1/jwc \rightarrow 1$
Shunt impedance $Z2= jwl \rightarrow 2$
$Z_1Z_2=(1/jwc)*(jwl)$
$=L/C$
$=Ro^2$(say)(Ro being a real quantity) $\rightarrow 3$
The characterstics impedance of a T section in given by.
$Z_{ot}=\sqrt{(Z_1^2/4+Z_1Z_2)} \rightarrow 4$
In case at the prototype HPF section
$Z_{ot}=\sqrt{(-1/4W_2C_2+L/C)}$
Utility equation 2,3&4
$=\sqrt{(L/C)}\ \sqrt{(1-(1/(4WLC)))}$

PROCEDURE:

1set the function generator at constant voltage.

2) Connect the probes of cro and function generator with HPF.
3) Vary the i/p frequency and take the reading step by step.
4) Plot graph between frequencyand voltage oip.

PRECAUTION:

1 voltage must be constant.
2) The C.R.O should be used carefully.
3) The frequency should be increased step by step.

RESULT

High pass filter passes all frequencies above cut off frequencies

QUESTIONS

1) define attenuation?
2) Define passband?
3) What is Fc in HPF? v
4) Filter is a ....selecting device.
5) Ineper is equal to db.

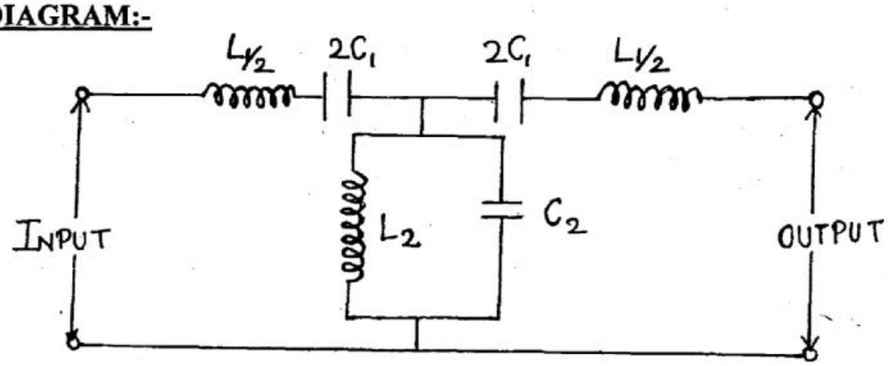
EXPERIMENT NO 4

AIM:- To study and verify Band pass filter.
APPARATUS:-

C.R.O., function generator, band pass filter, connecting wires.
THEORY:-

A band pass filter allows transmission of a limited band of all frequencies **(f1-f2)** and rejects all other frequency below or above frequency band . **A** band pass filter series tuned circuit in series arm and parallel tuned circuit in the shunt arm . This filter performs its functions when series arm as well as shunt arm in resonance.

CIRCUIT DIAGRAM:-



T Configuration of a BPF

OBSERVATION TABLE:-

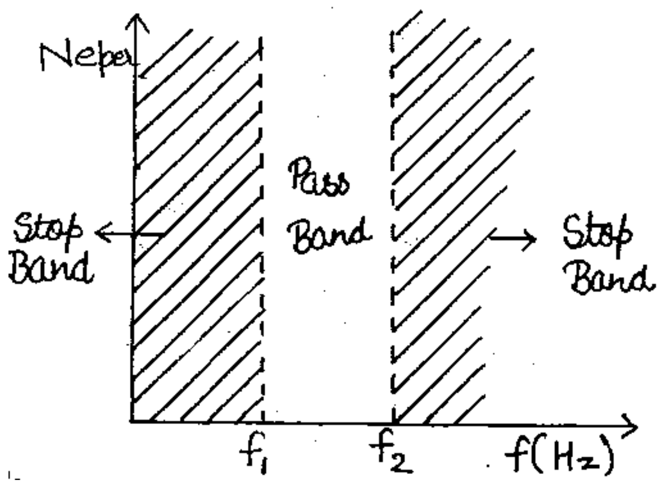
S.NO.	INCREASING VOLTAGE	INCREASING FREQUENCY	DECREASING VOLTAGE	DECREASING FREQUENCY

PROCEDURE:
1. Connect the circuit to function generator and **CR0.**
2. Set the function generator at the constant voltage.
3. Increase the frequency step by step and note down the reading from **CR0.**
4. Plot the graph btw frequency and output voltage..

FORMULA USED:-

$F_0 = (f_{c1}.f_{c2})^{1/2}$

Hence the resonant frequency (or the cehtre frequency) of the pass band filter is equal to the geometric mean of the cut off frequencies



PRECAUTIONS: 1

1Voltage must be constant.
2. The CR0 should be used carefully.
3. The frequency should be increased step by step.

RESULT:- If we increase the frequency after cut off frequency, voltage increases from 0V.

REFERENCE:-

1. N.F.T.L. by A Chakrabrati.
2. Circuits and systems —K.M. Soni.

RELATED VIVA:-

Qi :- Define Pass Band Filter?
Q2:- In Band Pass Filter pass band is from f1-
Q3:- Write the uses of Filter?
Q4:- In audio amplifi’r, filters are used to reduce harmonic distortion and
Q5:- Operational amplifier is a component.

EXPERIMENT 5

AIM:

_To verify ABCD parameter in 'T'&'π' configuration.

APPARTUS:

_Multiple power supply,resistance kit,bread board ,connecting wires etc.

ABCD PARAMETER: ABCD parameters are widely used in analog of power transmission engineering where they are termed as "Generalized Ckt Parameters" .ABCD parameters are also called as transmission parameters.

Here the ABCD parameters equation are given as :

$$\begin{pmatrix} V_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} A & B \\ C & D \end{pmatrix} \begin{pmatrix} V_2 \\ -I_2 \end{pmatrix}$$

SUCH AS:

$$V_1 = AV_2 + B(-I_2)$$

$$I_1 = CV_2 + D(-I_2)$$

$A = V_1/V_2 \,|\, I_2=0$ =reverse voltage ratio

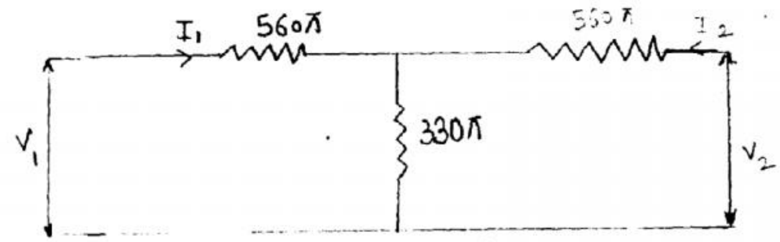
$B = -V_1/I_2 \,|\, V_2=0$ = transfer impedence .

$C = I_2/V_2 \,|\, I_2=0$ =transfer admittance

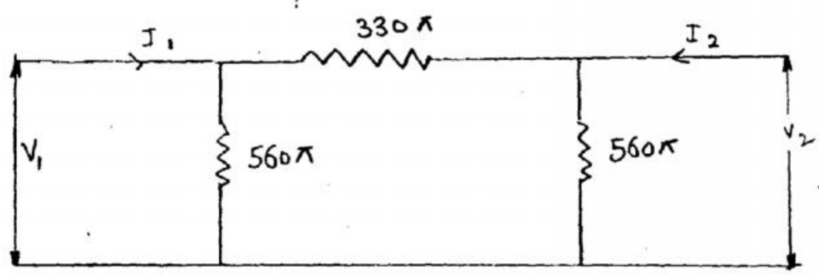
$D = -I_1/I_2 \,|\, V_2=0$ =reverse current ratio.

PROCDURE :1) Make the connections as shown as :in fig.
2) firstly open the ckt &apply 10 v on input &take readings.
3) secondly short the output ckt.& apply 10 v on input &take readings.

DIAGRAM :



T- CONFIGURATION



π- CONFIGURATION

PRACTICAL VALUES (T-CONFUGIRATION):

V_1 = I_1=

V_2 = I_2 =

A=

B=
C=
D=

THEORETICAL VALUES :

A = ,

B =

C =

D =

PRACTICAL VALUES (π configuration)

V1= I1 =

V2= I2 =

A =

B =

C =

D =

THEORITICAL VALUES
A =
B =
C =
D =

PRECAUTIONS
1 Connection should be tight and clean.
2 Before using the resistance in resistance kit check its value with the help of multi meter
3 Multi meter should be used care fully .

RESULT :
Theoretical and practical values are approximately same.

EXPERIMENT 6

AIM : TO verify "Y" parameter in T and π- section

APPARATUS: multiple power supply, resistance kit, wires etc.
THEORY:

1)T-SECTION:- When a *network* section looks like **a** 'T',it is known as T section.. In a symmetrical section ,the series arm impedance is equal in both the sides of the shunt arm impedance. In unsymmetrical section the impedances **ZI&Z3** are not equal to each other.the net series arm impedance of unsymmetrical section is (Zl+Z3)π while in symmetricaI ;ection is 2Z1 π, .The shunt arm impedance in both the cases is given by Z2π.
π- SECTION:-when a network section looks like a π.,it is known as π. section the shunt arm are not equal but in symmetrical. π.- section shunt arm impedance are equal.
'Y-PARAMETER (short circuit admittance parameter):-ln a two part n/w if V1& V2 are input and output voltages & I_1 ,I_2 are currents at input and output respectively.

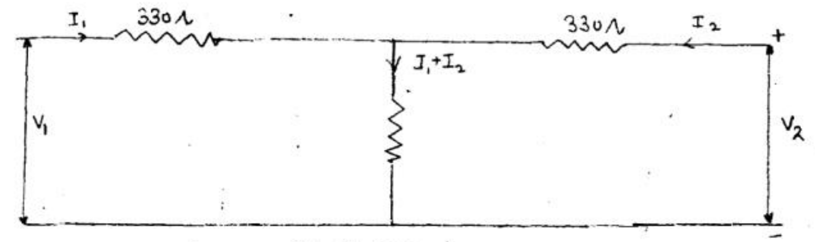
$$[I] = [Y][V]$$

$$\begin{pmatrix} I_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix}$$

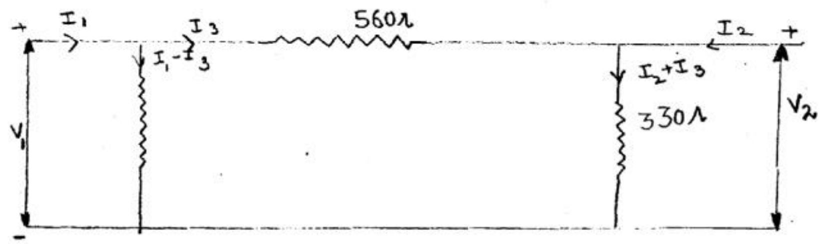
In a two port network representation the network is assumed to be a rectangular box & the direction of input part and output parts current and voltages have been shown in fig.
The eq of a Y parameter is

$$I_1 = y_{11}V_1 + y_{12}V_2 \quad (1)$$
$$I_2 = y_{21}V_1 + y_{22}V_2 \quad (2)$$

Assuming o/p port is short ckted. ie V2 = 0
So eq becomes
Y 11 =I1/V1 V2 =0 short ckted i/p admittance



T-SECTION



Π-SECTION

T section :
To find Y11 & Y22
I1= I2 =
V1 = V2 =
Y11=
Y22=
To find Y12 &Y22
I1= I2=
V2= V1=
Theoretical
Y11=
Y12=
Y21=
Y22=

PIE SECTION :
To find Y11 &Y21
V1= I2=
V1= V2=

Y11 =
Y21 =

To find Y12 &y22
I1= I2=
V1= V2=
Y12=
Y22=

Theoretical Values :
Y11=
Y12=
Y21=
Y22=
RESULT : Theoretical & practical values are same.
Y21 =I2/V1 ,V2=0 short ckt for transfer admittance
Again assuming i/p port is short cktd,
Y12 = I1/V2 V1 =0 short ckt. Reverse transfer admittance
Y22= I2/V2 V1=0 short ckt. o/p admittance

RESULT:- practical &theoretical values of y-parameters are app.same.hence y parameters is verified.
PROCEDURE:- 1)make the connection with the help of bread board as shown
2)firstly give 15 v supply of i/p part &o/p part is short circuited and note the readings of I1 and 12.
3) Put these values in formula &find the values of V1 and **V2.**
4) secondly give the 15v supply of o/p part is short circuited &note the readings of I1and 12.
5)put these values in formula &fixed out the value of Y12 and **Y22**
PRECAUTIONS: 1)Connection should be tight and clean.
2)first check the value of resistance used by multi meter.

EXPERIMENT 7

AIM: To verify Z-parameters in 'T' & 'π configuration.

APPARATUS:

Multiple power supply, resistance kit, bread board, connecting wires.

THEORY:

1) T-section: When a network section looks like a "T", it is known as T-section. Fig(1)&(2)represents unsymmetrical & symmetrical T section. In a symmetrical section, the series arm impedance is equal in both the sides of the shunt arm impedance. In unsymmetrical section, the impedance **Zi** & **Z3** are not equal to each other. The net series arm impedance of the unsymmetrical section is(z + z3)ohm while that for the symmetrical section is (2z)ohm. The shunt arm impedance in both the cases is given by **Z2** ohm.

2) π - section: When a NIW section looks like a 'π 'it is known as - section. Fig (1) & Fig(2) represents unsymmetrical & symmetrical - section. In asymmetrical - section the shunt arm impedance are not equal but in symmetrical - section shunt arm impedance are equal.

Z-PARAMETERS(Open Circuit Impedance Parameters): For the two port NIW, the input & output voltages **Vi** & V2 can be expressed in terms of input & output current resp. as

$$[V]=[Z][I]$$

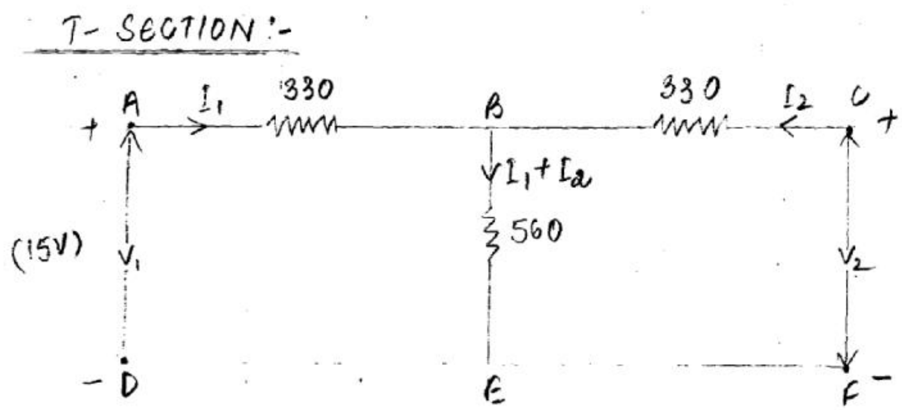
where [Z]=impedance matrix. also

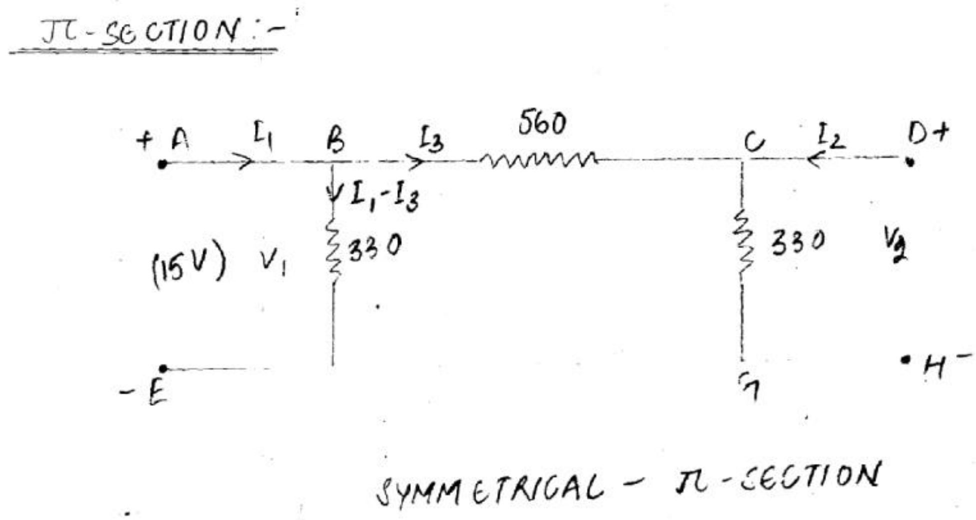
$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}$$

In a two N/W representation, the N/W is assumed to be a rectangular box & the direction of input port & output port currents & voltages have been shown in fig.

The equation of Z—parameters

Diagram





Observation: For T section

To find Z11 & Z21

V1= V2=

I1 = I2=

Z11=

Z21=

To find out Z12 , Z22

V1= V2=

I1= I2=

Z12=

Z22=

Theoretical values

Z11 = Z12=

Z21= Z22=

For pie section

Z11=

Z12=

Z21=

Z22=

Procedure

1 make the connection with the help of bread board as shown in fig,

2 first give the 5 V supply to i/p port and o/p port is open cktd.and take the readings.

3.in 2nd case give 5 V supply to the o/p port & i/p port is open cktd. and take readings

PRECAUTIONS: 1)Connection should be tight and clean.

2)first check the value of resistance used by multimeter.

RESULT: Practical & theoretical values of Z-parameters are applied same. Hence Z-parameter is verified.

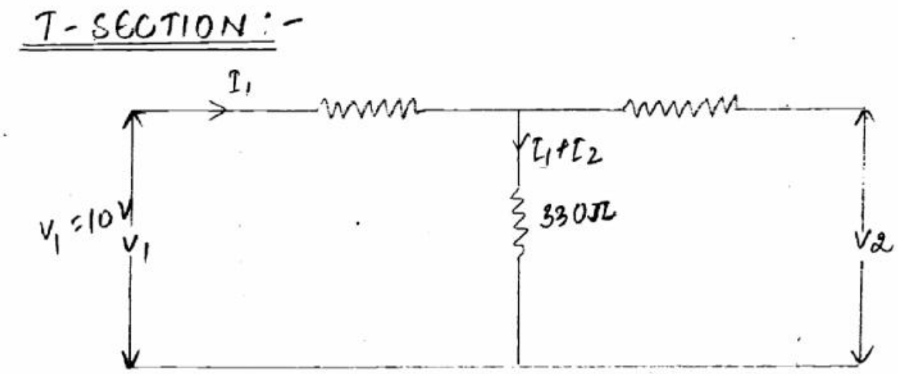
EXPERIMENT 8

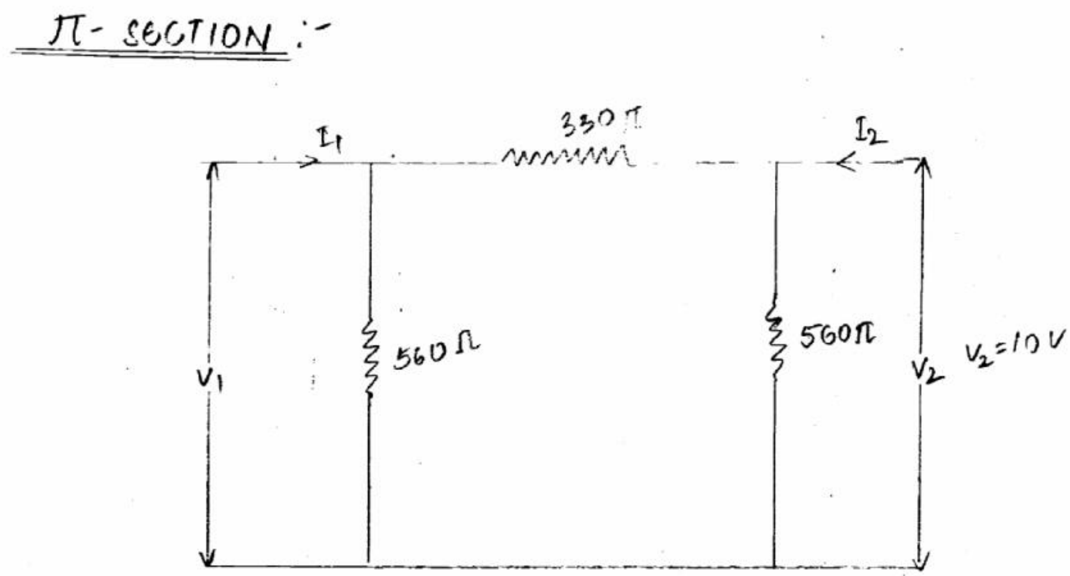
AIM: To verify H-parameters in ‘T’ &‘ π configuration.
APPRATUS: Multiple power supply, resistance kit, bread board, connecting wires etc.
HYBRID PARAMETERS: H-parameters representation is widely used in modelling of electronics components & circuits, particularly transistors. As both short circuits & open circuit terminal conditions are satisfied hence , this parameter representation known as hybrid parameter representation. Equation of hybrid parameter is given by
Assuming short circuit conditions at the output V2=0. This gives,from (I)
PROCEDURE:

1) Make the connections as shown in fig. with the help of bread board.
2)Fixed the supply at 10V
3)Initially give the 10V supply to input port & output port is short circuited. Take the readings of │I & │2.
4) By putting these values find out H11 & H21.
5) Secondly give the I0V supply to output port &
input port is short circuited.
Take the readings of VI & I 2.
6) By putting these values find out H12 &H22.
PRECAUTIONS:I) Connections should be tight & clean.
2) Always before use the resistance in resistance kit check its value with the help of multi meter.

3) Use an extra wire in bread board for taking the readings.
4) Multi meter should be used carefully.
RESULT: Theoretical & practical values comes out to be approximately same.

Diagram





Practical values of T section

To find F121

I1= I2=

V1= V2=

F111=

F121=

To find F112 & F122

V1= V2=

I1= I2=

F112=

F122=

T (Theoritically)
F111=
F112=
F121=
F122=

<u>Π section</u> (practically)
To find F111 & F121
V1= V2=
I1= I2=
F111=
F121=
To find F112 &F122
V1= V2=
I1= I2=
F112=
F122=
Theoretically values
F111=
F112=
F121=
F122=

EXEPERIMENT 9

AIM: To study thç transient response of RLC ckt.
APPARATUS: C:R.O., function generator, connecting wires, trace paper.
THEORY: A series RLC ckt is connected as shown in the figure. Initially before switching on the battery the inductor acts as open ckt and charge, across the capacitor is zero. Applying the initial condition and kvl in RLC loop, we get

E = R(t) +L di /dt + 1/C int (0.t) idt

The characteristics eq of the above eq. comes out to be

S^2 + RS/L + 1 / LC = 0

The roots of the above equation are

S_1 = -R /2L + {(R / 2L) ^{2} – 1/ LC }$^{1/2}$

S_2 = -R /2L - {(R / 2L) ^{2} – 1/ LC }$^{1/2}$

Thus conditions are

1) Over damped : (R / 2L)^2 > 1/ LC

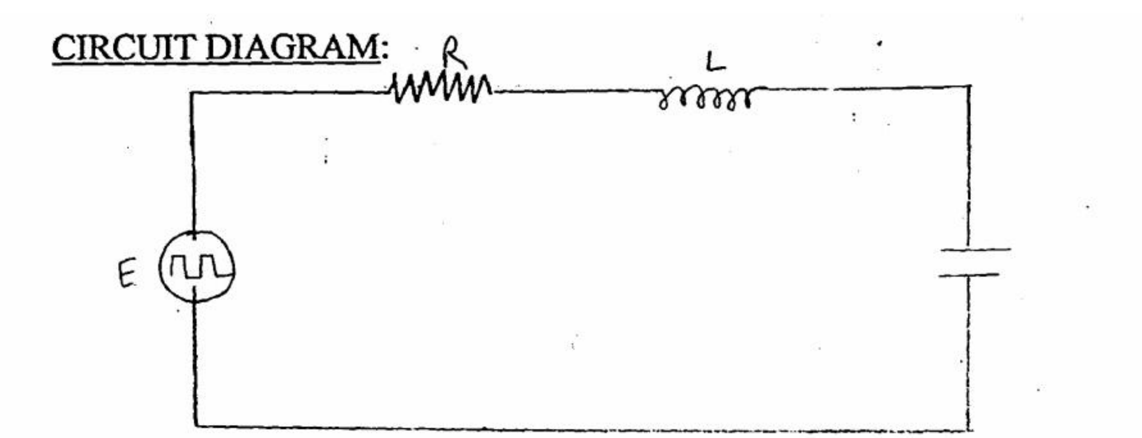
=> roots are real &unequal

2) Critically damped : (R / 2L)^2 = 1/ LC

=>Roots are real and equal

3) Under damped : (R / 2L)^2 = 1/ LC

=>Roots are imaginary



The various condition are shown in fig

PROCEDURE : 1) Connect the wire as shown in ckt diagram
2. Connect the probes of C.R.O. and function generator taking sign s in mind.
3. Vary the i/p frequency and take the readings step by step.
4. Plot graph b/w frequency and voltage oip.

PRECAUTIONS:

1. Voltage must be constant.
2.. The C.R.O. should be used carefully.
3. The frequency should be increased step by step.

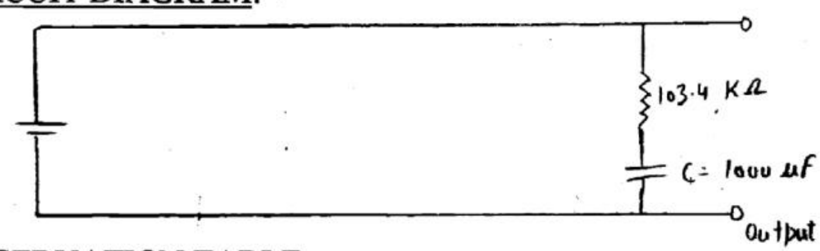
RESULT:

If we increase the frequency after the cut off frequency voltage increases from 0V.

EXPERIMENT 10

AIM: To study transient response of RC CIRCUIT. To study charging and discharging of capacitor.
APPARATUS: Probes, Bread board, resistors., connecting wires
THEORY:
In the charging process when an external battery is connected across the RC circuit. Then initially the current flows only through the capacitor but as time passes the current through the capacitor decreases and the in steady state the current supplied by battery flows only through the resistor. In the discharging process external battery is removed and the current supplied by the battery flows only through the resistor.

CIRCUIT DIAGRAM:



OBSERVATION TABLE:

S.NO.	Charging of Capacitor		Discharging of Capacitor	
	Time(s)	Voltage(V)	Time(s)	Voltage(V)

PROCEDURE :
1)Connect the ckt as shown

2) . Take the readings by supplying voltage.
3. After complete charging remove the battery and's.c the terminals.
4. Take the readings of the discharging of capacitor w.r.t time.
5. Draw separate graphs for charging and discharging.
6. Point all the time constants.

PRECAUTIONS:

1. Take the readings carefully.
• 2. Supply should be adjusted carefully.
3. Range of capacitor should be proper.

RESULT:

Practical and theoretical values for time constant are approx. same.

Theoretical value Rc =

% error of charging

% error of discharging =

EXPERIMENT 11

AIM : To study the frequency response of RLC ckt.

Apparatus : CRO Function generator, RLC kit ,connecting wires

Theory : Consider a series RLC ckt having element resistance R, inductance L, and capacitance C. The impedence of series RLC ckt. Is given

$Z= R + j (X_L – X_C)$

$Z= R + j (\omega L –1/ \omega C)$

In a series RLC ckt resonance occurs when $X_L -X_C =0$ The frequency at which resonance occurs is called resonance freq.

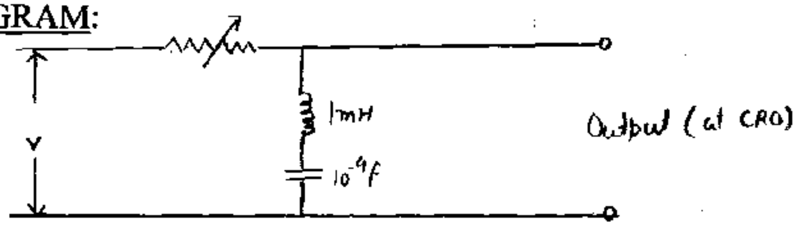
At resonance

$X_L = X_C$

⇨ $f = 1/ 2\pi (LC)^{½}$

At this frequency current will be maximum ..

CIRCUIT DIAGRAM:



OBSERVATION TABLE:

S.NO.	Vout (volts)	Frequency

PROCEDURE:

1. Firstly set the frequency at 100 Hz and connect the element from RLC ckt.
2. Increasing the value of frequency take corresponding readings of output voltage in C.R.O.
3. Plot the graph between voltage and frequency.

PRECAUTIONS:

1. Take the readings of frequency carefully.
2. The connection should be tight.

RESULT:

The RLC ckt has been studied.

Observed resonant frequency = **V**

Experimental value

% error =