MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY

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DEPARTMENT OF ELECTRICAL ENGINEERING

LABORATORY MANUAL

ELECTRICAL CIRCUITS LAB

For

B.E. V SEM (EEE& EIE) AND III SEM (EEE)

2021-22

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MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY

ELECTRICAL ENGG. DEPARTMENT

LIST OF EXPERIMENT

ELECTRICAL CIRCUITS LAB **(PC263EE)**

Cycle -I

1. **Charging and discharging characteristics of RC series circuit**
2. **Verification of Thevenin's and Norton's theorems.**
3. **Verification of Superposition theorem and Maximum power transfer theorem.**
4. **Frequency response of a RLC series circuit**
5. **Characteristics of Linear, Non-Linear and Bilateral Elements.**

Cycle -II

6. **Frequency response of a RLC parallel circuit**
7. **Locus diagram of RC/RL circuit.**
8. **Parameters of two port network**
9. **Measurement of Power by Two Wattmeter Method.**
10. **Mesh and Nodal analysis of electric circuit using pspice software**

EXPERIMENT 1

CHARGING AND DISCHARGING CHARACTERISTICS OF RC SERIES CIRCUIT

AIM: To obtain the transient response of an RC circuit.

1. When charging through a Resistor from constant voltage source.
2. When discharging through a Resistor.

APPARATUS:

1. Regulated power supply.
2. Digital Voltmeter.
3. Stop watch.
4. RC Network.

THEORY:

When an increasing DC voltage is applied to a discharged capacitor, the capacitor draws a charging current and "charges up", and when the voltage is reduced, the capacitor discharges in the opposite direction. Because capacitors are able to store electrical energy they act like small batteries and can store or release the energy as required.

The charge on the plates of the capacitor is given as: Q = CV. This charging (storage) and discharging (release) of a capacitors energy is never instant but takes a certain amount of time to occur with the time taken for the capacitor to charge or discharge to within a certain percentage of its maximum supply value being known as its **Time Constant** (τ).

If a resistor is connected in series with the capacitor forming an RC circuit, the capacitor will charge up gradually through the resistor until the voltage across the capacitor reaches that of the supply voltage. The time also called the transient response, T

This transient response time T, is measured in terms of $\tau = R \times C$, in seconds, where R is the value of the resistor in ohms and C is the value of the capacitor in Farads.

CHARGING:

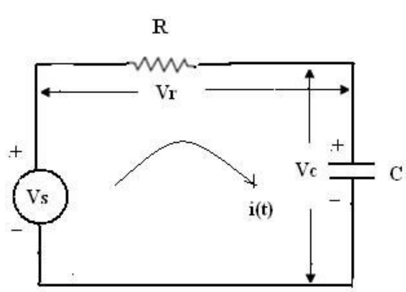


Fig -1

Applying KVL across the RC circuit (Fig.1) and solving, we get,

$$i(t) = \frac{V_S}{R}\, e^{\frac{-t}{RC}} \qquad \rightarrow (1)$$

$$V_C(t) = V_S - V_R(t) = V_S - R.\,i(t)$$

$$= V_S\left(1 - e^{\frac{-t}{RC}}\right) \qquad \rightarrow (2)$$

The equation gives the variation of voltage across the capacitor with the time i.e. the charging of the capacitor. See also Fig.2. which gives charging curve i.e. the relation between voltage and time during charging.

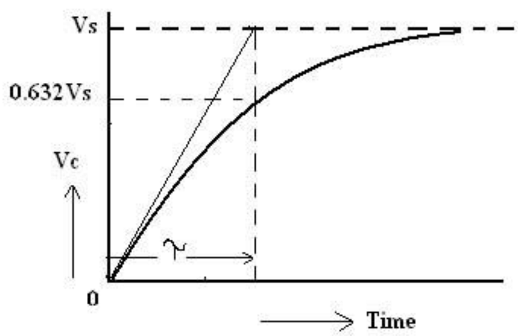


Fig- 2

Differentiating equation (2)

$$\frac{dV_C}{dt} = \frac{V_S}{RC} e^{-t/_{RC}} \qquad \rightarrow (3)$$

$$\left(\frac{dV_C}{dt}\right)_{t=0} = \frac{V_S}{RC}\ \ volts/\sec \qquad \rightarrow (4)$$

If this rate of rise (Eqn.4.) is maintained, then the time taken to reach voltage V_S would be

$$\frac{V_S}{V_S/_{RC}} = RC$$

This time is known as Time constant (τ) of the circuit. ie. the time constant of the RC circuit is defined as time during which the voltage across the capacitor would have reached its maximum value VS had it maintained its initial rate of rise.

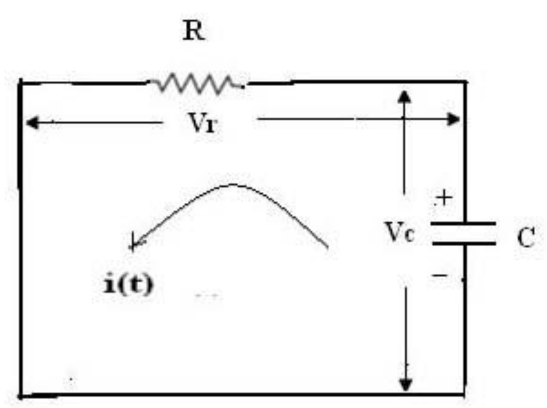
From equation (3) at $t = \tau$,

$$V_C = V_S\left(1 - e^{-t/\tau}\right) = V_S(1 - e^{-1}) = V_S(1 - 1/e)$$

$$= V_S\left(1 - \frac{1}{2.718}\right) = 0.632Vs$$

Hence, time constant may be defined as the time during which capacitor voltage actually rises to 0.632 of its final value.

DISCHARGING:



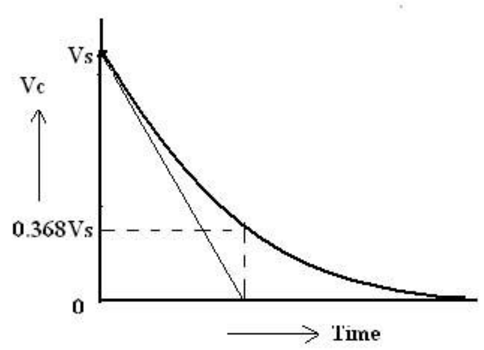


Fig- 3 Fig-4

Referring to fig.3

$$i(t) = \frac{V_S}{R}e^{-t/\tau} \qquad \rightarrow(5)$$

$$\& \;\; V_C(t) = -V_R(t)$$

$$= -R.i(t) = -V_S e^{-t/\tau} \qquad \rightarrow (6)$$

$$\left(\frac{dV_c}{dt}\right) = \frac{V_s}{\tau}e^{-t/\tau} \qquad \rightarrow (7)$$

$$\left(\frac{dV_c}{dt}\right)_{t=0} = \frac{V_S}{RC}\ volts/\sec \qquad \rightarrow (8)$$

From (6) at t=τ, $V_C = V_S\, e^{-1} = V_S/2.718 = 0.368V_S \rightarrow (9)$

Equation (6) gives the relation between the voltage and time during discharging. The tangent on the discharging curve at t=0, (Fig.4) yields the time constant and the voltage across the capacitor will be 0.368 of the full voltage at t=τ.

CONNECTION DIAGRAM:

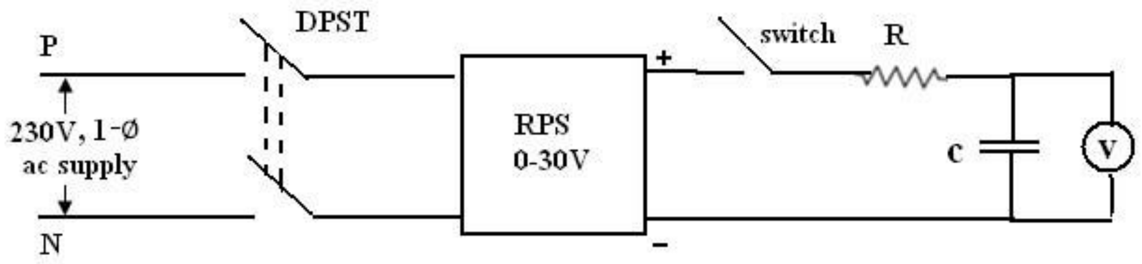


Fig-5

PROCEDURE:

1. Make the connections as shown in Fig.5.

2. Note the values of the Resistor and Capacitor and hence determine the theoretical time constant of the circuit RC

3. Switch on the RPS and adjust it to a voltage of 5V.

4. Simultaneously close the switch SW and start the stop clock.

5 Take the readings of the capacitor voltage every 15 secs. Continue this for 4-5 time constants.

6. Replace RPS by a short circuit and simultaneously restart stop clock.

7. Take readings of capacitor voltage every 1.5secs for 4-5 time constants.

8. Plot the charging and discharging curves (Vs versus t)

9. From charging curve, find the time taken to reach 0.632V_S (τ). Compare this with the theoretical value. Also observe that the tangent of the curve at t=0 touches the horizontal line from Vs at t= τ

10. Draw the tangent at t=0 on the discharging curve and note the time when it touches the X-axis (τ). Compare this with the theoretical value. Also observe that the voltage at t= τ is equal to 0.368 Vs.

OBSERVATION:

SUPPLY VOLTAGE = ------------ V

CHARGING		**DISCHARGING**	
Time(sec)	**Charging voltage (V)**	**Time(sec)**	**Discharging voltage(V)**

RESULT:

DISCUSSION OF RESULTS:

EXPERIMENT 2

VERIFICATION OF THEOREMS (A) THEVENINS THEOREM (B) NORTON THEOREM

AIM: To verify Thevenin's Theorem and Norton's Theorem.

APPARATUS:

1. Regulated power supply.
2. Digital multimeter.
3. Decade resistance box.
4. Resistance network.

THEORY:

THEVENIN'S THEOREM:

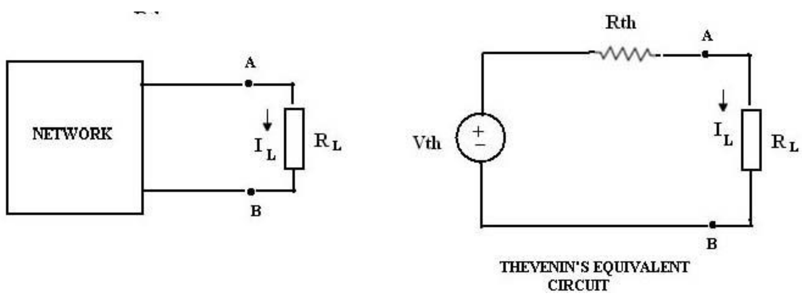


Fig:1

Any linear bilateral network with respect to two terminals (A and B) can be replaced by a single voltage source V_{th} in series with a single resistance R_{th}. Where, V_{th} is the open circuit voltage across the load terminals and R_{th} is the internal resistance of the network as viewed back into the open circuited network from the terminals A and B with voltage sources and current sources replaced by their internal resistances. Then the current in the load resistance is given by,

$$I_L = V_{th} / (R_{th} + R_L)$$

NORTON'S THEOREM:

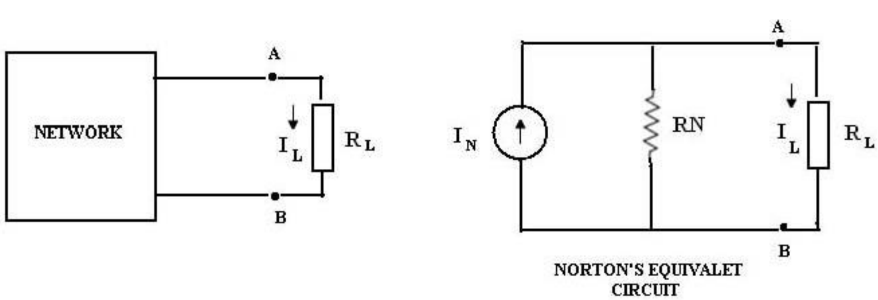


Fig:2

Any linear bilateral network with respect to a pair of terminals (A and B) can be replaced by a single current source I_N in parallel with a single resistance R_N.Where,I_N is the short circuit current in between the load terminals and $R_N(=R_{th})$ is the internal resistance of the network as viewed back into the open circuited network from the terminals A and B with voltage sources and current sources replaced by their internal resistances. Then the current in the load resistance is given by,

$$I_L = I_N R_N / (R_N + R_L)$$

(A)THEVENIN'S THEOREM:

CIRCUIT DIAGRAMS:

To find Thevenin's Voltage:

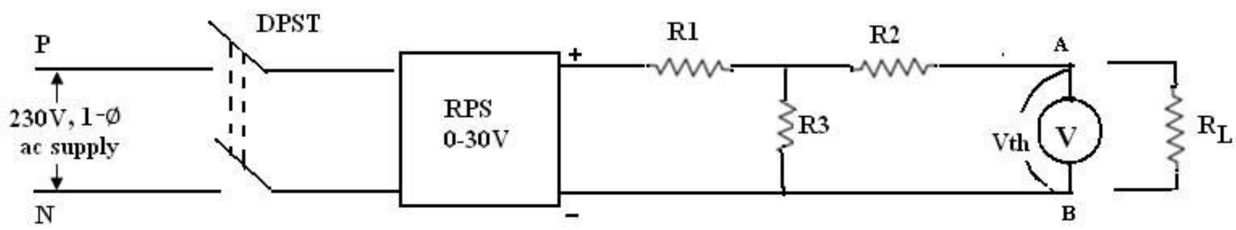


Fig:3

To find Thevenin's resistance :

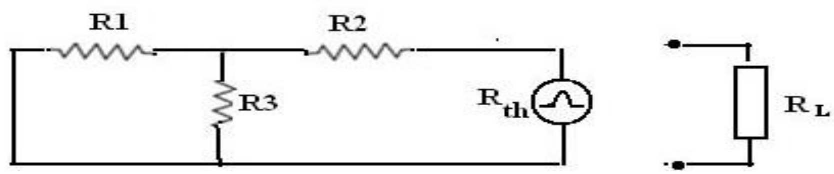


Fig:4

To find load current :

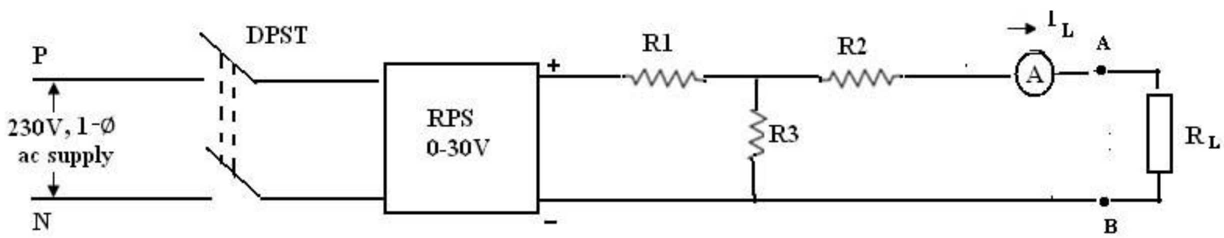


Fig-5

PROCEDURE:

1. Connect the circuit as shown in fig.3 and apply suitable voltage. Note down the open circuit voltage (V_{th}).
2. Connect the circuit as shown in fig.4 and note the Thevenin's resistance R_{th} by means of a multimeter.
3. Connect the circuit as shown in fig.5.For a particular value of load resistance R_L, keeping the voltage of RPS at the same value as in step1, note the value of the current. Verify the current value obtained by applying the Thevenin's theorem i.e I_L should be equal to V_{th} / (R_{th}+R_L).
4. Repeat step3 for various values of load resistances and compare with the calculated values, as obtained by applying Thevenin's theorem.
5. Vary the input voltage and take three sets of readings (step 2 need not be repeated as long as the network is not changed).

OBSERVATIONS:

R_{th}=

S.No.	V_s	V_{th}	R_L	I_L(Measured Value)	I_L(By applying theorem) $I_L=V_{th}/(R_{th}+R_L)$
1					

(B)NORTON'S THEOREM:

CIRCUIT DIAGRAMS:

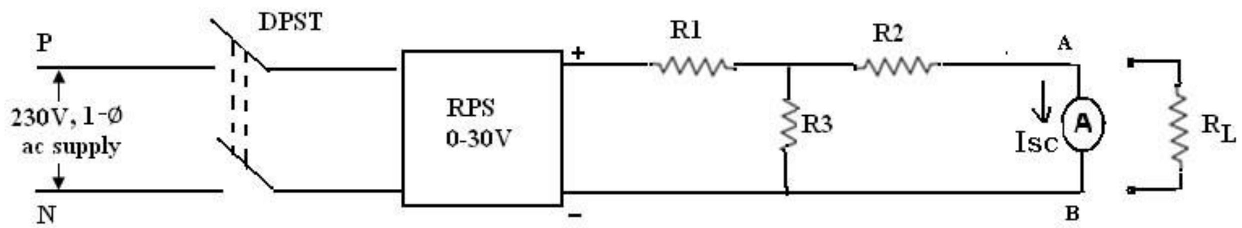


Fig-6

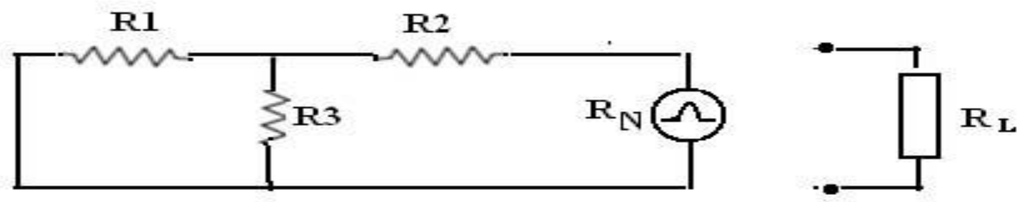


Fig - 7

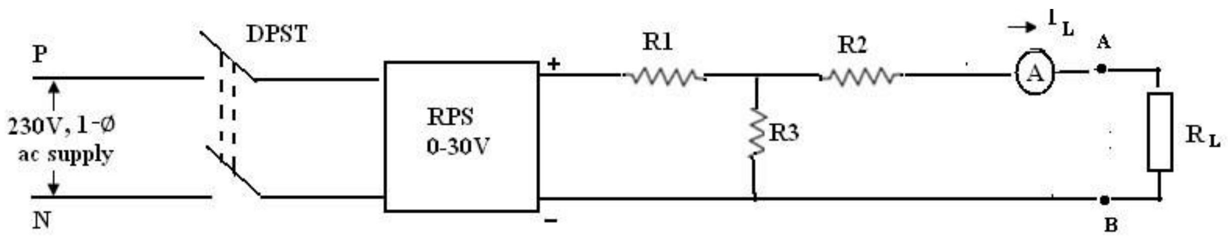


Fig - 8

PROCEDURE:

1. Connect the circuit as shown in fig.6 and by applying suitable voltage through RPS, determine the short circuit current (I_N / I_{sc}.).
2. Note down the load currents for various values of load resistance (R_L) and compare with the theoretical values obtained using Norton's equivalent circuit.
3. Repeat steps 1 & 2 for various values of source voltages.
   (Note R_N is same as R_{th} obtained in Thevenin's equivalent circuit).

OBSERVATIONS:

R_N =

S.No.	V_s	I_N /I_{sc}	R_L	I_L(Measured Value)	I_L(By applying theorem) I_L=I_N R_N/(R_N + R_L)

Result:

Discussion of Result:

EXPERIMENT 3

VERIFICATION OF THEOREMS (A) SUPER POSITION THEOREM (B) MAX POWER TRANSFER THEOREM

AIM: To verify Super Position Theorem and Maximum Power Transfer Theorem.

APPARATUS:

1. Regulated power supply.
2. Digital multimeter.
3. Decade resistance box.
4. Resistance network.

THEORY:

SUPERPOSITION THEOREM:

In a bilateral network consisting of a number of sources, the response in any branch is equal to sum of the responses due to individual sources taken one at a time with all other sources reduced to zero. When a network consists of several sources, this theorem helps us to find the current in any branch easily, considering only one source at a time.

MAXIMUM POWER TRANSFER THEOREM:

A resistance load will absorb Maximum power from a network when its resistance equals to the resistance of the network as viewed from the output terminals with all the sources removed leaving behind their internal resistances if any.

(A) SUPERPOSITION THEOREM:

CIRCUIT DIAGRAMS:

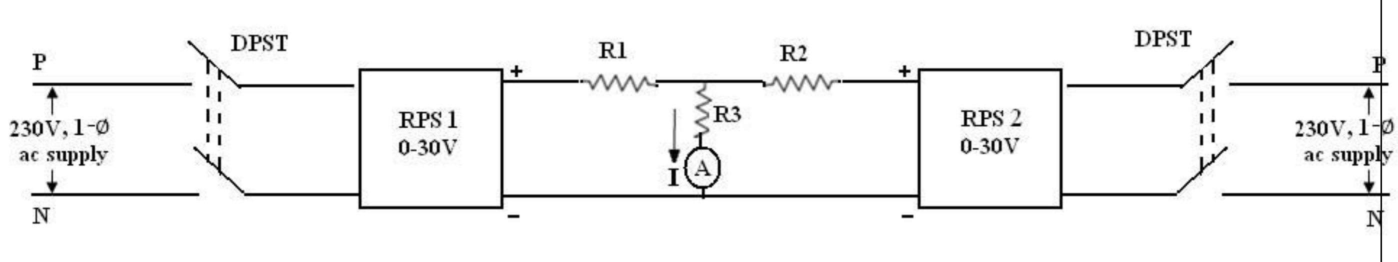


Fig-9

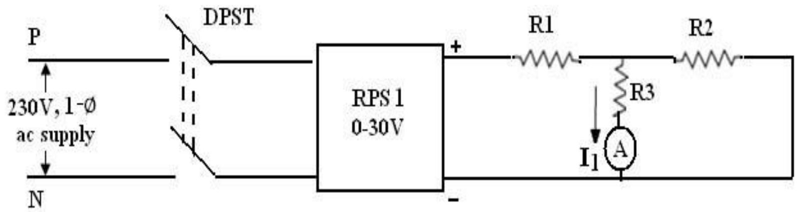


Fig-10

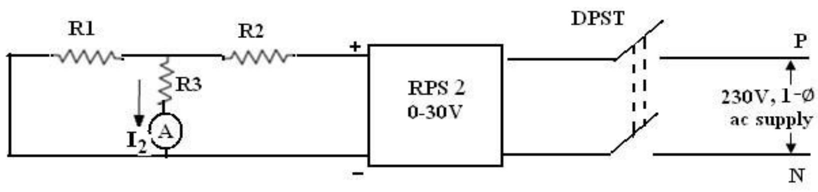


Fig-11

PROCEDURE:

1. Connect the circuit as shown in fig.9.
2. Adjust the voltage of the source (1) to 5V and that of source (2) to 10V.Note the current (I) read by the ammeter.
3. Disconnect source (2) and short the terminals as in fig(10) with source Voltage (1) at 5V read the ammeter current (I_1).
4. Disconnect source and short the terminals as in fig(11).With source (2) voltage at 10V read the ammeter current (I_2).
5. Verify the equation $I = I_1 + I_2$.
6. Repeat steps 2 to 5 for different voltages.

OBSERVATIONS:

S.No	V_1	V_2	I	I_1	I_2	$I=I_1+I_2$
1						

(B) MAXIMUM POWER TRANSFER THEOREM:

CIRCUIT DIAGRAMS:

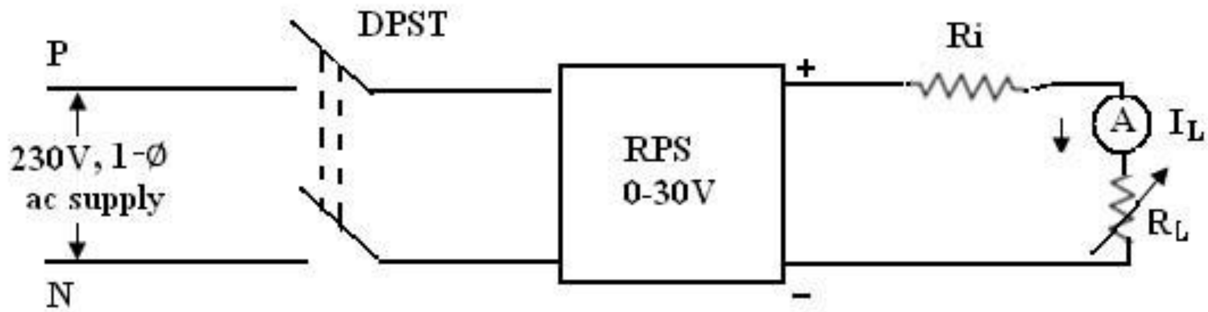


Fig-12

PROCEDURE:

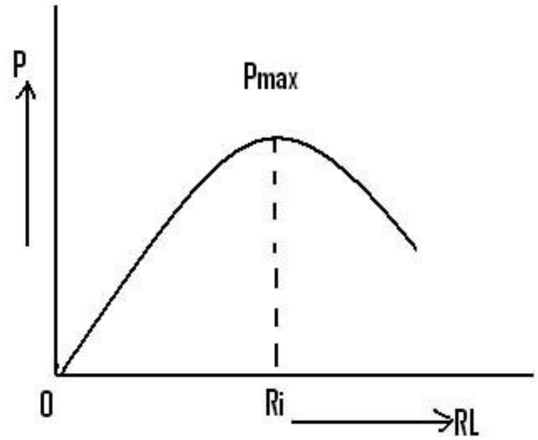
1. Connect the circuit as shown in the fig.12
2. Vary the load resistance RL from values lower than R_i and measure the current I_L. Calculate the power output in each case ($P = I_L^2 R_L$)
3. Tabulate the readings of R_L, I_L and power P.
4. Plot the curve R_L versus power
5. From the curve, observe that Maximum power occurs when $R_L = R_i$

OBSERVATION:

R_i =

S.No	R_L	I_L	$P=I_L^2 R_L$

EXPECTED GRAPHS:



RESULT:

DISCUSSION OF RESULTS:

EXPERIMENT 4

FREQUENCY RESPONSE OF A RLC SERIES CIRCUIT

AIM: To determine the resonant frequency of a series circuit.

APPARATUS: 1. Circuit Board.

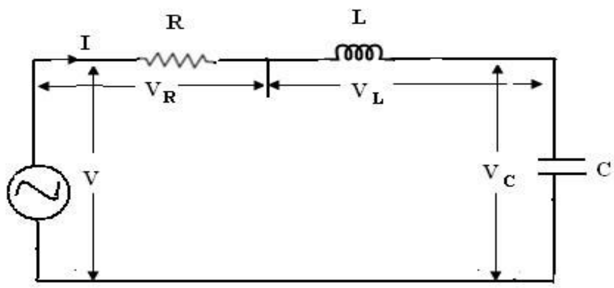
2. Connecting Wires.

3. Digital Voltmeter.

4. Ammeter.

5. Signal Generator.

THEORY:



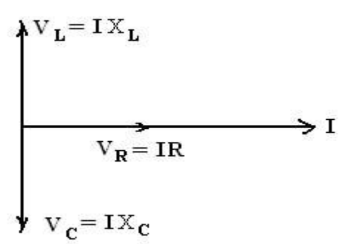


Fig-1 Fig-2

We know that the net reactance of a series RLC circuit is $X = X_L - X_C$ and Z = $\sqrt{R^2 + (X_L - X_C)^2 =}.\sqrt{R^2 + X^2}$

If for some frequency of the applied voltage $X_L = X_C$ then $X = 0$ and $Z = R$.

$V_L = X_L.I$ and $V_C = X_C.I$ and they are equal in magnitude but opposite in direction (phase).Then the voltage is in phase with VR and it acts as a pure resistive circuit. The frequency at which the net reactance is zero is given from the relation $X_L - X_C = 0$ or $X_L = X_C$

$$X_L - X_C = 0 \text{ (or) } X_L = X_C$$

$$\omega L = 1/\omega C$$

$$\omega^2 = 1/LC$$

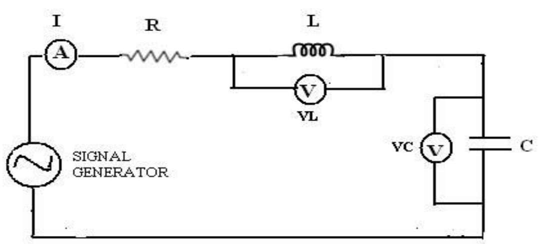
$$\omega = 1/\sqrt{LC}$$

$$2\pi f_0 = 1/\sqrt{LC}$$

$$f_0 = 1/2\pi\sqrt{LC}$$

Then the impedance of circuit is equal to the holmic resistance R and the current has a maximum value of $I = V/R$ and is in phase with 'V'. (Refer the vector diagram of Fig.2). The condition is known as series resonance and frequency at which it occurs is called resonant frequency f_0.

CIRCUIT DIAGRAM:



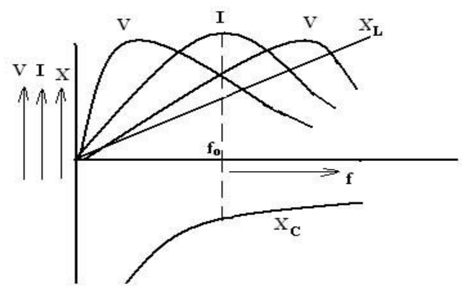


Fig- 3

Fig-4

PROCEDURE:

1. Connect the circuit as shown in fig 3.
2. Fix the frequency at a particular point (i.e. 500HZ).
3. Note down the current, V_L & V_C.
4. Vary the frequency with the help of a signal generator in steps of 500HZ.
5. Note the corresponding values of I, V_L, V_C.
6. Plot the curve frequency V_S, I, V_L, V_C. (Fig.4)
7. From the graph find the value of the frequency at which the current is maximum. This is the resonant frequency. Also note at f_0, V_L=V_C.
8. Verify the above value with the theoretical value.

OBSERVATIONS

S. No.	F(Hz)	I(mA)	$X_L(\Omega)$	$X_C(\Omega)$	V_L(V)	V_C(V)

RESULT:

DISCUSSION OF RESULTS:

EXPERIMENT 5
CHARACTERISTICS OF LINEAR AND NON LINEAR ELEMENT

LINEAR ELEMENT

AIM: To conduct a suitable experiment for verifying the characteristic of linear element.

APPARATUS REQUIRED:

S.No	Equipment	Range	Type	Quantity
l	RPS	0-30V	DC	I
2	Ammeter	0-l0mA	MC	3
3	Voltmeter	0-10V	MC	3
4	Resistor	1Kohm	---	3
S	Bread board	---	---	1
6	Connecting wires	---	---	As required

THEORY:

OHM'S LAW:

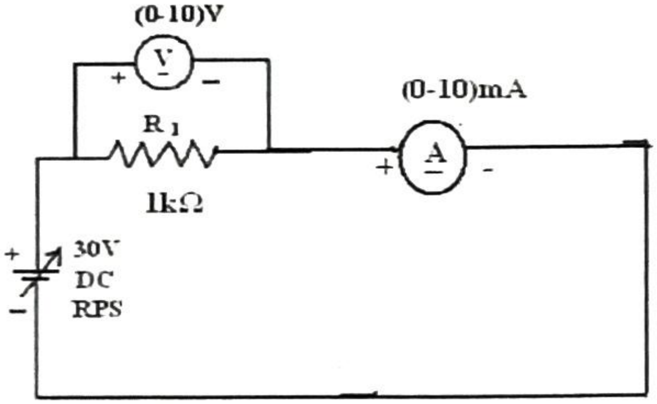
Ohm's law states that at constant temperature the current flow through a conductor is directly Proportional to the potential difference between the two ends of the conductor.

$$V=IR$$

Where R is a constant and is called the resistance of the conductor

FORMULA:

$$V = IR$$



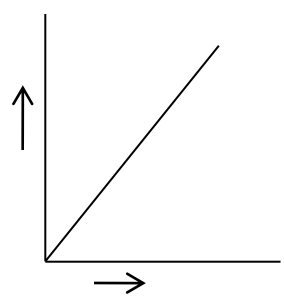
PROCEDURE:

1. Connections are made as per the circuit diagram
2. Switch on the power supply.
3. For various values of Voltage V, note the values of current I
4. Draw a graph of Voltage Vs Current.
5. The Slope of the graph gives the resistance value.
6. Ohm's law is verified by measuring the value of R using millimetre and comparing with experimental values

OBSERVATION:

S.NO	VOLTAGE(V)	CURRENT(inA)	R = V/I (f2)

MODEL GRAPH:



RESULT:

DISCUSSION OF RESULT:

NON-LINEAR ELEMENT

AIM: Study of V-I characteristics of a Diode

APPARATUS REQUIRED:

S.No	Equipment	Range	Type	Quantity
1	Diode Characteristics Kit	-----	----	1
2	DRPS	0-30V	DC	1
3	Ammeter	0-200mA	MC	1
4	Voltmeter	0-20V	DC	1
5	Connecting wires	----	---	As required

THEORY :

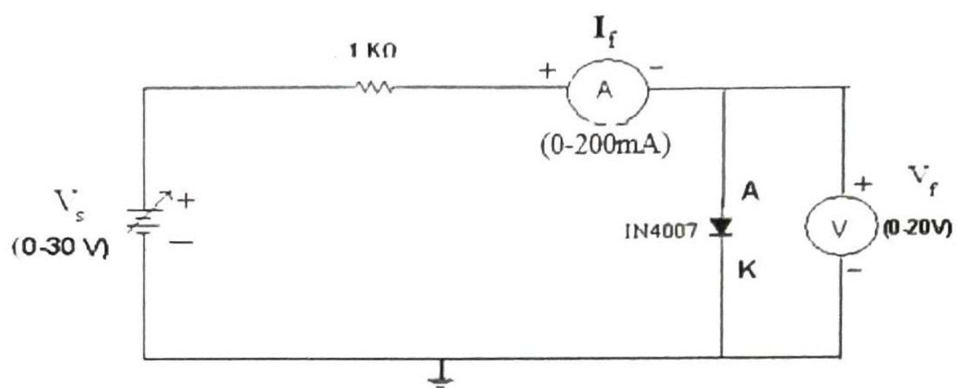
A PN junction diode conducts only in one direction. It is an example of unilateral element. The V-I characteristics of the diode are curve between voltage across the diode and current through the diode. When external voltage is zero, circuit is open and the potential barrier does not allow the current to flow. Therefore, the circuit current is zero. When P-type (Anode) is connected to +e terminal and N type (cathode) is connected to -ve terminal of the supply voltage, is known as forward bias. The potential barrier is reduced, when diode is in the forward biased condition. At some forward voltage, the potential barrier altogether eliminated and current starts flowing through the diode and also in the circuit. The diode is said to be in ON state. The current increases with increasing forward voltage. When N-type (cathode) is connected to +ve terminal and P-type (Anode) is connected to the -ve terminal of the supply voltage is known as reverse bias and the potential barrier across the junction increases. Therefore, the junction resistance becomes very high and a very small current (reverse saturation current) flows in the circuit. The diode is said to be in OFF state. The reverse bias current is due to minority charges carriers. An ideal PN junction Diode is a two terminal po1arity sensitive device that has zero resistance (diode conducts) when it is forward biased and infinite resistance (diode doesn't conduct) when it is reverse biased. Due to this characteristic, the diode finds number of applications as 1. Rectifiers in DC power supply, 2. Switch in digital circuits, 3. Clamping, Clipping circuits network used in TV Receiver, 4. Demodulation (detector) circuits.

Forward Biasing: When P-type semiconductor is connected to the +ve terminal and N-type to -ve terminal of voltage source. Nearly zero resistance is offered to the flow of current.

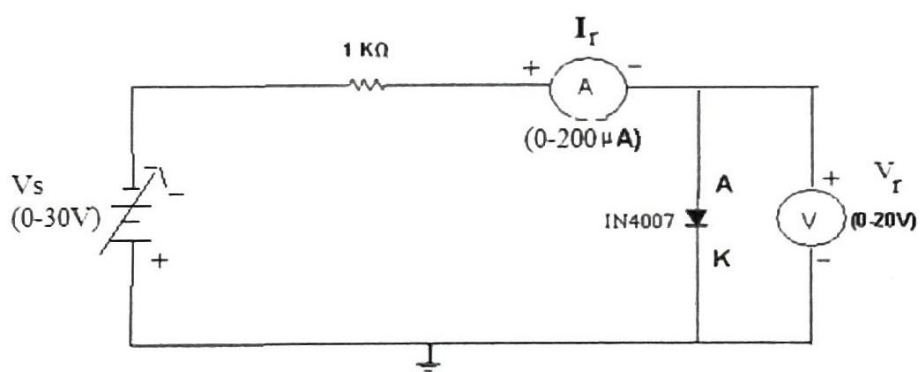
Reverse biasing: When P-type semiconductor is connected to the -ve terminal and N - type to +ve Terminal. Nearly zero current flow in this condition.

CIRCUIT DlAGRAM :

Farward Bias:



Reverse Bias:



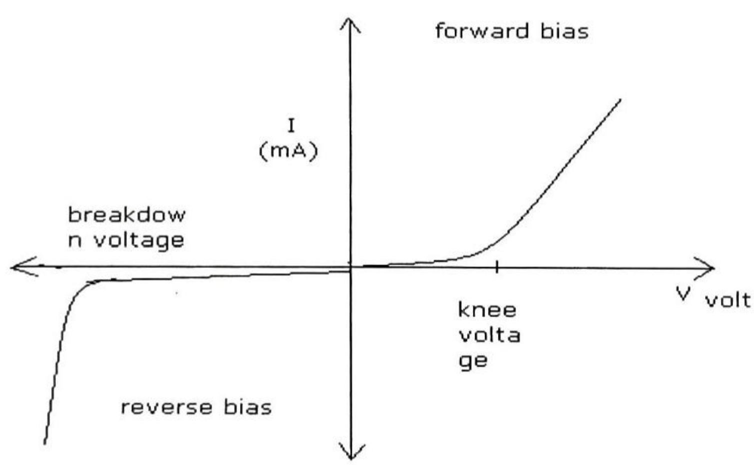
PROCEDURE :

1. Connect the ckt. as show in fig.
2. Connect the ckt. as show in fig.
3. Vary the value of input dc supply in steps.
4. Note down the ammeter & voltmeter readings for each step.
5. Plot the graph of Voltage Vs Current
6. Connect the ckt. as shown in fig.

OBSERVATION TABLE:

S.NO.	When Diode Is Forward Biased		When Diode Is Reverse Biased	
	Current(naA)	Voltagc(V)	Current [pA)	Voltage(V)
1.				
2.				
3.				

GRAPH:



RESULT:

DISCUSSION OF RESULT:

EXPERIMENT 6

FREQUENCY RESPONSE OF A RLC PARALLEL CIRCUIT

AIM: To determine the resonant frequency of a parallel circuit.

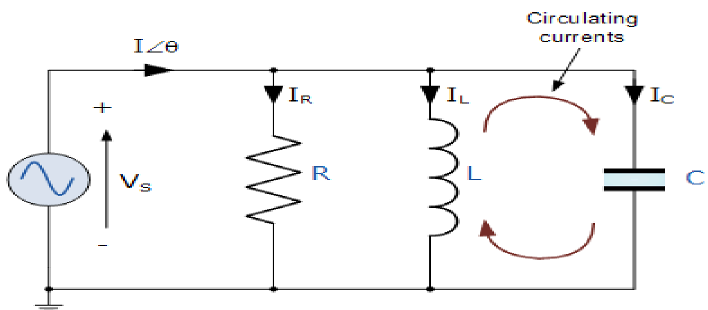
APPARATUS: 1. Circuit Board.

2. Connecting Wires.

3. Ammeter.

4. Signal Generator.

THEORY:



let us define about parallel RLC circuits.

$$\text{Admittance, } Y = \frac{1}{Z} = \sqrt{G^2 + B^2}$$

$$\text{Conductance, } G = \frac{1}{R}$$

$$\text{Inductive Susceptance, } B_L = \frac{1}{2\pi f L}$$

$$\text{Capacitive Susceptance, } B_C = 2\pi f C$$

Resonance takes place when $V_L = -V_C$ and this situation occurs when the two reactances are equal, $X_L = X_C$. The admittance of a parallel circuit is given as:

$$Y = G + B_L + B_C$$

$$Y = \frac{1}{R} + \frac{1}{j\omega L} + j\omega C$$

or

$$Y = \frac{1}{R} + \frac{1}{2\pi f L} + 2\pi f C$$

Resonance occurs when $X_L = X_C$ and the imaginary parts of Y become zero. Then:

$$X_L = X_C \quad \Rightarrow \quad 2\pi f L = \frac{1}{2\pi f C}$$

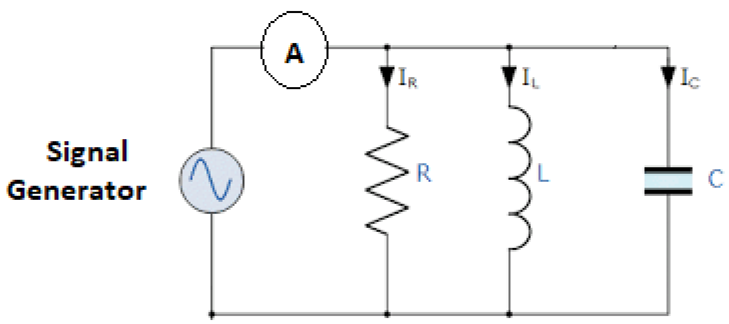
$$f^2 = \frac{1}{2\pi L \times 2\pi C} = \frac{1}{4\pi^2 LC}$$

$$f = \sqrt{\frac{1}{4\pi^2 LC}}$$

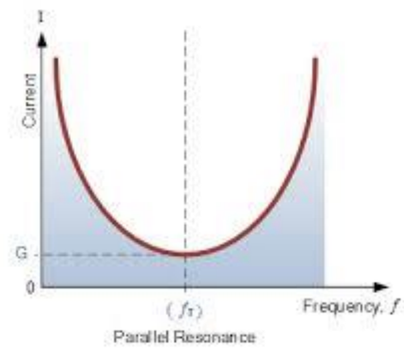
$$\therefore \ f_r = \frac{1}{2\pi\sqrt{LC}} \text{(Hz)} \quad \text{or} \quad \omega_r = \frac{1}{\sqrt{LC}} \text{(rads)}$$

Notice that at resonance the parallel circuit produces the same equation as for the series resonance circuit. Therefore, it makes no difference if the inductor or capacitor are connected in parallel or series.

CIRCUIT DIAGRAM:



Expected Graph



PROCEDURE:

1. Connect the circuit as shown in fig 3.
2. Fix the frequency at a particular point (i.e. 500HZ).
3. Vary the frequency with the help of a signal generator in steps of 500HZ.
4. Note down the current
5. Plot the curve frequency V_S I
6. From the graph find the value of the frequency at which the current is minimum. This is the resonant frequency.
7. Verify the above value with the theoretical value.

OBSERVATIONS

S. No.	f(Hz)	I(mA)	$X_L(\Omega)$	$X_C(\Omega)$

THEORITICAL CALCULATIONS:

$$f_0 = 1/2\pi\sqrt{LC}$$

RESULT:

DISCUSSION OF RESULTS:

EXPERIMENT 7

LOCUS DIAGRAM OF RC/RL CIRCUIT

AIM: To plot locus diagram of series R-L and R-C circuits by varying resistance parameter.

APPARATUS:

1. Locus diagram kit.
2. Function generator.
3. AC Ammeter (0-200mA).
4. Connecting wires etc.

THEORY:

A phasor diagram may be drawn and is expanded to develop a curve known as a locus. Locus diagrams are useful in determining the behavior or response of an R-L-C circuit when one of its parameters is varied while the frequency and voltage kept constant. The magnitude and phase of the current vector in the circuit depends upon the values of R, L and C and frequency at the fixed source voltage.

The path traced by the terminus of the current vector when the parameter R, L or C are varied while the frequency and voltage are kept constant is called the current locus.

R-C series circuit: To draw the loci current of constant capacitive reactance, the circuit is as shown below. The current semi-circle for the R-C circuit with variable R will be as shown of voltage vector OI_m with diameter V/ Xc as shown. The current vector leads voltage by theta. The active component of current is OImCosϴ which is proportional to power consumed in R-C circuit.

$X_c = 1/2\pi fc$

$\Theta = \tan^{-1}(-X_c/R)$

R-L series circuit: The circuit to be considered is as below and it has constant reactance but variable resistance. The applied voltage will be assumed with constant rms voltage V. The power factor angle is designed by ϴ. If R=0, IL is obviously equal to V/X_L and has maximum value. Also I lags V by 90^0. This is as shown below. If R is increased from zero value, the magnitude of I becomes less than V/X_L and ϴ becomes less than 90^0 and finally when the limit is reached, i.e. when R equals to infinity, I equals to zero and ϴ equals to zero.

$X_L = 2\pi fL$

$\Theta = \tan^{-1}(X_L/R)$

CIRCUIT DIAGRAMS:

R-C Series Circuit:

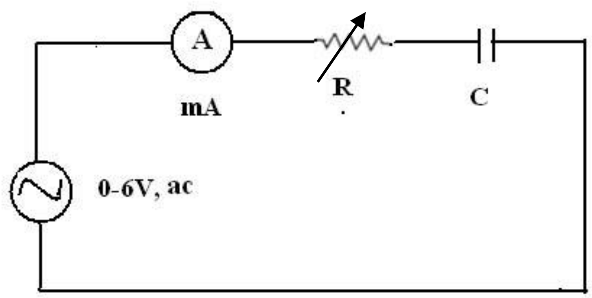


Fig-1

R-L Series Circuit:

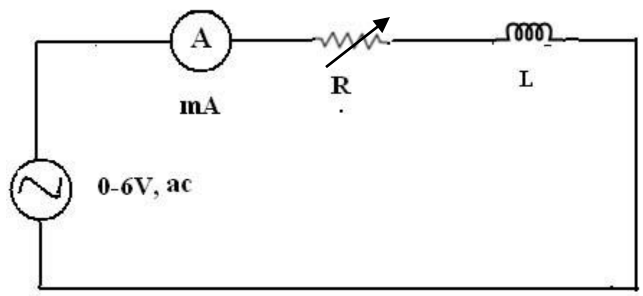


Fig-2

PROCEDURE:

1. Connect the circuit as shown in fig1
2. Apply signal of maximum amplitude to the circuit from the signal generator with minimum R applied, which is provided on the panel.
3. Note the readings on ammeter by varying the R provided.
4. Draw the locus for current as R is varied.
5. Repeat the procedure by replacing L with C

OBSERVATION:

R-C Series Circuit: C =

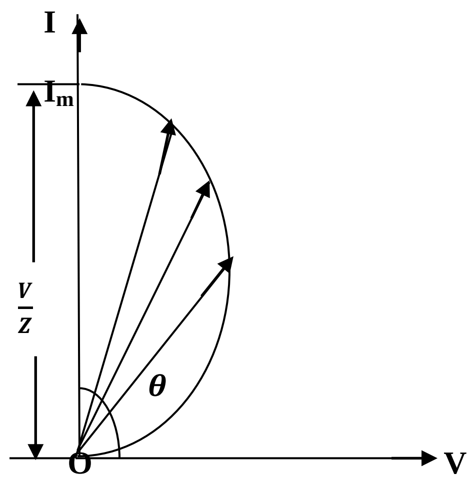
S.NO.	Variable R	X_C	$Z = \sqrt{R^2 + {X_C}^2}$	$\Theta = \tan^{-1}(-X_C/R)$	I(mA) Measured	I(mA) $= \frac{V}{IZI}$ Calculated
1						

R-L Series Circuit: L =

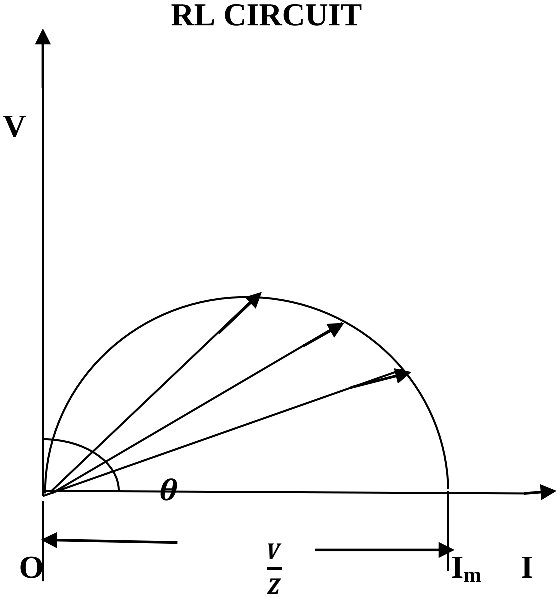
S.NO.	Variable R	X_L	$Z = \sqrt{R^2 + {X_L}^2}$	$\Theta = \tan^{-1}(X_L/R)$	I(mA) Measured	I(mA) $= \frac{V}{IZI}$ Calculated
1						

EXPECTED GRAPHS:

RC CIRCUIT



RL CIRCUIT



RESULT:

DISCUSSION OF RESULTS:

EXPERIMENT 8

PARAMETERS OF TWO PORT NETWORK

AIM: To determine Z, Y, ABCD and h parameters for a two port network.

APPARATUS:

1. Two port network board.
2. Digital ammeters.
3. Connecting wires.

THEORY:

A two port network (fig1) can be represented by

(a) Open circuit impedance parameters (Z).

(b) Short circuit admittance parameters(Y)

(c) ABCD parameters.

(d) Hybrid parameters (h)

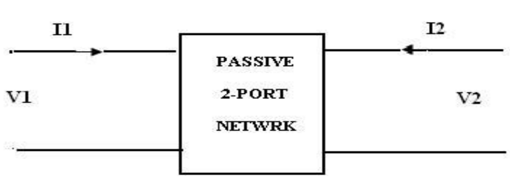


Fig-1

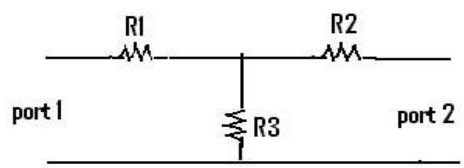


Fig-2

The various input-output relationships between the voltages and currents may be described by the following matrix equations.

Any set of above four types of parameters may be used to describe the network as far as its behavior at the external terminals is concerned.

DETERMINATION OF Z-PARAMETERS:

CONNECTION DIAGRAM:

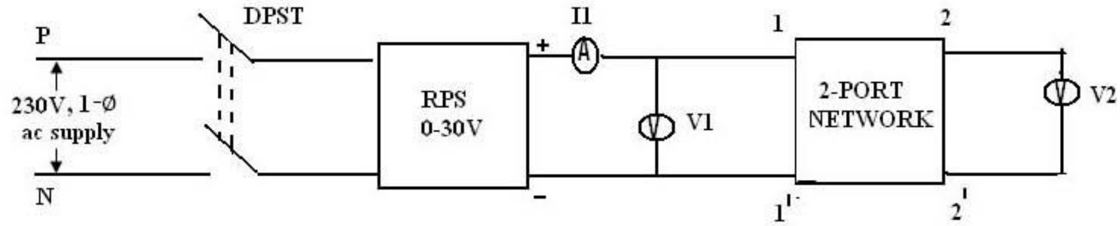


Fig- 3

PROCEDURE:

1. Connect the circuit as shown in fig.3.
2. For different values of input voltages, obtain the values of V1, I1 and V2 with port 2 open circuited (i2=0)

3. Connect the source of port 2 and open circuiting port 1, as in Fig 4.

Obtain the values of V2, I2, and V1. (I1=0)

FORMULAE

Calculate the Z-parameters using the following relations.

$Z_{11}=V_1/I_1 \ |I_2=0$ Driving point impedance at port 1.

$Z_{21}=V_2/I_1 \ |I_2=0$ Transfer impedance.

$Z_{12}=V_1/I_2 \ |I_1=0$ Transfer impedance

$Z_{22}=V_2/I_2 \ |I_1=0$ Driving point impedance at port 2.

DETERMINATION OF Y-PARAMETERS:

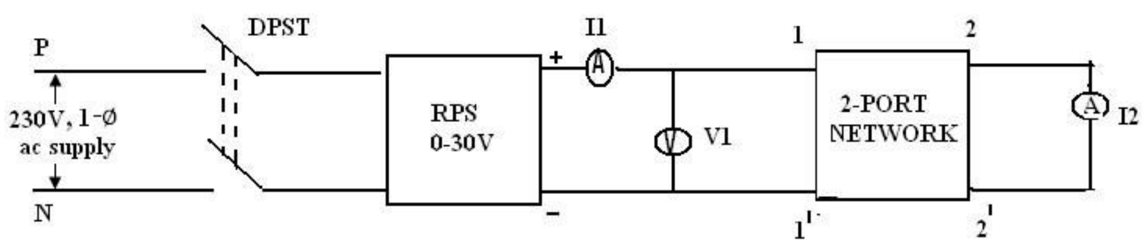


Fig-4

PROCEDURE:

1. Short circuit the port 2 (fig. 3) through an ammeter and apply voltage at port 1 (V2=0).
2. Obtain the values of V1, I1, and I2 for different values of supply voltages.
3. Short circuit the port 1 through an ammeter and apply voltage at port 2.Note the values of V2, I2 and I1 for various values of V2. (V1=0)

FORMULAE & MODEL CALCULATIONS:

Calculate the Y-parameters using the following relations.

$Y_{11}=I_1/V_1 \ |V_2=0$ Driving point admittance at port 1

$Y_{21}=I_2/V_1 \ |V_2=0$ Transfer admittance.

$Y_{12}=I_1/V_2 \ |V_1=0$ Transfer admittance

$Y_{22}=I_2/V_2 \ |V_1=0$ Driving point admittance at port 2.

Relation of Y parameter in terms of Z parameter

$Y_{11}= Z_{22} / \Delta Z$

$Y_{12}= -Z_{12} /\Delta Z$

$Y_{21}= -Z_{21} / \Delta Z$

$Y_{22}= Z_{11} / \Delta Z$

CALCULATION OF ABCD PARAMETERS :

Obtain the ABCD parameters by using the following relations from the readings obtained in expt. 1 and expt. 2.

$A=V_1/V_2 \ |I_2=0$

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

$C=I_1/V_2 \ |I_2=0$

$D=I_1/-I_2 \ |V_2=0$

Relation of ABCD parameter in terms of Z parameter

$A = Z_{11} / Z_{12}$

$B = \Delta Z / Z_{21}$

$C = 1 / Z_{12}$

$D = Z_{22} / Z_{21}$

CALCULATION OF h-PARAMETERS :

Obtain the hybrid(h) parameters using the following relations from the readings obtained in expt. 1and expt. 2.

$h_{11}=V_1/I_1 \quad |V_2=0$

$h_{12}=V_1/V_2 \quad |I_1=0$

$h_{21}=I_2/I_1 \quad |V_2=0$

$h_{22}=I_2/V_2 \quad |I_1=0$

Relation of h parameter in terms of Z parameter

$h_{11} = \Delta Z / Z_{22}$

$h_{12} = -Z_{21}/ Z_{22}$

$h_{21} = Z_{12}/ Z_{22}$

$h_{22} = 1 / Z_{22}$

RESULT:

DISCUSSION OF RESULTS:

EXPERIMENT 9

MEASUREMENT OF POWER BY TWO WATTMETER METHOD

AIM: Measurement of power in a three phase system by two wattmeter method

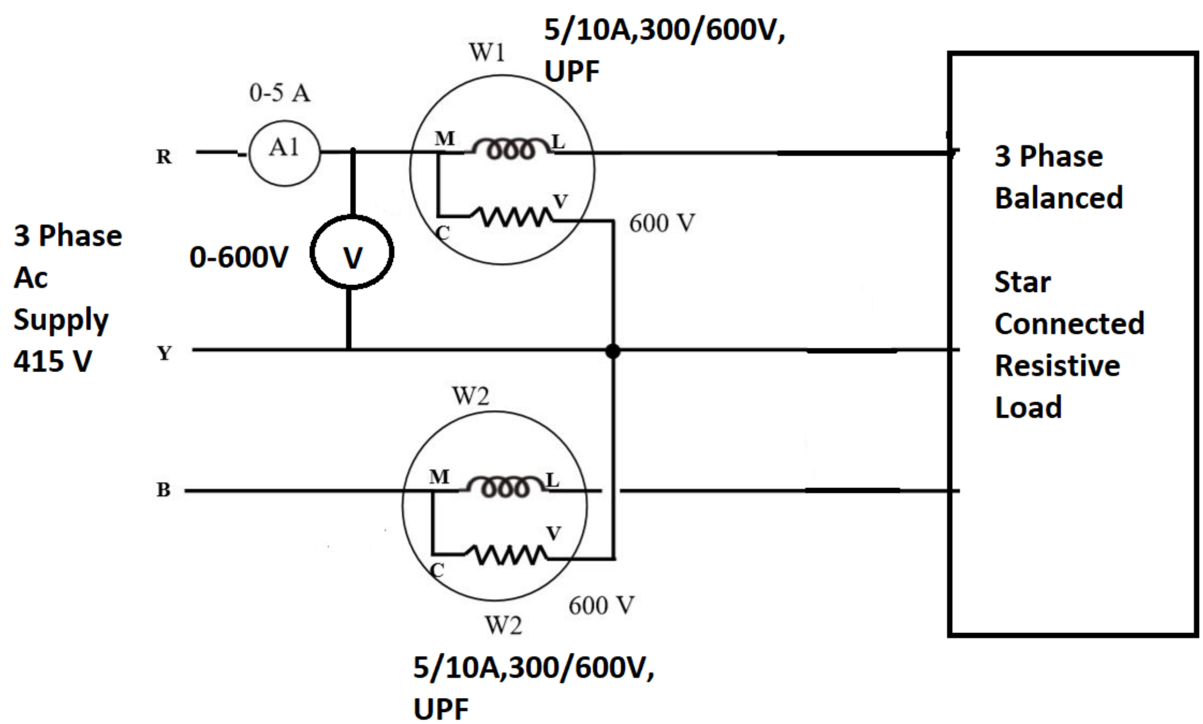
APPARATUS:

1. Three Phase Resistive load
2. Ammeters 0-10 A,MI (1 No)
3. Wattmeter's 5/10 A, 300/600V (2 No)
4. Voltmeter 0-600V,MI.(1 No)
5. Connecting wires

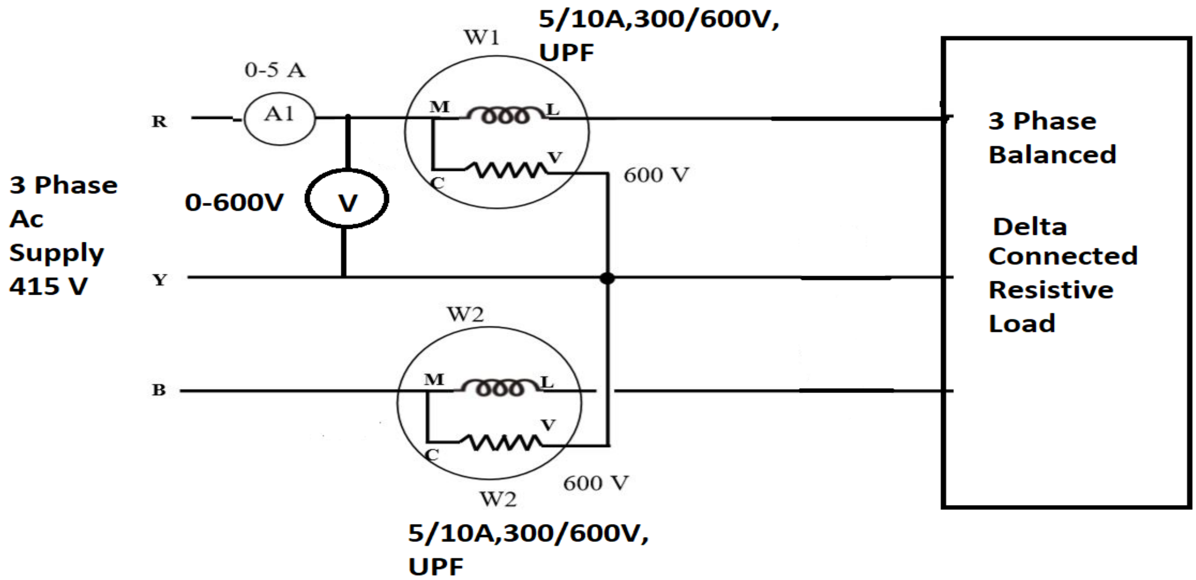
THEORY: Surprisingly, only two single phase wattmeters are sufficient to measure the total power consumed by a three-phase balanced circuit. The two wattmeters are connected as shown in figure. The current coils are connected in series with two of the lines. The pressure (or voltage) coils of the two wattmeters are connected between that line and reference.

CIRCUIT DIAGRAM

a) **Star Connected System**



b) Delta Connected System



Procedure

1. Connect the circuit as shown in figure.
2. Keep the three phase variac at its zero position.
3. Switch on the main supply.
4. Increase the voltage supplied to the circuit by changing the positions of variac so that all the meters give readable deflection.
5. Note down readings of all the meters

Observation Table

a) Star Connection

S. No	Voltage(V)	Current(A)	W_1 (W)	W_2 (W)	P= W_1+ W_2 (W)	P=√3VICosΘ (W)

b) Delta Connection

S. No	Voltage(V)	Current(A)	W_1 (W)	W_2 (W)	P= W_1+ W_2 (W)	P=√3VICosΘ (W)

RESULT:

DISCUSSION Of RESULT:

EXPERIMENT 10

Mesh and Nodal analysis of electric circuit using pspice software

Aim: To perform mesh and nodal analysis of electric circuit using pspice software

Apparatus:

1.pspice software
2.Windows XP SP2.

Theory: Mesh analysis is used to find loop currents .Using Kirchhoff's voltage law the loop currents and branch voltages are determined

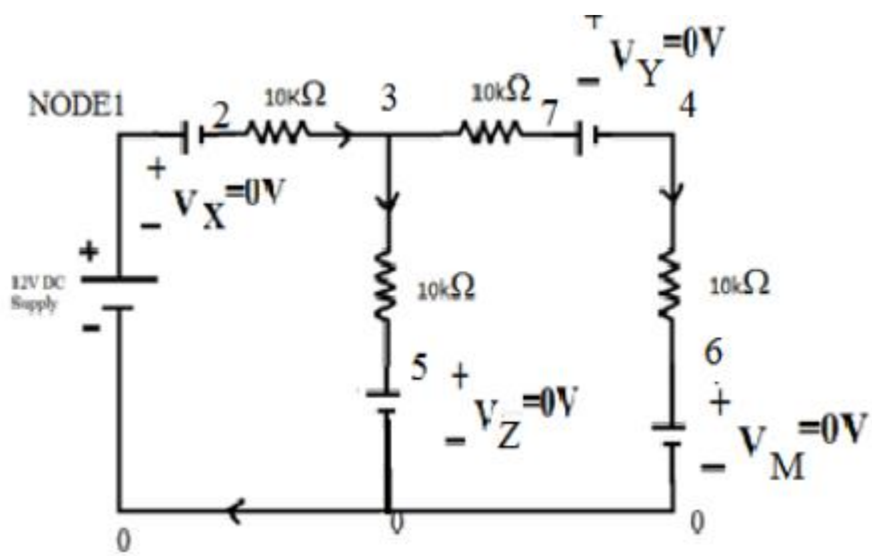
Nodal analysis is used to find node voltages. using Kirchhoff's current law the node voltages and branch currents are determined

PROCEDURE:

1. Open pspice AD software
2. Select file ◊New◊ Text file
3. Enter the code
4. Save the file as filename.cir
5. Run the file
6. Check for errors

MESH AND NODAL ANANALYSIS

Circuit diagram:



PROGRAM:

```
VS 1 0 DC 12V
R1 2 3 10KOHMS
R2 3 7 10KOHMS
R3 4 6 10KOHMS
R4 3 5 10KOHMS
VX 1 2 0V
VY 7 4 0V
VZ 5 0 0V
VM 6 0 0V
.OP
.END
```

Output File:

Node Voltages:

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
(1)	12.0000	(2)	12.0000	(3)	4.8000	(4)	2.4000
(5)	0.0000	(6)	0.0000	(7)	2.4000		

Mesh currents:

VOLTAGE SOURCE CURRENTS

NAME	CURRENT
VS	-7.200E-04
VX	7.200E-04
VY	2.400E-04
VZ	4.800E-04
VM	2.400E-04

TOTAL POWER DISSIPATION 8.64E-03 WATTS

Result:

Discussion of Result: