METHODIST
COLLEGE OF ENGINEERING & TECHNOLOGY
(An UGC Autonomous Institution)
Approved by AICTE, New Delhi & Affiliated to Osmania University
Accredited by NBA and NAAC with A+
College Code: 1607

LABORATORY MANUAL

ELECTRICAL CIRCUITS LABORATORY

BE, III Semester (AICTE): 2021-22

NAME: _____

ROLL NO:_____

BRANCH:_____

SEM:_____

DEPARTMENT OF ELECTRICAL AND ELECTRONCS ENGINEERING

Empowering youth- Architects of Future World

VISION

To produce ethical, socially conscious and innovative professionals who would contribute to sustainable technological development of the society.

MISSION

To impart quality engineering education with latest technological developments and interdisciplinary skills to make students succeed in professional practice.

To encourage research culture among faculty and students by establishing state of art laboratories and exposing them to modern industrial and organizational practices.

To inculcate humane qualities like environmental consciousness, leadership, social values, professional ethics and engage in independent and lifelong learning for sustainable contribution to the society.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

LABORATORY MANUAL

ELECTRICAL CIRCUITS LABORATORY

Prepared By

Mr. N. Nireekshan,

Assistant Professor

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To become a reputed centre for imparting quality education in Electrical and Electronics Engineering with human values, ethics and social responsibility.

MISSION

- To impart fundamental knowledge of Electrical, Electronics and Computational Technology.
- To develop professional skills through hands-on experience aligned to industry needs.
- To undertake research in sunrise areas of Electrical and Electronics Engineering.
- To motivate and facilitate individual and team activities to enhance personality skills.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

BE-Electrical Engineering graduates shall be able to:

- **PEO1**. Utilize domain knowledge required for analyzing and resolving practical Electrical Engineering problems.
- **PEO2**.Willing to undertake inter-disciplinary projects, demonstrate the professional skills and flair for investigation.
- **PEO3**. Imbibe the state of the art technologies in the ever transforming technical scenario.
- **PEO4**. Exhibit social and professional ethics for sustainable development of the society.

DEPARTMENT OF ELECTRICAL AND ELCTRONICS ENGINEERING

PROGRAM OUTCOMES

Engineering Graduates will have ability to:

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of electrical and electronics engineering problems.
- **PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex electrical and electronics engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for complex electrical and electronics engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex electrical and electronics engineering activities with an understanding of the limitations.
- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional electrical and electronics engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO.8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the electrical and electronics engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

At the end of BE program Electrical and Electronics Engineering graduates will be able to:

- **PSO1**.Provide effective solutions in the fields of Power Electronics, Power Systems and Electrical Machines using MATLAB/MULTISIM.
- **PSO2.** Design and Develop various Electrical and Electronics Systems, particularly Renewable Energy Systems.
- **PSO3.** Demonstrate the overall knowledge and contribute for the betterment of the society.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION

Academic Year	**2021-22**
Course Code	**PC451EE, PC263EE**
Course Title	**ELECTRICAL CIRCUITS LAB**
Room No:	**B-106**
Curriculum Regulation	**AICTE – OU (Affiliated Colleges)**
Semester	**III & V**
Lab Incharge	**Mr. N.Nireekshan, Assistant Professor**
Course Instructor	
Lab Assistant	**Mr.**

I. PREREQUISITE(S):

Level	Credits	Semester	Prerequisites
UG	1	1	Electrical Circuits

II. SCHEME OF INSTRUCTIONS

Lectures	Tutorials	Practical	Credits
0	0	2	1

III. SCHEME OF EVALUATION & GRADING

S. No	Component	Duration	Maximum Marks
	Continuous Internal Evaluation (CIE)		
1.	Internal Examination – I and II	1 hour each	25
	CIE (Total)		**25**
2.	**Semester End Examination** (University Examination)	3 hours	**50**
		TOTAL	**75**

%Marks Range	>=90	80 to < 90	70 to < 80	60 to < 70	50 to < 60	40 to < 50	< 40	Absent
Grade	S	A	B	C	D	E	F	Ab
Grade Point	10	9	8	7	6	5	0	-

LABORATORY CODE OF CONDUCT

1. Students should report to the labs concerned as per the scheduled time table.
2. Students, who report late to the labs will not be permitted to perform the experiment scheduled for the day.
3. Students to bring a 100 pages note book to enter the readings /observations while performing the experiment.
4. After completion of the experiment, certification of the staff in-charge concerned, in the observation book is necessary.
5. Staff member in-charge shall evaluate for 25 marks, each experiment, based on continuous evaluation which will be entered in the continuous internal evaluation sheet.
6. The record of observations, along with the detailed procedure of the experiment performed in the immediate previous session should be submitted for certification by the staff member in-charge.
7. Not more than three students in a group would be permitted to perform the experiment on the equipment-based lab set up. However only one student is permitted per computer system for computer-based labs.
8. The group-wise division made at the start of the semester should be adhered to, and no mix up with any other group would be allowed.
9. The components required, pertaining to the experiment should be collected from the stores in-charge, after duly filling in the requisition form / log register.
10. After the completion of the experiment, students should disconnect the setup made by them, and return all the components / instruments taken for the purpose, in order.
11. Any damage of the equipment or burn-out of components will be charged at cost as a penalty or the total group of students would be dismissed from the lab for the semester/year.
12. Students should be present in the lab for the total time duration, as scheduled.
13. Students are required to prepare thoroughly, before coming to Laboratory to perform the experiment.
14. Procedure sheets / data sheets provided to the students, if any, should be maintained neatly and returned after the completion of the experiment.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

DOS AND DON'TS IN THE LABORATORY

Dos:

- All bags must be left at the place indicated
- There must be at least two people in the laboratory while working on live circuits.
- Shoes and apron must be worn at all times while in the laboratory.
- Consider all circuits to be "HOT" unless proven otherwise.
- When making measurements, form the habit of using only one hand at a time.
- Be as neat a possible. Keep the work area and workbench clear of items not used in the experiment.
- Always check to see that the power switch is OFF before plugging into the outlet. Also, turn instrument or equipment OFF before unplugging from the outlet.
- When disassembling a circuit, first remove the source of power.
- The lab timetable must be followed strictly.
- Be PUNCTUAL for your laboratory session.
- Experiment must be completed within the given time.
- Noise must be kept to a minimum.
- Handle all apparatus with care.

Don'ts;

- No part of a live circuit should be touched by the bare hand.
- No ungrounded electrical or electronic apparatus is to be used in the laboratory unless it is double insulated or battery operated.
- When unplugging a power cord, pull on the plug, not on the cable.
- Students are strictly PROHIBITED from taking out any items from the laboratory.

Before Leaving Lab:

- Place the seating stools under the lab bench.
- Turn off the power to all instruments.
- Return all the equipment to lab assistant.
- Turn off the main power switch to the lab bench.
- Please check the laboratory notice board regularly for updates.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CONTENTS

Sl. No.	Name of Experiment	Page No.
1	Characteristics of Linear, Non-Linear and Bilinear Elements.	
2	Verification of Thevenin's and Norton's theorems.	
3	Verification of Superposition theorem and Maximum power transfer theorem.	
4	Parameters of two port network.	
5	Charging and Discharging Characteristics of RC and RL series circuits.	
6	Frequencies Response of a Series RLC Circuits.	
7	Frequencies Response of a Parallel RLC Circuits.	
8	Measurement of Power by using Two Wattmeter method.	
9	Simulation and transient analysis of series RLC circuits using PSPICE.	
10	Mesh and Nodal analysis of electrical circuit using PSPICE.	
Additional Experiments		
11	Millman's theorem.	
12	Charging and Discharging Characteristics of RC and RL series circuits by using MATLAB/Simlink.	

ELECTRICAL CIRCUITS LAB

PC263EE

2020-21 V SEM

Estd:2008

METHODIST

COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Outcomes

COs	Course Outcomes	BT LEVEL
C263EE .1	Evaluate the time response and frequency response character sties of R,L, C Series and parallel circuits	Evaluate
C263EE .2	Simplify the complicated circuits using Thevenin's, Norton's and Superposition theorems.	Analyze
C263EE .3	Examine various parameters of a two-port network.	Analyze
C263EE.4	Develop code to obtain transient analysis of electrical circuits using spice	Apply
C263EE .5	Evaluate the three phase power of balanced loads	Evaluate
C263EE .6	Analyze the networks from a given transfer function	Analyze

List of Experiments:

1. Locus diagrams of RC and RL Circuits.
2. Frequencies Response of a Series RLC Circuits.
3. Frequencies Response of a Parallel RLC Circuits.
4. Parameters of two port network.
5. Series, parallel and cascade connection of two port networks.
6. Verification of Thevenin's and Norton's theorems.
7. Verification of Superposition theorem and Maximum power transfer theorem
8. Two Wattmeter method.
9. Simulation and transient analysis of series RLC circuits using PSPICE.
10. Mesh and Nodal analysis of electrical circuit using PSPICE.
11. Network Synthesis.
12. Characteristics of Linear, Non-Linear and Bilinear Elements.

EXP 1.

Locus diagrams of RC and RL Circuits.

AIM :

To Plot the current locus diagrams for RL and RC circuits.

APPARATUS:

1. Resistance Box
2. Inductance Box
3. Capacitance Box
4. Ammeter AC -- (0-20mA) --- 1 No
5. Volt meters AC -- (0-20V) --- 2 No.s
6. Function Generator
7. CRO

THEORY :

Locus diagrams are useful in determining the behaviour or response of an RLC circuit, when one of its parameters is varied while the frequency and voltage are kept constant. The magnitude and phase of the current vector in the circuit depend upon the values of R, L and C and frequency at the fixed source voltage. The path travelled by the tip of the current vector when the parameters R, L or C are varied while frequency and voltage are kept constant is
called the locus diagram.

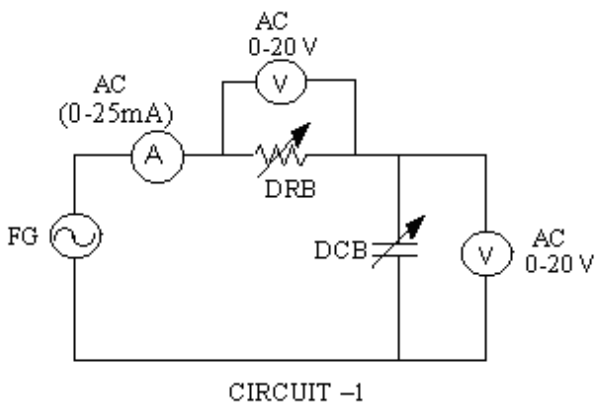
R-varying :

If R = 0, then I = V/ X_L or V/ X_C and has maximum value. It will lag or lead the voltage by
90^0 depending on whether the reactance is inductive or capacitive. The angle θ represents the phase angle ($\theta = \tan^{-1}(V_X/ V_R)$). As R is increased from zero value, I and θ decrease. In the limiting case when R= ∞, then I = 0 and $\theta = 0^0$. The locus of end-point qitI is a semi-circle of radius V / X.

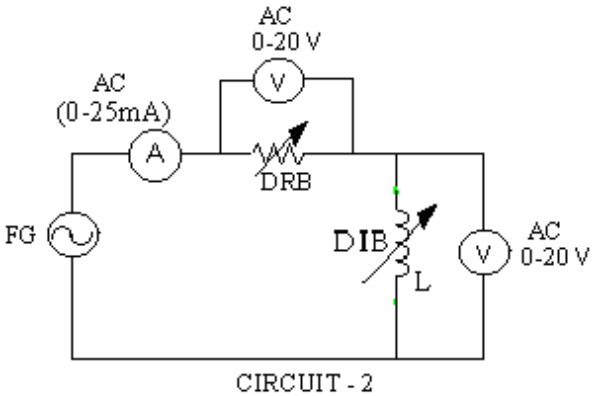
R-Fixed :

If X = 0, then I = V/ R and has maximum value. The current will be in phase with voltage as it is a purely resistive circuit i.e., the phase θ is zero. As X is increased depending on whether the reactance is inductance or apacitance the current starts lagging or leading V i.e., the current I decreases and phase angle θ increases. In the limiting case when X = ∞, then I = 0 and $\theta = 90^0$. The locus of end point of I is a semi-circle of radius V/ R.

CIRCUIT DIAGRAM :



CIRCUIT –1



CIRCUIT - 2

PROCEDURE :

Circuit – 1:

1. Connect the circuit as shown in CIRCUIT – 1. Note down the values of applied voltage and frequency.
2. Fix the resistance at a suitable value (say 1KΩ).
3. Note down the values of V_R, V_C and I for at least three different values of the Capacitor.
4. Now fix the capacitance at a suitable value (say 0.01μF).
5. Note down the values of V_R, V_C and I for at least three different values of the resistor.
6. Draw the corresponding current locus diagrams.

Circuit – 2 :

1. Connect the circuit as shown in CIRCUIT – 2. Note down the values of applied voltage and frequency.
2. Fix the resistance at a suitable value (say 1KΩ).
3. Note down the values of V_R, V_L and I at least three different values of the Inductor.
4. Now fix the Inductance value at a suitable value (say 45mH).
5. Note down the values of V_R, V_L and I at least three different values of the resistor.
6. Draw the corresponding current locus diagrams.

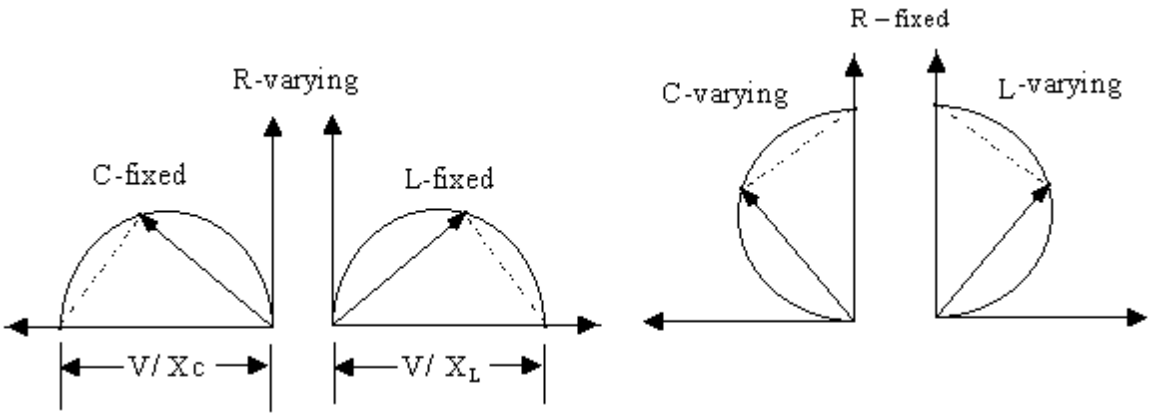
TABULAR COLOUMN:

f = $V_{i/p}$ =

Circuit – 1 **Circuit – 2**

R – fixed						**R – fixed**					
S.No	R (Ω)	C (μF)	V_R (V)	V_C (V)	I (mA)	S.No	R (Ω)	C (μF)	V_R (V)	V_L (V)	I (mA)
C – fixed						**L – fixed**					
S.No	R (Ω)	C (μF)	V_R (V)	V_C (V)	I (mA)	S.No	R (Ω)	C (μF)	V_R (V)	V_L (V)	I (mA)

EXPECTED WAVE FORMS:



RESULT :

VIVA QUESTIONS:

1. Define resonance.
2. Give condition for series resonance.
3. Define band width.
4. Define quality factor.
5. What is the importance of quality factor?

EXP:2

Frequencies Response of a Series RLC Circuits.

AIM:

To determine resonant frequency, band width and Q-factor for series RLC Circuits

APPARATUS:

NAME	RANGE	QUANTITY
1. Resistor	1KΩ	1 No.
2. Inductor	45mH	1 No
3. Capacitor	0.01μF	1 No
4. Ammeter	0-20mA (AC)	1 No
5. Function generator		

THEORY

An AC circuit is said to be in Resonance when the applied voltage and current are in phase. Resonance circuits are formed by the combination of reactive elements connected in either series or parallel.

Resonance frequency in series circuit is given by $fr = 1/ (2\pi \sqrt{LC})$ Hz

The impedance of the RLC circuit is

$Z = R + j (\omega_L - 1/\omega_C) = R + jX$

The circuit is in resonance when X = 0 ie., when $\omega_L = 1/\Omega_c$

In series RLC circuit the current lags behind or leads the applied voltage depending upon the value of X_L and Xc. When X_L is greater than Xc the circuit is inductive and when X_c is greater than X_L, the circuit is capacitive.

Quality factor (Q-factor) or (Selectivity) :

Quality factor can be defined as ,

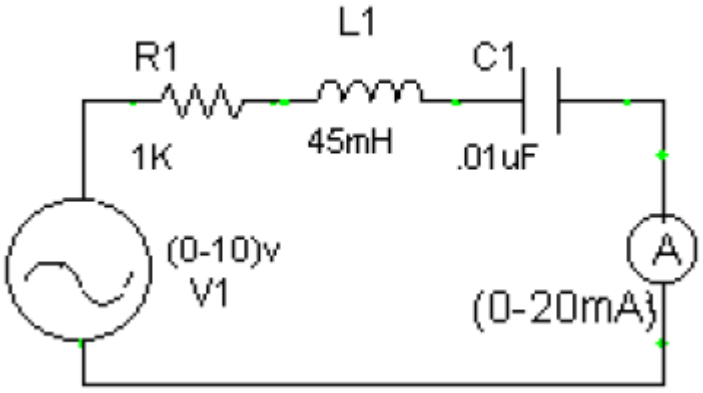
$= 2 \pi$ (maximum energy stored)/ (energy dissipated per cycle).

$= (f_2 - f_1) / f_r$

Band width: Band width of a resonance circuit is defined as the band of frequencies on either sides of resonance frequency. This frequency range can be obtained by dropping a vertical in the graph at its half power value, i.e., $1/ \sqrt{2}$ times of maximum value.

Band width = $f_2 - f_1$

CIRCUIT DIAGRAM :



PROCEDURE :

1. Connect the circuit as shown in diagram(1).
2. Apply 20V (peak to peak) from the Function Generator.
3. Vary the input frequency in suitable steps (starting from 1K Hz to 10K Hz in step of 500 Hz).
4. Note down the readings of the milli Ammeter for different values of frequency.
5. Calculate the Impedance Z.
6. Plot the graphs for current Vs frequency and Z Vs frequency.
7. Identify the values of f_0, f_1 and f_2 from the graph, Calculate the Q-factor and Band width.
8. Compare with theoretical values.

TABULAR COLOUMN :

S. No	Input (V)	Frequency, Hz	IL, Amp	Z=V/IL Ω

CALCULATIONS:

For Series Resonance:

$$f_0 = \frac{1}{(2\pi\sqrt{LC})}$$

$$f_1 = f_0 - (R/4\pi L)$$

$$f_2 = f_0 + (R/4\pi L)$$

$$\text{Band width} = f_2 - f_1$$

$$Q\text{-factor} =$$

THEORETICAL CALCULATIONS :

Series

$$f_0 = \frac{1}{(2\pi\sqrt{LC})}$$

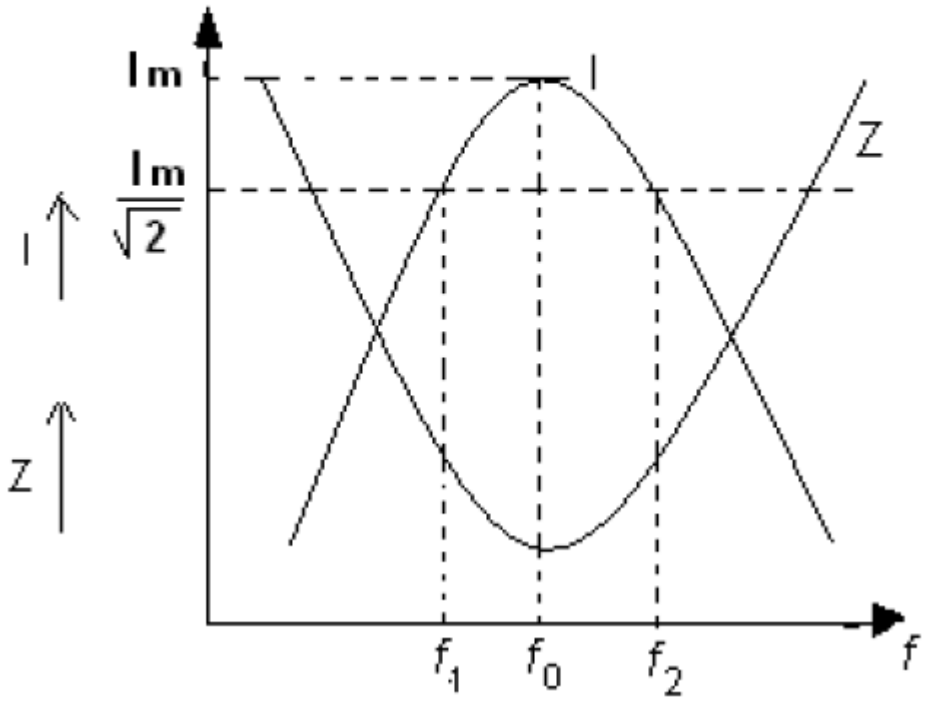
$$f_1 = f_0 - (R/4\pi L)$$

$$f_2 = f_0 + (R/4\pi L)$$

$$\text{Band width} = f_2 - f_1$$

$$\text{Q-factor} =$$

EXPECTED GRAPH :



RESULT :

VIVA QUESTIONS:

1. Define resonance.
2. Give condition for series resonance

3. Define band width.
4. Define quality factor.
5. What is the importance of quality factor?

EXP:3

Frequencies Response of a Parallel RLC Circuits.

AIM :

To determine resonant frequency, band width and Q-factor for Parallel RLC Circuits

APPARATUS:

NAME	RANGE	QUANTITY
1. Resistor	1KΩ	1 No.
2. Inductor	45mH	1 No
3. Capacitor	0.01μF	1 No
4. Ammeter	0-20mA (AC)	1 No
5. Function generator		

THEORY

An AC circuit is said to be in Resonance when the applied voltage and current are in phase. Resonance circuits are formed by the combination of reactive elements connected in either Series or parallel.

Resonance frequency in series circuit is given by $fr = 1/ (2\pi \sqrt{LC})$ Hz

The impedance of the RLC circuit is

$$Z = R + j (\omega_L - 1/\omega_C) = R + jX$$

The circuit is in resonance when X = 0 ie., when $\omega_L = 1/\Omega_c$

In series RLC circuit the current lags behind or leads the applied voltage depending upon the value of X_L and Xc. When X_L is greater than Xc the circuit is inductive and when X_c is greater than X_L, the circuit is capacitive.

Quality factor (Q-factor) or (Selectivity) :

Quality factor can be defined as ,

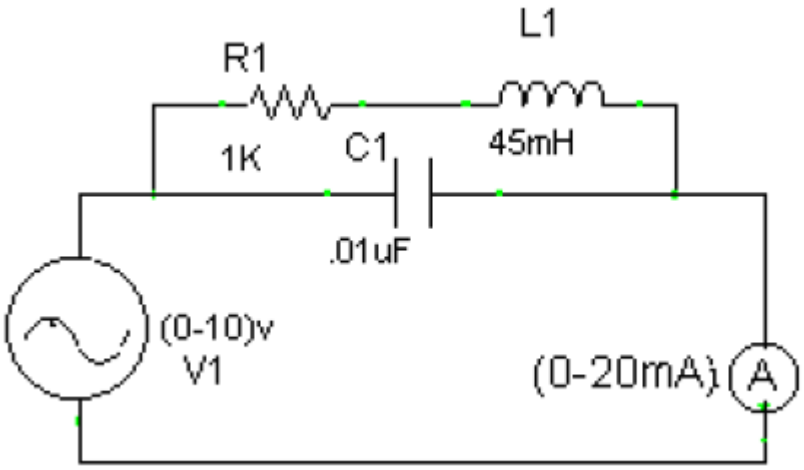
$= 2 \pi$ (maximum energy stored)/ (energy dissipated per cycle).

$= (f_2 - f_1) / f_r$

Band width: Band width of a resonance circuit is defined as the band of frequencies on either sides of resonance frequency. This frequency range can be obtained by dropping a vertical in the graph at its half power value, i.e., $1/ \sqrt{2}$ times of maximum value.

Band width = $f_2 - f_1$

CIRCUIT DIAGRAM :



PROCEDURE :

1. Connect the circuit as shown in diagram(1).
2. Apply 20V (peak to peak) from the Function Generator.
3. Vary the input frequency in suitable steps (starting from 1K Hz to 10K Hz in step of 500 Hz).
4. Note down the readings of the milli Ammeter for different values of frequency.
5. Calculate the Impedance Z.
6. Plot the graphs for current Vs frequency and Z Vs frequency.
7. Identify the values of f_0 , f_1 and f_2 from the graph, Calculate the Q-factor and Band width.
8. Compare with theoretical values.

TABULAR COLOUMN :

S. No	Input (V)	Frequency, Hz	IL, Amp	Z=V/IL Ω

CALCULATIONS:

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

$$f_1 = f_0 - (R/4\pi L)$$

$$f_2 = f_0 + (R/4\pi L)$$

$$\text{Band width} = f_2 - f_1$$

$$\text{Q-factor} =$$

THEORETICAL CALCULATIONS :

Parallel

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

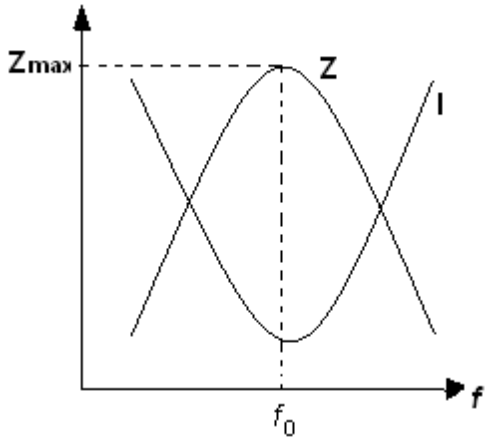
$$f_1 = f_0 - (R/4\pi L)$$

$$f_2 = f_0 + (R/4\pi L)$$

$$\text{Band width} = f_2 - f_1$$

$$\text{Q-factor} =$$

EXPECTED GRAPH :



RESULT :

EXP4:

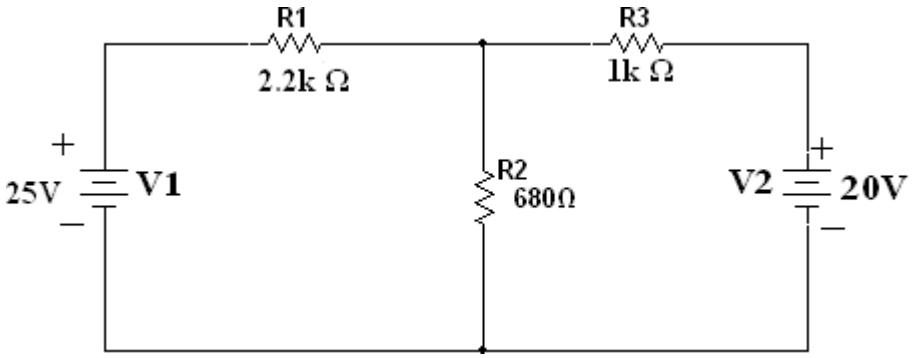
4.A.Open circuit, Short circuit parameters of two port parameters

AIM: To determine the Impedance (Z) and admittance (Y) parameters of a two portnetwork.

APPARATUS REQUIRED:

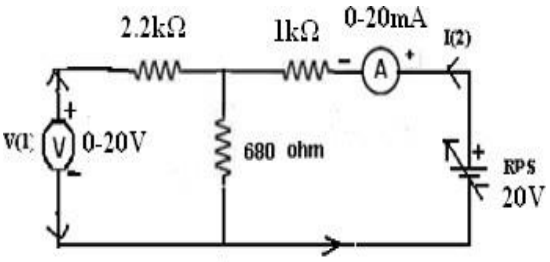
S.No	Name Of The Equipment	Range	Type	Quantity
1	Voltmeter	(0-20)V	Digital	1 NO
2	Ammeter	(0-20)mA	Digital	1 NO
3	RPS	0-30V	Digital	1 NO
4	Resistors	2.2k Ω	-	1 NO
		1k Ω	-	1 NO
		680 Ω	-	1 NO

CIRCUIT DIAGRAMS:



GIVENCIRCUIT:

PRACTICAL CIRCUITS:



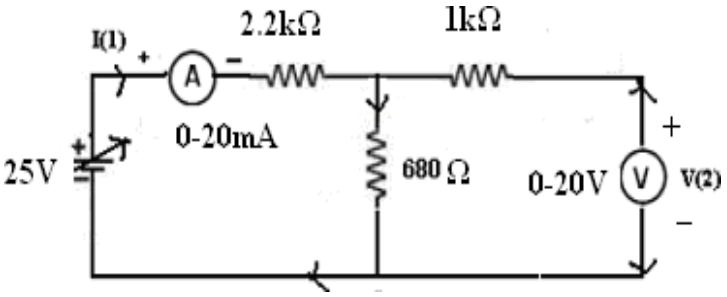
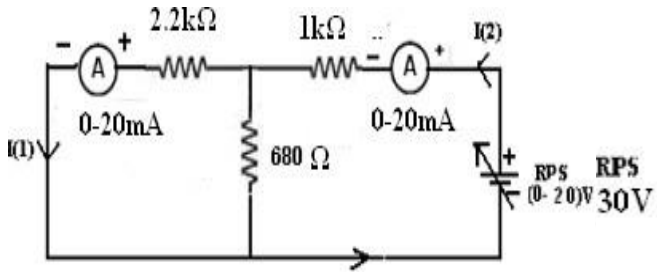


Fig.1. When $I_1 = 0$: **fig.2. When $I_2 = 0$:**



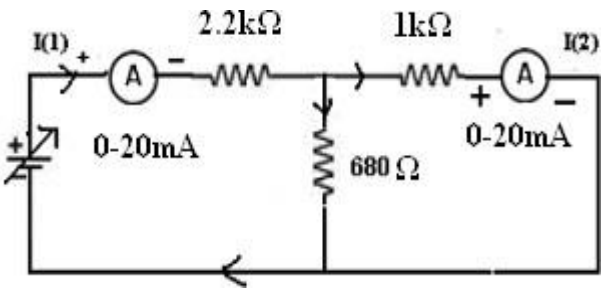


fig .3.When $V_1 = 0$

fig.4. When $V_2 = 0$:

THEORY:

A pair of terminals between which a signal may enter or leave the network is known as port. If a network has only one such pair of terminals, it is known as One-Port Network and those with two ports are known as Two-Port Networks.

Consider a general two-port network composed of linear, bilateral elements and no independent sources.

If we relate the **voltage of one port to the current of the same port**, we get **driving point admittance**. On the other hand, if we relate the **voltage of one port to the current at another port**, we get **transfer admittance**. Admittance (= 1 / Z) is a general term used to represent either the impedance or the admittance of a network.

The voltage and current at port1 are V_1 and I_1 and at port2are V_2 and I_2. The position of V_1 and V_2 and the directions of I_1 and I_2 are customarily selected. Out of these four variables, only two are independent variables. The other two are expressed in terms of the independent variable of network parameters. The relation between the voltages and currents in terms of Z and Y parameters are as follows.

$$V_1=Z_{11}(I_1)+Z_{12}(I_2)$$

$$V_2=Z_{21}(I_1)+Z_{22}(I_2)$$

$$I_1=Y_{11}(V_1)+Y_{12}(V_2)$$

$$I_2=Y_{21}(V_1)+Y_{22}(V_2)$$

Z-PARAMETERS:

$Z_{11}=V_1/I_1$, for $I_2=0$

$Z_{22}=V_2/I_2$, for $I_1=0$

$Z_{12}=V_1/I_2$, for $I_1=0$

$Z_{21}=V_2/I_1$, for $I_2=0$

Y-PARAMETERS

$Y_{11}=I_1/V_1$, for $V_2=0$

$Y_{22}=I_2/V_2$, for $V_2=0$

$Y_{12}=I_1/V_2$, for $V_1=0$

$Y_{21}=I_2/V_1$,for $V_2=0$

PROCEDURE

1. Connections are made as per the circuitdiagram.
2. Open circuit the port – 1 i.e., $I_1=0$, find the values ofV_1, I2 andV_2.
3. Short circuit the port-1 i.e. $V_1=0$, find the values of V_2, I_1andI_2.
4. Open circuit the port – 2 i.e., $I_2=0$, find the values of V_1, I1 andV_2.
5. Short circuit the port-2 i.e. $V_2=0$, measure the values of V_1, I_1andI_2.
6. Find the Z and Y parameters of the given two port network

THEORITICAL VALUES

$V_1 = 0$	$V_{2=}$	$I_{1=}$	$I_{2=}$
$V_2 = 0$	$V_{1=}$	$I_{1=}$	$I_{2=}$
$I_1 = 0$	$V_{1=}$	$V_{2=}$	$I_{2=}$
$I_2 = 0$	$V_{1=}$	$V_{2=}$	$I_{1=}$

PRACTICAL VALUES:

$V_1 = 0$	$V_{2=}$	$I_{1=}$	$I_{2=}$
$V_2 = 0$	$V_{1=}$	$I_{1=}$	$I_{2=}$
$I_1 = 0$	$V_{1=}$	$V_{2=}$	$I_{2=}$
$I_2 = 0$	$V_{1=}$	$V_{2=}$	$I_{1=}$

parameters	Theoretical	Practical
Z PARAMETERS		
Y PARAMETERS		

PRECAUTIONS:

1. Initially keep the RPS output voltage knob in zero voltposition.
2. Avoid looseconnections.
3. Avoid short circuit of RPS outputterminals.

RESULT:

VIVA QUESTIONS:

1. DefinePort?
2. Define Z & Yparameters?
3. What is the condition for symmetry in case Z & Yparameters?
4. Define characteristicimpedance?
5. What is the condition for reciprocity in case Z & Yparameters?

4.B.DETERMINATION OF TRANSMISSION AND HYBRID PARAMETERS OF A TWO-PORT NETWORK

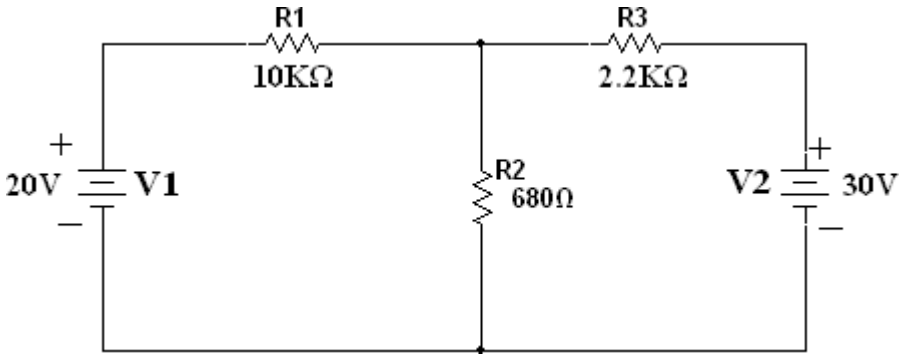
AIM: To determine the Transmission and Hybrid parameters of a two port network

APPARATUS REQUIRED:

S.No	Name Of The Equipment	Range	Type	Quantity
1	Voltmeter	(0-20)V	Digital	1 NO
2	Ammeter	(0-20)mA	Digital	1 NO
3	RPS	0-30V	Digital	1 NO
4	Resistors	10K Ω		1 NO
		2.2Ω		1 NO
		680 Ω		1 NO
5	Breadboard	-	-	1 NO
6	Connecting wires			Required Number

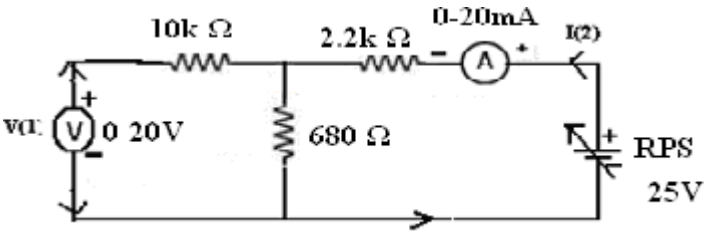
CIRCUIT DIAGRAMS

GIVEN CIRCUIT:

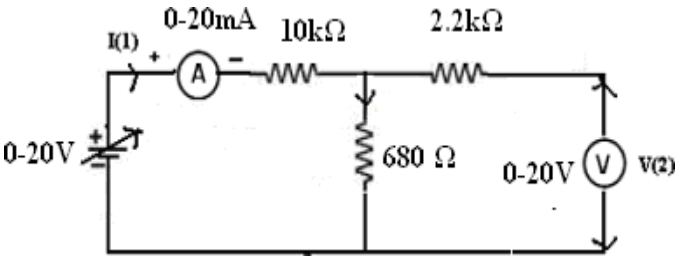


PRACTICAL CIRCUITS:

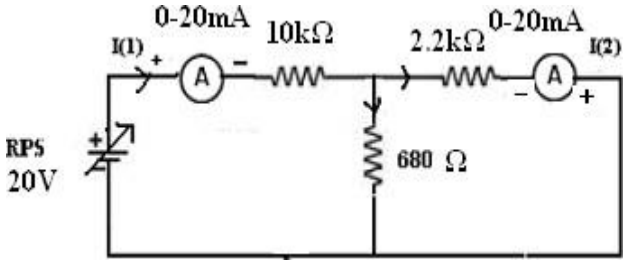
1. When $I_1 = 0$:



2. When $I_2 = 0$:



3.When $V_2 = 0$:



THEORY:

The relation between the voltages and currents of a two port network in terms of ABCD and h–parameters is given as follows.

ABCD PARAMETERS:

$V_1=AV_2-BI_2$ $A=V_2/V_1,\ I_2=0$ $B=V_1/I_2,\ V_2=0$

$I_1=CV_2-DI_2$ $C=I_1/V_2,\ I_2=0$ $D=I_1/I_2, V_2=0$

HYBRID PARAMETERS

$V_1=h_{11}I_1+h_{12}V2$ $h_{11}=V_1/I_1,\ V_2=0$ $h_{12}=V_1/V_2,\ I_1=0$

$I_2=h_{21}I_1+h_{22}V_2$ $h_{21}=I_2/I_1,\ V_2=0$ $h_{22}=I_2/V_2,\ I_1=0$

PROCEDURE:

1. Connections are made as per the circuitdiagram.

2. Open circuit the port – 1 i.e., I_1=0 measure the values ofV_1, I2 andV_2.
3. Short circuit the port-1 V_1 =0 measure the values of V_2, I_1andI_2.
4. Open circuit the port – 2 i.e., I_2=0 measure the values of V_1, I1 andV_2.
5. Short circuit the port-2 i.e. V_2 =0 measure the values of V_1, I_1andI_2
5. Measure the ABCD and h-parameters of the given two port network from the above data.

THEORITICAL VALUES:

$V_2 = 0$	$V_{1=}$	$I_{1=}$	$I_{2=}$
$I_1 = 0$	$V_{1=}$	$V_{2=}$	$I_{2=}$
$I_2 = 0$	$V_{1=}$	$V_{2=}$	$I_{1=}$

PRACTICALVALUES:

$V_2 = 0$	$V_{1=}$	$I_{1=}$	$I_{2=}$
$I_1 = 0$	$V_{1=}$	$V_{2=}$	$I_{2=}$
$I_2 = 0$	$V_{1=}$	$V_{2=}$	$I_{1=}$

Parameters	Theoretical	Practical
ABCD		
HYBRID		

PRECAUTIONS:

1. Initially keep the RPS output voltage knob in zero voltposition.
2. Avoid looseconnections.
3. Avoid short circuit of RPS outputterminals.

RESULT:

VIVA QUESTIONS

1. DefinePort?
2. What is the condition for symmetry in case h-parameters & ABCD (T)parameters?
3. Define characteristicimpedance?
4. What is the condition for reciprocity in case Hybrid (h) & ABCD (T)parameters?

EXP:6

Verification of

(a) Thevinen's Theorem (b) Norton Theorem

A.VERIFICATION OF THEVENIN'S THEOREM

AIM:

To Verify Thevinen's theorem.

APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1	Ammeter			
2	Voltmeter			
3	R.P.S			
4	Bread Board			
5	Resistors			
6	Connecting Wires			As required

CIRCUITDIAGRAM:

Circuit - 1 : To find load current

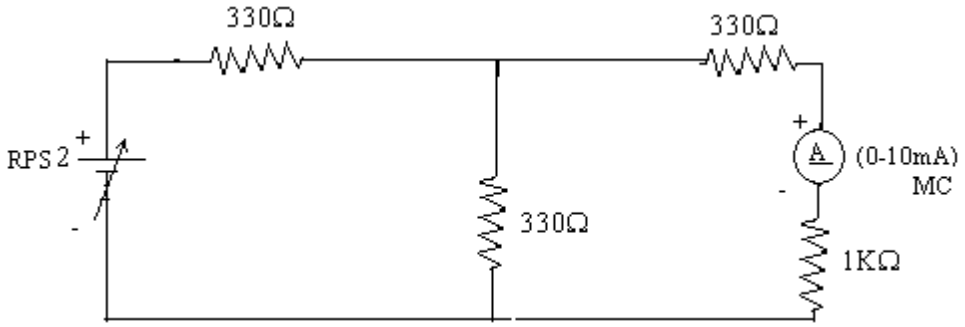


Figure.1 measurement of load current

To find V_{TH}

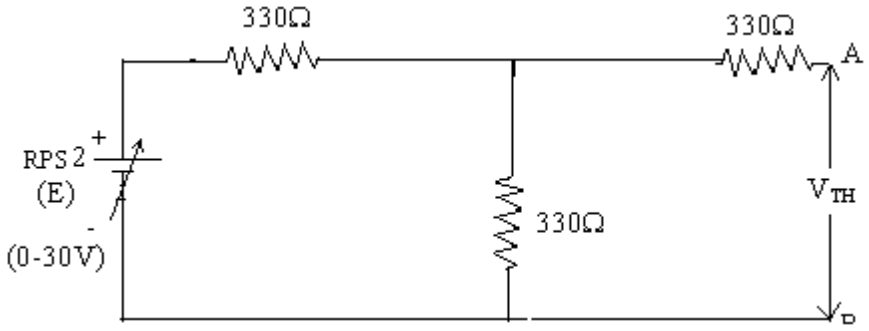


Figure.2 measurement of Vth

To find R_{TH}

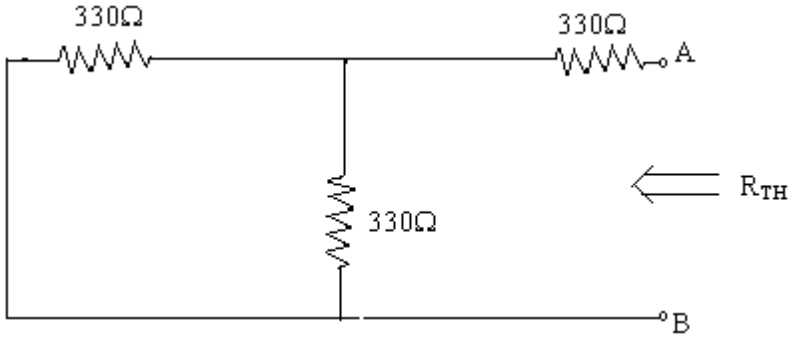


Figure.3 measurement of Rth

Thevinen's Equivalent circuit:

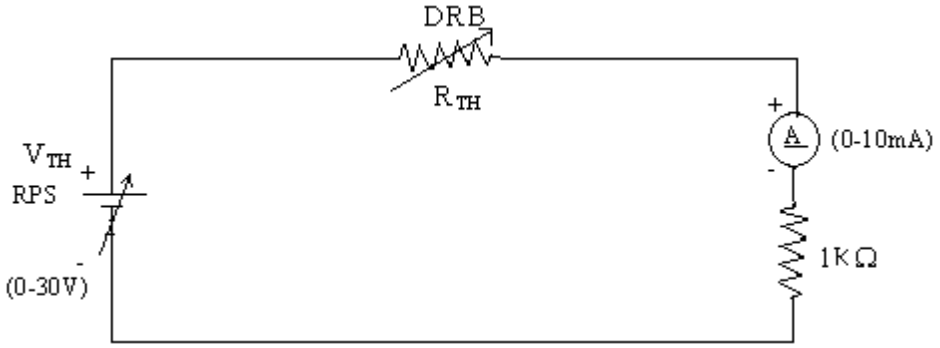
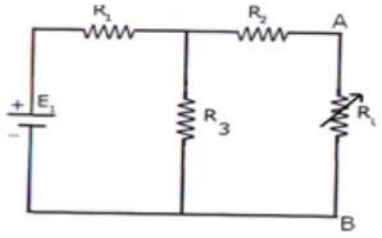
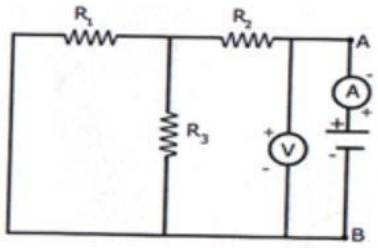


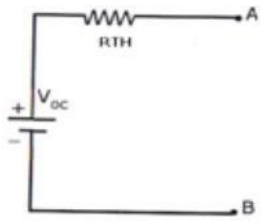
Figure.4 measurement of load current

THEORY:

Any linear, bilateral network having a number of voltage, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance, where the value of the voltage source is equal to the open circuit voltage and the resistance is the equivalent resistance measured between the open circuit terminals with all energy sources replaced by their ideal internal resistances







Measurement of I_L&V_{TH}orV_{OC} Measurement ofR_{TH}

Measurement of I_L ($I_L = V_{TH}$ or $V_{OC}/ R_{TH} + R_L$)

PROCEDURE:

1. Connect the circuit diagram as shown infig..1
2. Measure current in R_L.
3. Connect the circuit as shown infig.2.
4. Measure open circuit voltage V_{oc} by open circuiting terminals i.e.,V_{TH}
5. Connect the circuit as shown infig.3,measure equivalent resistance i.e. R_{th}
6. Connect the Thevinen's equivalent circuit as shown infig.4
7. Measurement current inR_L

TABULARCOLUMN:

Parameters	Theoretical Values	Practical Values
V_{oc}		
R_{TH}		
I_L		

PRECAUTIONS:

1. Check for proper connections before switching ON thesupply
2. Make sure of proper color coding ofresistors
3. The terminal of the resistance should be properlyconnected.

RESULT:

VIVAQUESTIONS:

1. What is load resistance?
2. How will you calculate Thevinen's resistanceR_{TH}?
3. How will you calculate Thevinen's voltageV_{TH}?
4. How will you calculate load current I_L?

B.VERIFICATION OF NORTON 'S THEOREM

AIM:

To Verify Norton's theorem.

Apparatus Required

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1K□, 330□	3,1
4	Bread Board	--	Required
5	DRB	--	1

CIRCUITDIAGRAM:

Circuit - 1 : To find load current

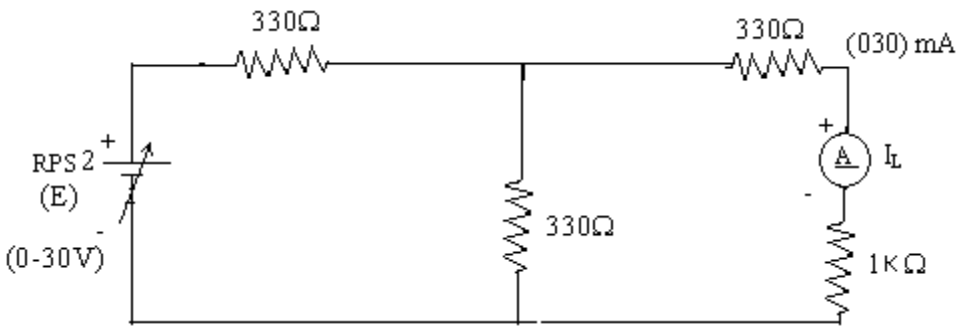


Figure.1 measurement of load current

To find I_N

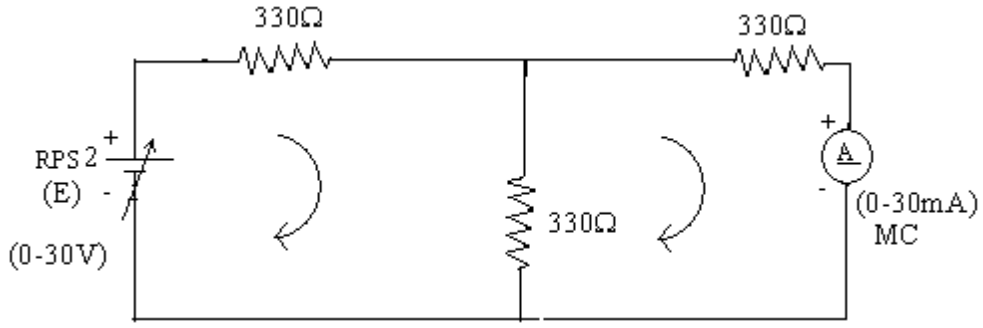


Figure.2 measurement of short circuit current

To find R_N

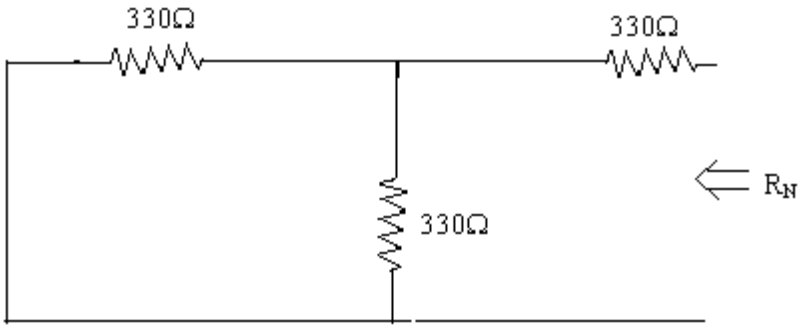


Figure.3 measurement of equivalent resistance

Norton's equivalent circuit

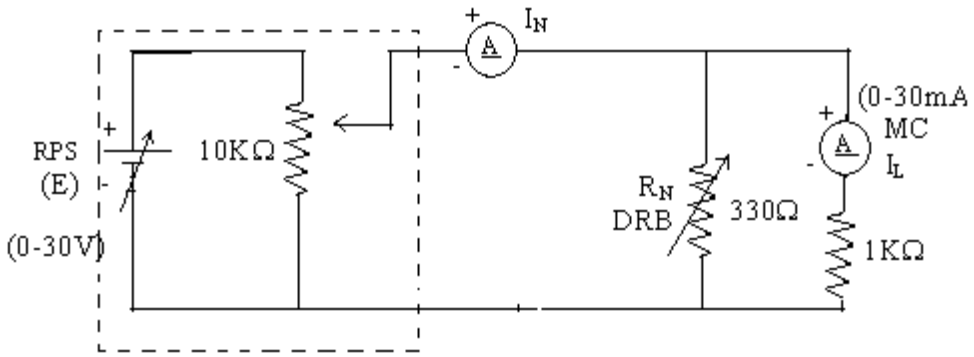
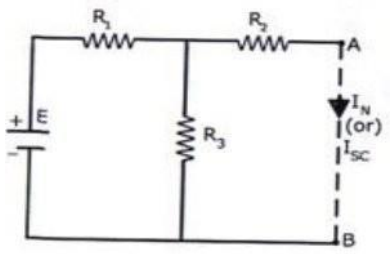
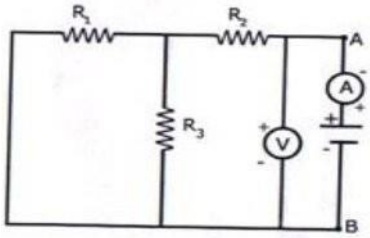


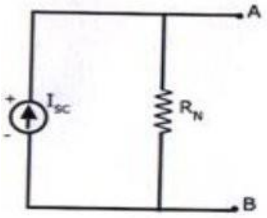
Figure.4 measurement of load current

STATEMENT

Any linear, bilateral network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a current source in parallel with a resistance. The value of the current source is the current flowing through the short circuit terminals of the network and the resistance is the equivalent resistance measured between the open circuit terminals of the network with all the energy







sources replaced by their internal resistances.

Norton's EquivalentResistancecircuit Norton's EquivalentCircuit Norton's Current

PROCEDURE:

1. Connect the circuit diagram as shown in fig.1.
2. Measure the current I_L
3. Connect the circuit diagram as shown in fig.2
4. Measure the current I_{SC} (or) I_N by short-circuiting load resistance
5. Connect the circuit diagram as shown in fig.3
6. Remove RPS and short circuit the terminal and remove the load and note down the resistance across the two terminals.
7. Connect Norton's equivalent circuit by connecting I_N & R_N in parallel as shown in fig.4 and find load current.

TABULARCOLUMN:

Parameters	Theoretical Values	Practical Values
I_{sc}/ I_N		
R_N		
I_L		

RESULT

VIVAQUESTIONS:

1. What is load resistance?
2. How will you calculate Norton's resistance R_N?
3. How will you calculate Norton's current I_{SC}?
4. How will you calculate load current I_L?

EXP:7

Verification of Superposition theorem and Maximum power transfer theorem

A.VERIFICATION OF SUPERPOSITIONTHEOREM

AIM:

ToVerify principle of Superposition theoretically and practically.

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APPARATUS:

S.No.	Equipment	Range	Type	Quantity
1.	Resistors	-	-	
2.	Ammeter			
3.	R.P.S			
4.	Bread Board	-	-	
5.	Connecting Wires			required

CIRCUITDIAGRAM:

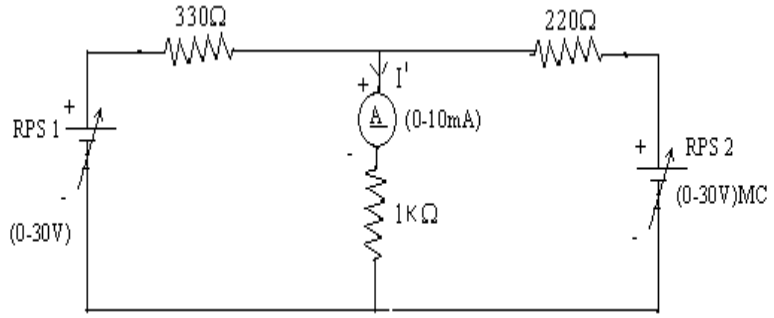


Fig- 1 Both Voltage Sources areacting($V_{1= RPS1}$&$V_{2= RPS2}$)

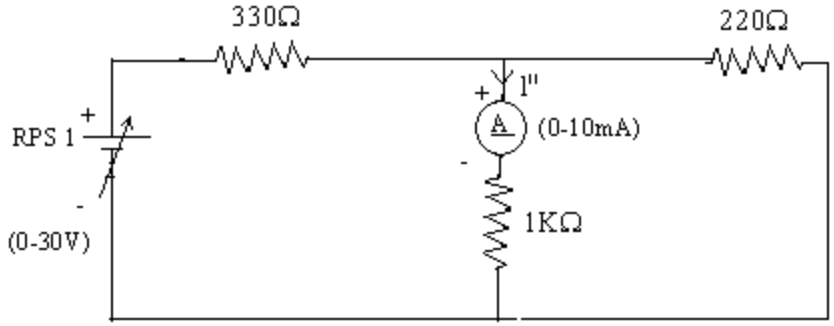


Fig - .2 Voltage Source V_1 is actingalone

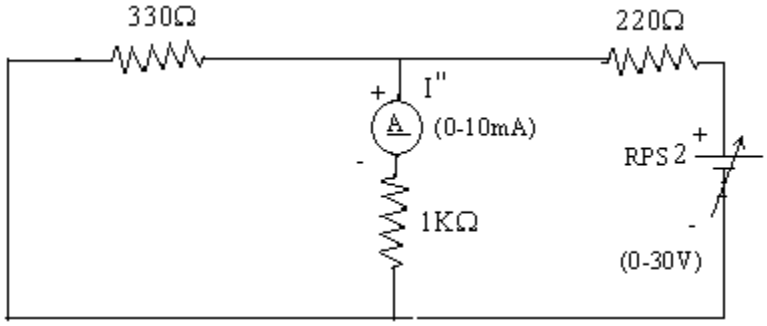
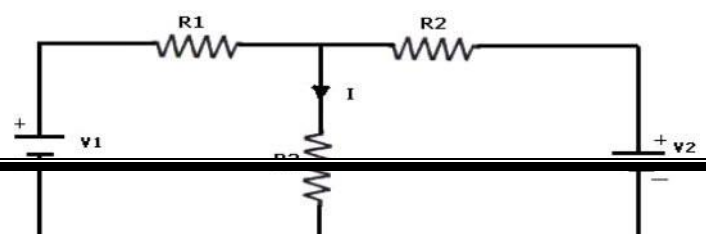
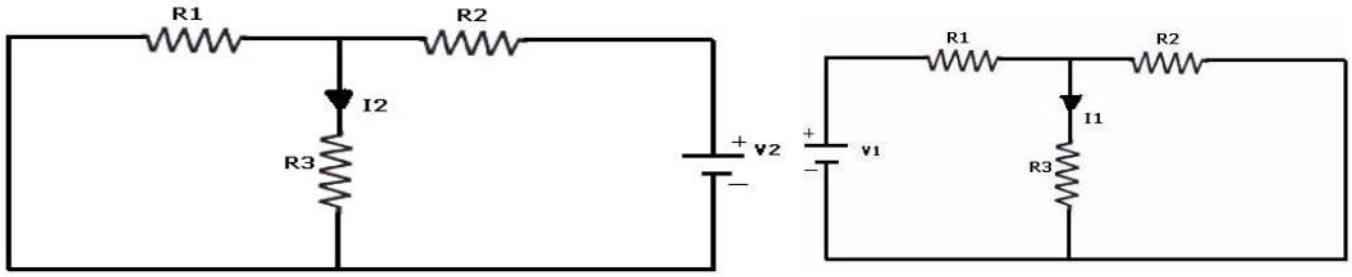


Fig - 3 Voltage Source V_2 is acting alone

STATEMENT:

In a linear, bilateral network the response in any element is equal to sum of individual responses with all other sources being non-operative.





PROCEDURE:

1. Connect the circuit as shown in figure (1) and note down the current flowing through 1KΩ and let it beI.
2. Connect the circuit as shown in figure 2 and note down the ammeter Reading, and let it beI_1.
3. Connect the circuit as shown in figure .3 and note down the ammeter reading, and let it beI_2.
4. Verify for $I=I_1+I_5$.

5. Compare the practical value of current observed with that of theoretically calculated.

TABULARCOLUMN:

PARAMETERS	WHEN BOTH V_1 & $V_2 \neq 0$ (I)	WHEN $V_1 \neq 0$ & $V_2 = 0$ (I_1)	WHEN $V_1 = 0$ & $V_2 \neq 0$ (I_2)
Current through R3 (Theoretical Values)			
Current through R3 (Practical Values)			

PRECAUTIONS:

1. Check for proper connections before switching ON thesupply
2. Make sure of proper color coding ofresistors
3. The terminal of the resistance should be properlyconnected

RESULT

VIVAQUESTIONS:

1. State Superpositiontheorem.
2. How to find power using Superpositiontheorem?
3. Write applications of super positiontheorem

B.VERIFICATION OF MAXIMUM POWER TRANSFERTHEOREM

AIM:

To design the load resistor this absorbs maximum power from source

Apparatus Required:

Sl.No.	Apparatus	Range	Quantity
1	RPS	(0-30V)	1
2	Voltmeter	(0-10V) MC	1
3	Resistor	1K Ω, 1.3K Ω, 3Ω	3
4	DRB	--	1
5	Bread Board & wires	--	Required

CIRCUITDIAGRAM:

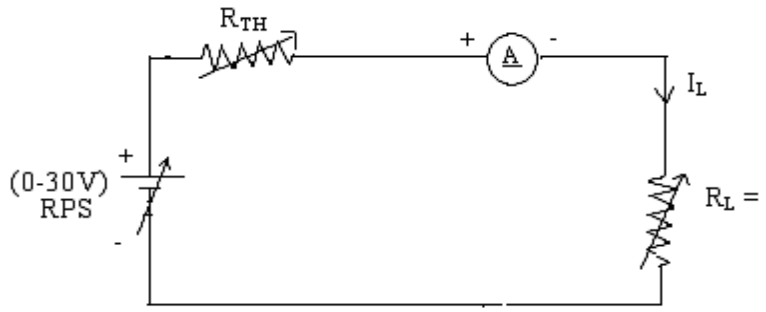
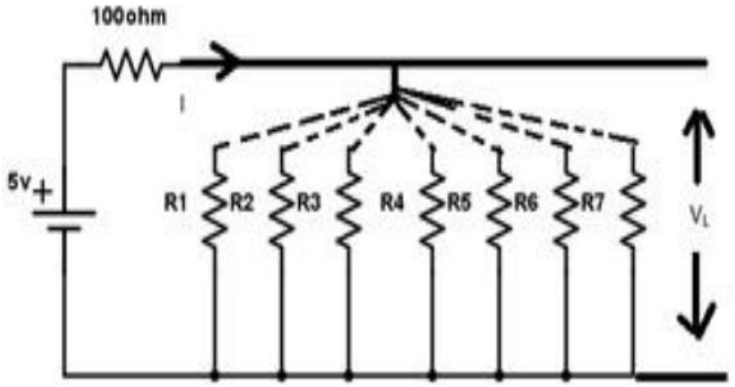


Fig –.1 Maximum Power Transfer Circuit

STATEMENT:

The maximum power transfer theorem states that maximum power is delivered from a source to an load resistance when the load resistance is equal to source resistance. ($R_L = R_S$ is the condition required for maximum power transfer).



PROCEDURE:

1. Connect the circuit as shown infig..1
2. Vary the load resistance in steps and note down current flowing through thecircuit.
3. Calculate power delivered to the load
4. Draw the graph between resistance and power (resistance on X- axis and power onY-axis).
5. Verify the maximum power is delivered to the load when R_L = Rs forDC.

TABULARCOLUMN:

S. No	R_L	V	I	P=VI
1				
2				
3				
4				
5				

MODELGRAPH:

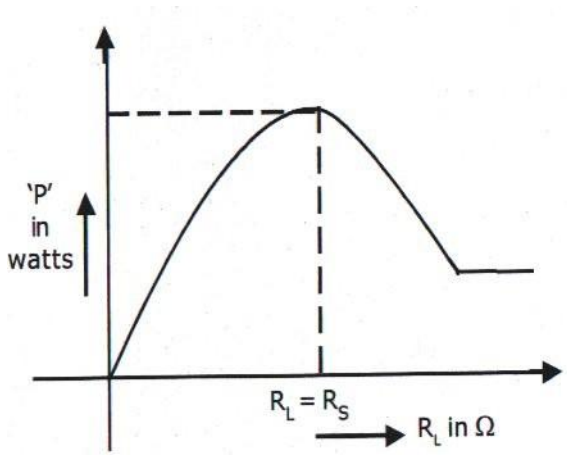


Fig –.2 Output Graph of Maximum Power Transfer Theorem

PRECAUTIONS:

1. Check for proper connections before switching ON thesupply
2. Make sure of proper color coding ofresistors
3. The terminal of the resistance should be properlyconnected

RESULT:

VIVAQUESTIONS:

1. State maximum power transfertheorem.
2. Is it possible to apply maximum power transfer theorem to ac as well as dccircuit?
3. How to find power using maximum power transfertheorem?
4. What are conditions for maximum power transfertheorem?
5. Is itpossible to apply maximumpower transfertheoremto nonlinearcircuit?

EXP:8

Measurement of active, reactive power using two watt meter method

AIM

To conduct a suitable experiment on a 3-phase load connected in star or delta to measure the three phase power and power factor using 2 wattmeter method.

OBJECTIVES

1. To study the working of wattmeter

2. To accurately measure the 3 phase power

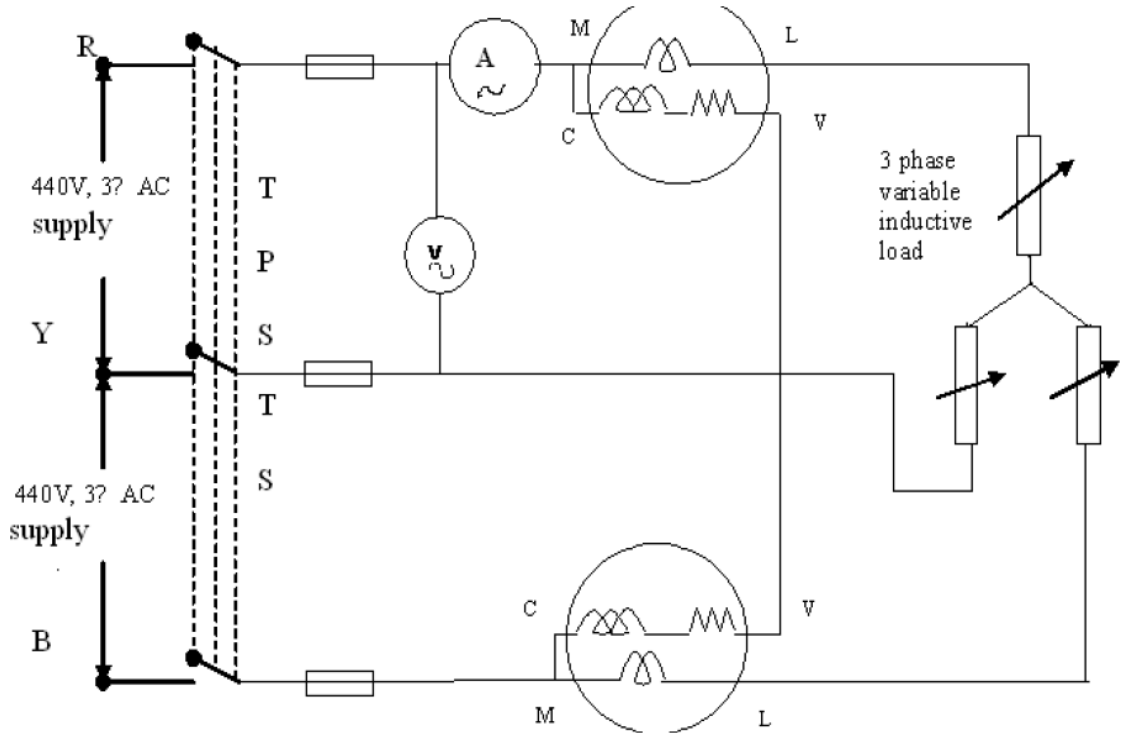
3. To accurately measure the power factor

4. To study the concept of star connected load and delta connected load

APPARATUS REQUIRED:

S.NO	NAME OF THE APPRATUS	RANGE	TYPE	QTY
1	Ammeter			
2	Voltmeter			
3	Wattmeter			
4	Connecting Wires			
5	3 phase inductive load			

CIRCUIT DIAGRAM



FORMULA USED:

1. Total power, $P = W_1+W_2$ (W)

2. $\emptyset = \tan^{-1}\sqrt{3}\,[(W_1-W_2)/(w1+w2)]$

3. P.F = $\cos\emptyset$

4. Reactive Power = $\sqrt{3}(W_1-W_2)$ (VAr)

PROCEDURE:

1. Connection are made as per the circuit diagram, keeping the inductive load in the minimum position.

2. Supply switch is closed and reading of ammeter and wattmeter are noted.If one of the

Wattmeter reads negative, then its potential coils (C and V) are interchanged and

reading is taken as negative.

3. The above procedure is repeated for different values of inductive coil. Care should be

taken that current should not exceed 10A during the experiment.

TABULAR COLUMN:

S.NO	I	V	W1	W2	POWER	REACTIVE POWER	PF
1 2 3 4 5 6							

RESULT:

VIVA QUESTIONS

1. Which method is the commonest method of measuring three balanced or unbalanced power?
2. The reactive power can be measured with wattmeter when voltage across voltage coil is adjusted to be out of phase with the current by----------
3. The total power P measured in Y star three-phase circuit is
4. The power in delta three-phase circuit is
5. The dynamometer wattmeter can be used to measure----- POWER
6. Induction wattmeter can be used to measure--- power
7. The one “unit” of energy measured in AC circuit is
8. How do you calculate Real Power , Reactive power and Apparent power , given W_1 and W_2?

EXP:9

Simulation and transient analysis of series RLC circuits

AIM:

To plot the magnitude curve for various frequencies for the given RLC series circuit.

SOFTWARE REQUIRED:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	01

THEORY:

A circuit is said to be in resonance when applied voltage V and current I are in phase with each other. Thus at resonance condition, the equivalent complex impedance of the circuit consists of only resistance (R) and hence current is maximum. Since V and I are in phase, the power factor is unity.

The complex impedance

$Z = R + j (XL – XC)$

Where XL

$= \omega L$ XC =

$1/\omega C$

At resonance, XL= XC and hence Z= R

Bandwidth of a Resonance Circuit:

Bandwidth of a circuit is given by the band of frequencies which lies between two points on either side of resonance frequency, where current falls through 1/1.414 of the maximum value of resonance. Narrow is the bandwidth, higher the selectivity of the circuit. As shown in the model graph, the bandwidth AB is given by f2 – f1. f1 is the lower cut off frequency and f2 is the upper cut off frequency

CIRCUIT DIAGRAM:

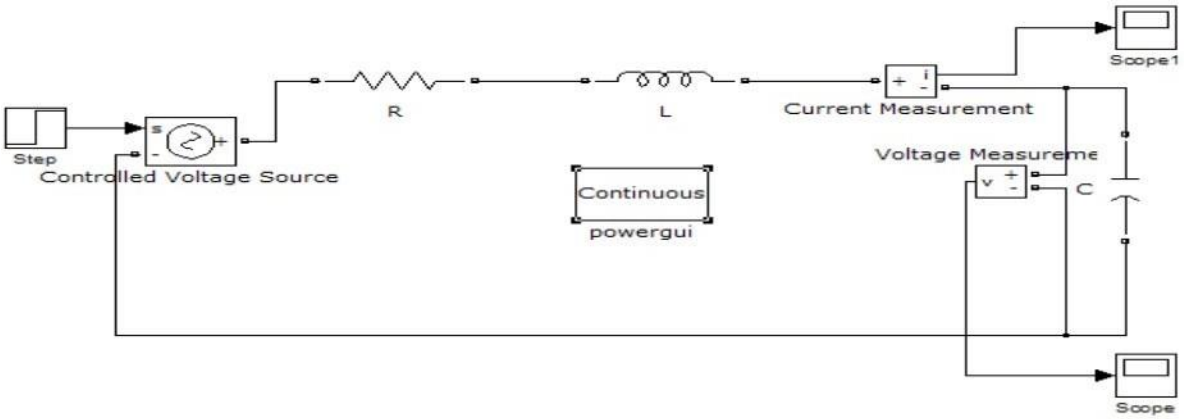


Fig – Series Resonance simulation diagram

PROCEDURE:

1. Open a new MATLAB/SIMULINK model
2. Connect the circuit as shown in the figure12.3
3. Debug and run the circuit
4. By double clicking the powergui plot the value of current for the different values of frequencies

MODEL GRAPH FOR SERIES RESONANCE

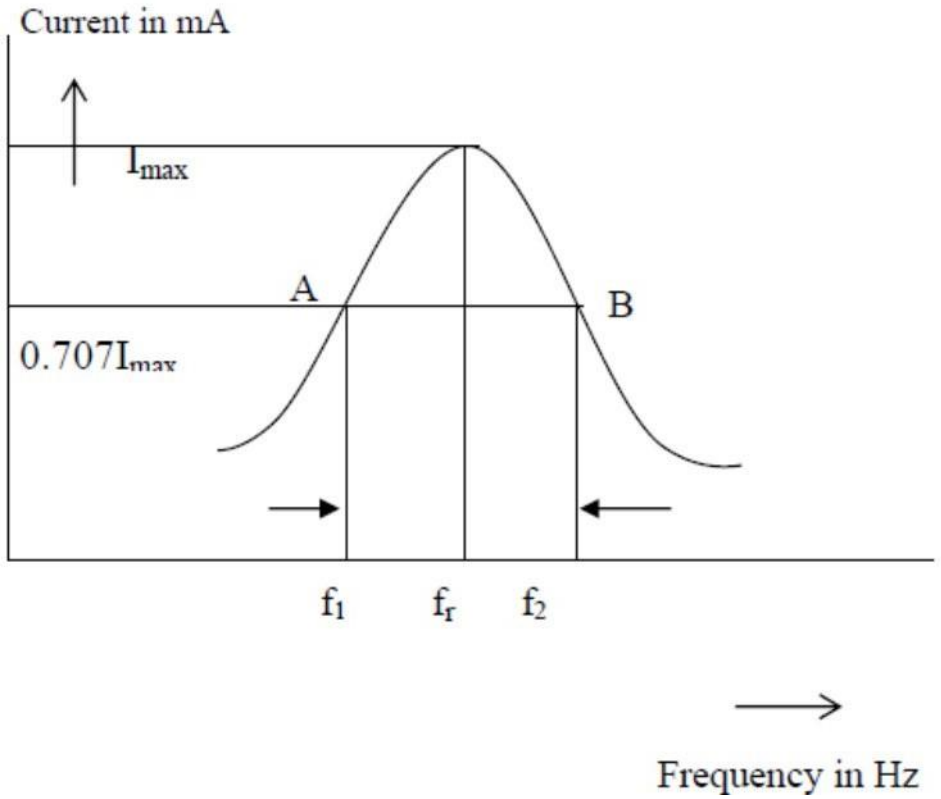


Fig – Series Resonance Model graph

%PROGRAM TO FIND THE SERIES RESONANCE

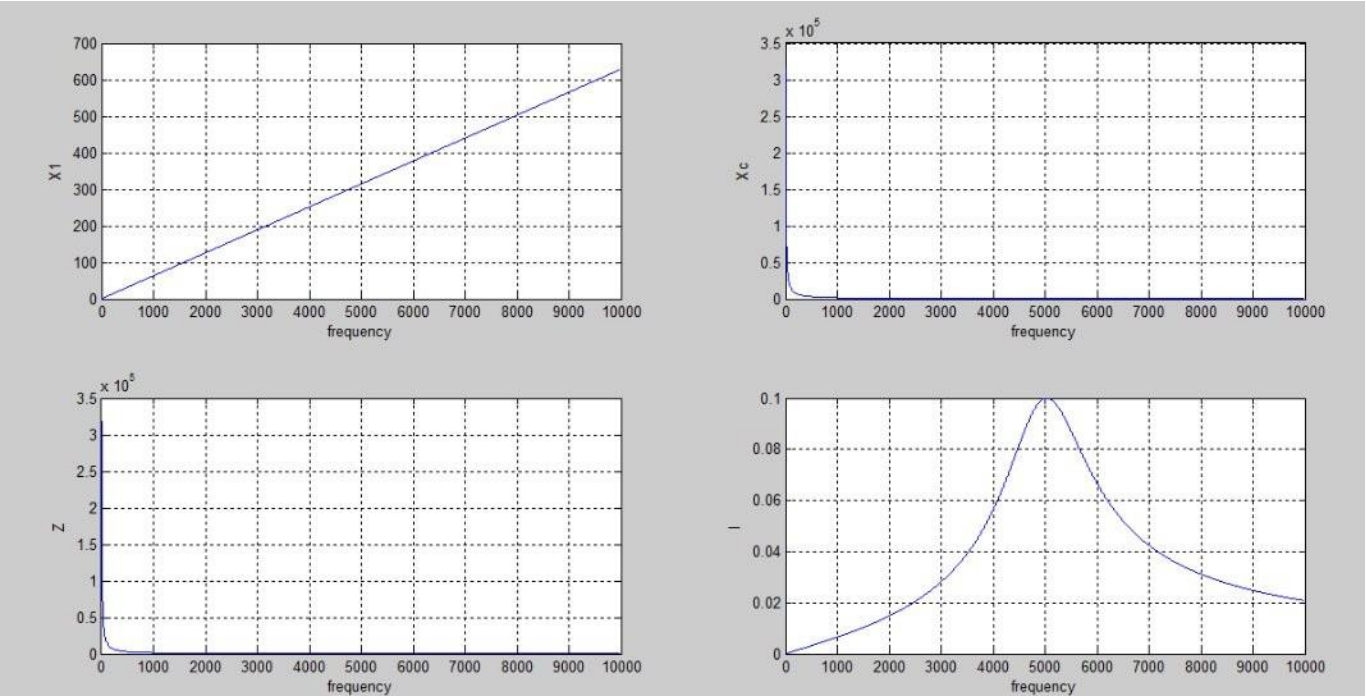
```
clc;
clear
all;
close
all;
r=input('enter the resistance value  >');
l=input('enter the inductance value - >');
c=input('enter the capacitance value->');
v=input('enter the input voltage -- >');
f=5:2:300;
```

```
xl=2*pi*f*l; xc=(1./(2*pi*f*c)); x=xl-xc
```

```
z=sqrt((r^2)+(x.^2)); i=v./z;
        %plotting the
        graph
        subplot(2,2,1);
        plot(f,xl)
        ; grid;
        xlabel('frequency'
        ); ylabel('X1');
        subplot(2,2,2);
        plot(f,xc)
        ; grid;
        xlabel('frequency'
        ); ylabel('Xc');
        subplot(2,2,3);
        plot(f,z)
        ; grid;
        xlabel('frequency'
        ); ylabel('Z');
        subplot(2,2,4);
        plot(f,i)
        ; grid;
        xlabel('frequency'
        ); ylabel('I');
```

PROGRAM RESULT:

```
enter the resistance value-->100
enter the inductance value------>10e-3
enter the capacitance value-----
>0.1*10^-6 enter the input voltage
 ------------------------------ >10
```



VIVA QUESTIONS:

1. Define resonance.
2. Give condition for series resonance.
3. Define band width.
4. Define quality factor.
5. What is the importance of quality factor?

EXP:10

Mesh and Nodal analysis of electrical circuit

AIM:

To verify mesh analysis using digital simulation.

APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

SIMULATION DIAGRAMS:

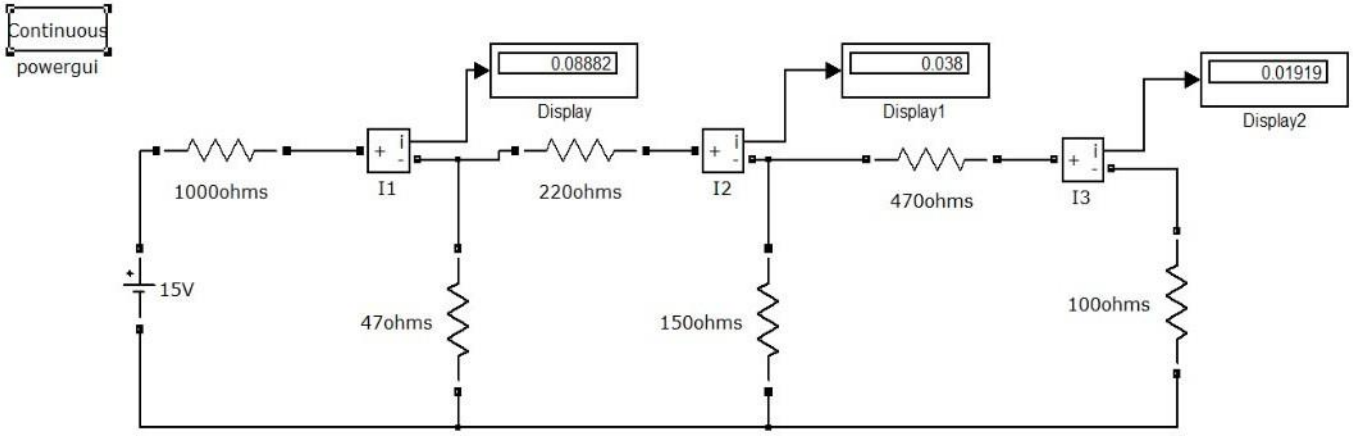


Figure – Mesh analysis in MATLAB

PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure current in each resistor.
3. Verify the mesh analysis.

OBSERVATIONS:

Applied Voltage V (volts)	Loop current(I_1)		Loop current (I_2)		Loop current(I_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

RESULT

VIVA QUESTIONS:

1. On which law is the mesh analysis based?
2. What is mesh analysis?
3. When do we go for super mesh analysis?
4. What is the equation for determining the number of independent loop equations in mesh current method?

AIM:

To verify nodal analysis using digital simulation.

APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	01

SIMULATION DIAGRAMS:

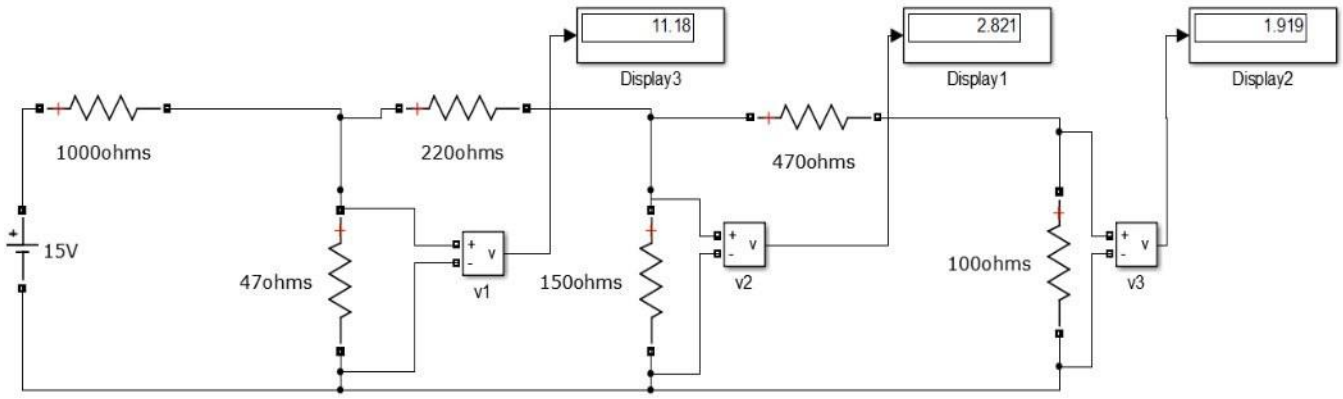


Figure – 3.2 Nodal analysis in MATLAB

PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the voltage across each node using voltage measurement.
3. Verify with the theoretical results obtained with practical results

OBSERVATIONS:

Applied Voltage V (volts)	Node voltage(V_1)		Node voltage (V_2)		Node voltage (V_3)	
	Theoretical	**Practical**	**Theoretical**	**Practical**	**Theoretical**	**Practical**

RESULT:

PRE LAB VIVA QUESTIONS:

1. On which law is the nodal analysis based?
2. What is nodal analysis?
3. When do we, go for super-node analysis?