ELECTRICAL CRCUITS LABORATORY

LAB MANUAL

Subject Code	**:**	**AEEB07**
Regulations	**:**	**IARE-18**
Class	**:**	**II Semester (EEE)**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

Department of Electrical and Electronics Engineering

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(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

Program Outcomes	
PO1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions**: Design solutions for complex 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 modeling to complex 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 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.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the 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	
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design, install, test,maintain power system and applications.

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ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Study of electrical and electronic components and their specifications	PO1	PSO2
2	Types of electrical wiring and residential house wiring	PO1, PO3	PSO2
3	Soldering practice	PO3	PSO2
4	Measurement of power consumed by fluorescent lamp	PO1	PSO2
5	Ohm's law, KCL and KVL	PO1	PSO2
6	Design of choke and small transformer	PO1, PO3	PSO2
7	Determination of circuit impedance.	PO1	PSO2
8	Study of constant current source.	PO1, PO3	PSO2
9	Measurement of electrical parameters	PO1	PSO2
10	Measurement of electrical energy	PO1, PO3	PSO2
11	Characteristics of periodic waveforms.	PO1, PO3	PSO2
12	Resonance phenomena in series circuit.	PO1, PO3	PSO2
13	Resonance phenomena in parallel circuit.	PO1	PSO2
14	Measurement of earth resistance and earth potential	PO1, PO3	PSO2

ELECTRICAL CRCUITS LABORATORY

OBJECTIVE:

The objective of this lab is to teach students to know the procedures for measuring Resistance, Inductance and Capacitance, power and power factor. To design experiments for calibration of energy meter and to know the industrial practices of Measuring earth resistance.

OUTCOMES:

Upon completion of study of the course should be able to

1. Understand the use of different electrical and electronics components by considering safety precautions.
2. Know how to do the wiring for residential houses.
3. Measure the electrical parameters such as resistance, inductance, power and power factor.
4. Evaluate Electrical Quantities Associated With Series RLC Circuit, Energy Meter and Observe Characteristics of Alternating Quantities
5. Observe The Resonance Phenomena in Series, Parallel Circuits and Calculate Electrical Earthing Resistance

EXPERIMENT– 1 (A)

STUDY OF ELECTRICAL AND ELECTRONIC COMPONENTS

1. A.1 AIM:

To study about the electronic components and equipments such as active and different types of passive components are resistors, capacitors and inductors.

1. A.2 APPARATUS:

S.No	Electronic Components	Electrical Components
1	Transistor	Resistor
2	Op-Amp	Inductor
3	Diode	Capacitor

1. A.3 TYPES OF ELECTRONIC COMPONENTS:

1.3.1 ELECTRONIC COMPONENT:

Definition:

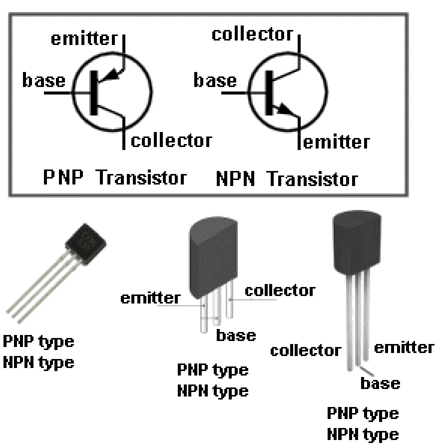
Electronic components are the elements of circuit which helps in its functioning. They can be classified into two types i.e. **Active Components** and **Passive Components.** Active elements are those which possess gain. They can give energy to the circuit. This could include the power supply, fans, storage device, transistors, diodes and other integrated circuits.

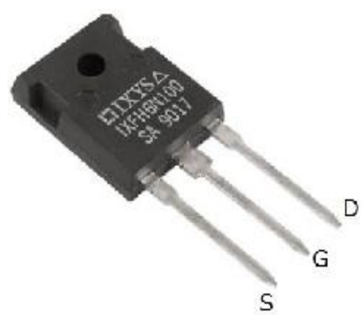
1.3.2 TRANSISTORS:

A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals.

1. A.4 TYPES OF TRANSISTORS:

1. Bipolar junction transistor
2. Field Effect Transistor





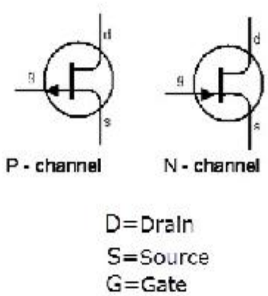
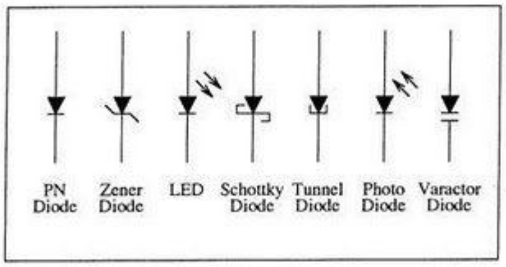


Figure: A.1.1 circuit symbols of transistors

1. A.5 DIODES:

An electronic device with two active terminals, an anode and a cathode, through which current passes more easily in one direction (from anode to cathode) than in the reverse direction. Diodes have many uses, including conversion of AC power to DC power, and the decoding of audio-frequency signals from radio signals.



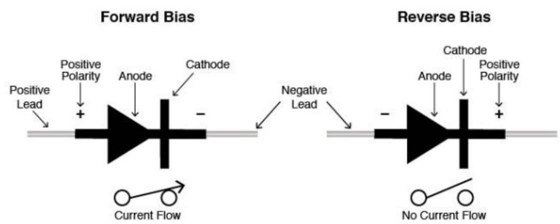


Figure: A.1.2 Types of diades and symbols **Figure: A.1.3 Modes of diode operations**

1. A.6 ELECTRICAL COMPONENTS:

Definition:

A passive component is a module that does not require energy to operate, except for the available Alternating Current (AC) circuit that it is connected to. A passive module is not capable of power gain and is not a source of energy. A typical passive component would be inductor, resistor, transformer, or capacitor.

Resistors:

Resistors are the most common components in electronic circuits. Its main function is to reduce the high current to the desired value and also to provide desired voltage in the circuit. The resistors are manufactured to have a specific value in ohm. The physical size of resistor determines how much power can be dissipated in the form of heat. However there is co-relation between resistor physical sizes and its resistance value. They are manufactured in variety of standard values and power settings.

There are two types of resistors:

• Fixed resistor
• Variable resistor

Fixed resistor has a resistance value that does not change where as a variable resistor having variable resistance range with 4 lines or color code. They indicate the resistance value in ohms out on a larger resistor; the resistance value is printed on the body of the resistor. The important feature of resistor is that its effect is same for both AC and DC circuits.

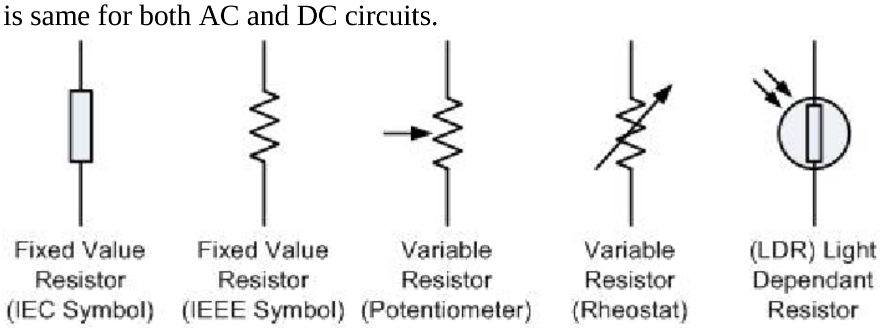
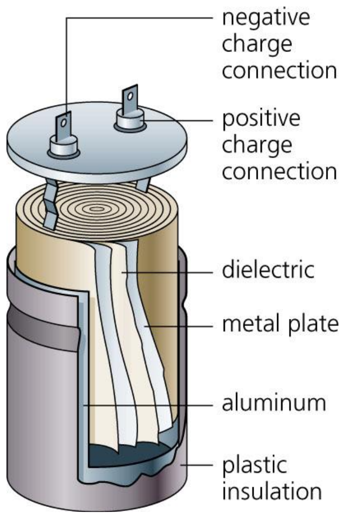


Figure: A.1.4 circuit symbols of resistors

1. A.7 CAPACITOR:

A capacitor is a passive two terminal component which stores electric charge. This component consists of two conductors which are separated by a dielectric medium. The potential difference when applied across the conductors polarizes the dipole ions to store the charge in the dielectric medium. The unit of capacitance is Farad and it is denoted as F. The circuit symbol of a capacitor is shown below:



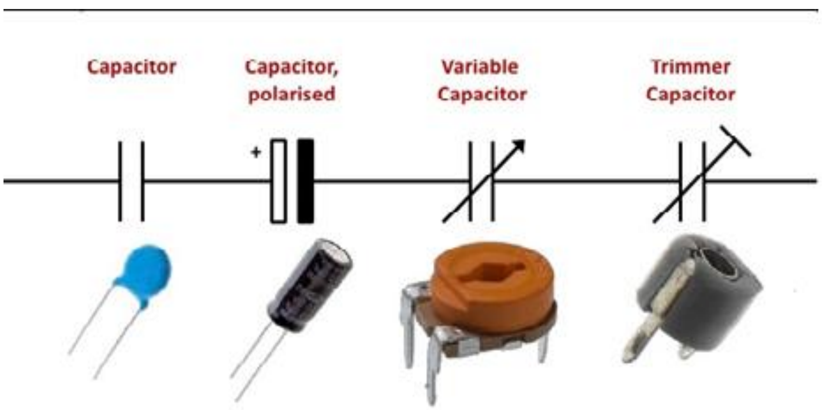


Figure: A.1.5 internal design of capacitor

Figure: A.1.6 Circuit symbols of capacitors

Consider the capacitor of ceramic disc type capacitor that has the code 473J printed onto its body. Then the

1^{st} digit	2^{nd} digit	3^{rd} digit/multiplier In (pF)	4^{th} digit/tolerance
4	7	3	J (5%)

Value = 47pF * 1000(3 zeros)
=47,000 pF
= 47 nF
= 0.047 µF

Now consider the capacitor of ceramic disc type capacitor that has the code 102M printed onto its body. Then the

1^{st} digit	2^{nd} digit	3^{rd} digit/multiplier In (pF)	4^{th} digit/tolerance
1	0	2	M (20%)

Value = 10pF * 100(2 zeros)
=1000 pF
= 1nF+

Tolerance values are given as

- B=0.1pF
- C=0.25pF
- D=0.5pF
- F=1pF
- G=2pF
- J=5%
- K=10%
- M=20%
- Z=80%

1. A.8 INDUCTOR:

An inductor (also choke, coil or reactor) is a passive two-terminal electrical component that stores energy in its magnetic field. For comparison, capacitor stores energy in an electric field and a resistor does not store energy but rather dissipates energy as heat. The unit of inductance is Henry and it is denoted as H.

Any conductor has inductance. An inductor is typically made of a wire or other conductor wound into a coil, to increase the magnetic field. When the current flowing through an inductor changes, creating a time-varying magnetic field inside the coil, a voltage is induced according to Faraday's law of electromagnetic induction, which by Lenz's law opposes the change in current that created it. Inductors are one of the basic components used in electronics where current and voltage change with time, due to the ability of inductors to delay and reshape alternating currents.

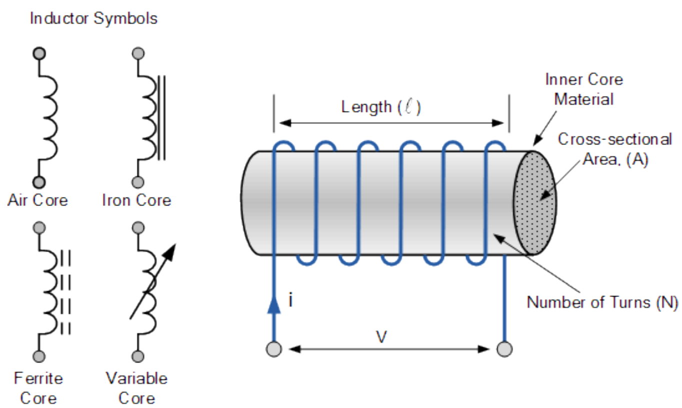


Figure: A.1.7Ciruit Symbol and Internal Design of Inductor

Let us consider inductor colors with red, violet, brown, black.

1st colour	2nd colour	3rd colour/multiplier (µH)	4th colour/tolerance
2	7	10	20%

Value = 27*10 µH
=270 µH

Band	1st	2nd	3rd	4th
Meaning	1st color/digit	2nd color/digit	3rd color/multiplier	4th color/ tolerance
Gold	-	-	0.1 (divide by 10)	±5%
Silver	-	-	0.01 (divide by 100)	±10%
Black	0	0	*1 (no zeros)	±20%
Brown	1	1	*10 (1 zero)	-
Red	2	2	*100 (2 zeros)	-
Orange	3	3	*1000 (3 zeros)	-
Yellow	4	4	*10000 (4 zeros)	-
Green	5	5	-	-
Blue	6	6	-	-
Violet	7	7	-	-
Grey	8	8	-	-
White	9	9	-	-

1. A.9 RESULT:

1.A.10 PRELAB VIVA QUESTIONS:

1. Define faradays laws?
2. What are passive elements?
3. What are active elements?
4. What is tolerance?

1.A.11 POSTLAB VIVA QUESTIONS:

1. What is rheostat?
2. How many types of transistors do we have?
3. Draw circuit symbols of different types of capacitors?
4. What are the different types of resistors available and how do we classify them?

EXPERIMENT – 1 (B)

STUDY OF RESISTOR COLOUR CODING

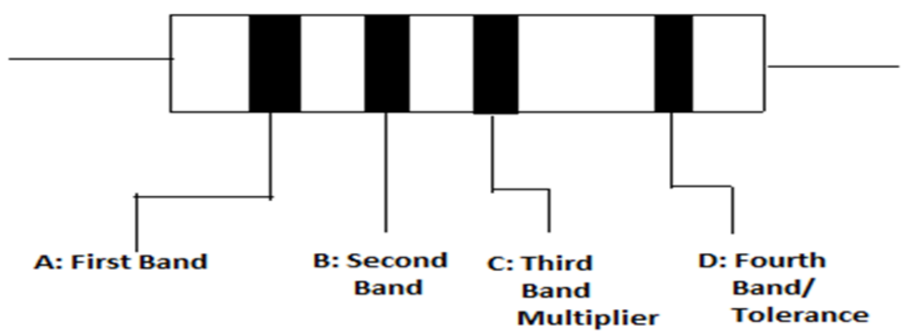
1. B.1 AIM:

To find the value of given resistors using colour coding chart.

1. B.2 APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	Resistors	-	-	-

1. B.3 CIRCUIT DIAGRAM:



Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
white	9

Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
white	9

Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
white	9

Color	Digit
Without	20%
Silver	10%
Gold	5%
Red	2%
Brown	1%

Figure: B.1.1colour coding of resistor

1. B.4 THEORY:

Resistors:

Resistors have three principal ratings: resistance in ohms, tolerance in percent, and power dissipation in watts. Most of the resistors we have in the lab can dissipate ¼ watt and have tolerances of +or -5%.Resistance values are coded on the resistors with colour bands. The first two bands give two significant digits of the value, the third band is a multiplier expressed as a power of 10, and the fourth band is the tolerance. The table below shows the colour code.

For example, red-red orange-gold is 22 KΩ + or - 5 %.

1st colour	2nd colour	3rd colour/multiplier	4th colour/tolerance
Red	Red	Orange	Gold (5%)

Value = 22×10^3 +5%

Similarly colour code for 470Ω is given as

1st digit	2nd digit	3rd digit/multiplier
4	7	10^1

Colour code = 4(yellow)7(violet)$\times10^{1(brown)}$

1. B.5 PROCEDURE:

1. Find the nominal value and the tolerance of each resistance using the colour codes.
2. Calculate the resistor values and using the digital multimeter as an ohmmeter, we can cross check and record the resistance of each.

1. B.6 TABULAR COLUMN:

S. No	First Band	Second Band	Third Band	Tolerance	Resistor
1					
2					
3					
4					
5					

1. B.8 RESULT:

1. B.9 PRELABVIVA QUESTIONS:

1. What is resistor?
2. What is the property of inductor?
3. What is the property of resistor?
4. What are the parameters on which the value of resistance depends?
5. What is the colour coding of 2.2k?

B.1.10 POSTLAB VIVA QUESTIONS:

1. What is rheostat?
2. What are passive elements?
3. What are active elements?
4. What is the value of resistor with colour code ‘Brown Green Brown’?

EXPERIMENT – 2 (A)

TYPES OF ELECTRICAL WIRING

2. A.1 AIM:

To study different types of wiring and to prepare the following wiring:

a) Staircase wiring
b) Fluorescent lamp wiring
c) Corridor wiring

2. A.2 APPARATUS:

S.No	Fluorescent Lamp Wiring	Staircase Wiring	Corridor Wiring	Tools Required
1	Fluorescent lamp with fitting (40W)	Two way switches (230V,5A)	Switches	Screw driver
2	Joint clips	Bulb (230V,40W), bulb holder	Bulb, bulb holder	Hammer
3	Wires	Clamps	Clamps	Cutting pliers
4	Screws	Screws	Screws	Line tester
5	Switch board	Ceiling rose	Ceiling rose	
6	Choke (40W, 230V)	Switch board	Switch board	
7	Switches	Connecting wires	Connecting wires	

2. A.3 CIRCUIT DIAGRAM

Staircase Wiring:

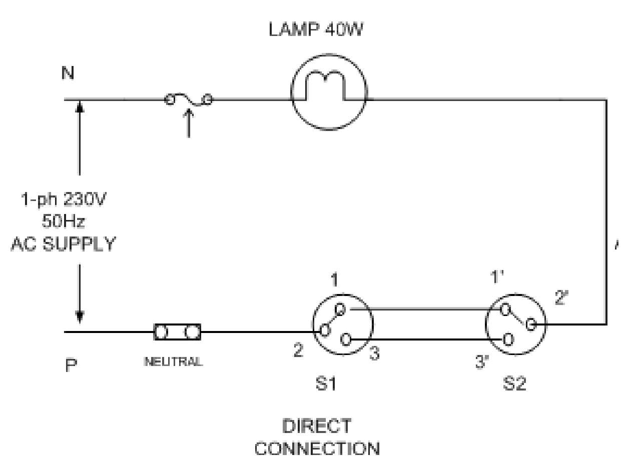


Figure – A.2.1 Staircase Wiring

Fluorescent lamp wiring:

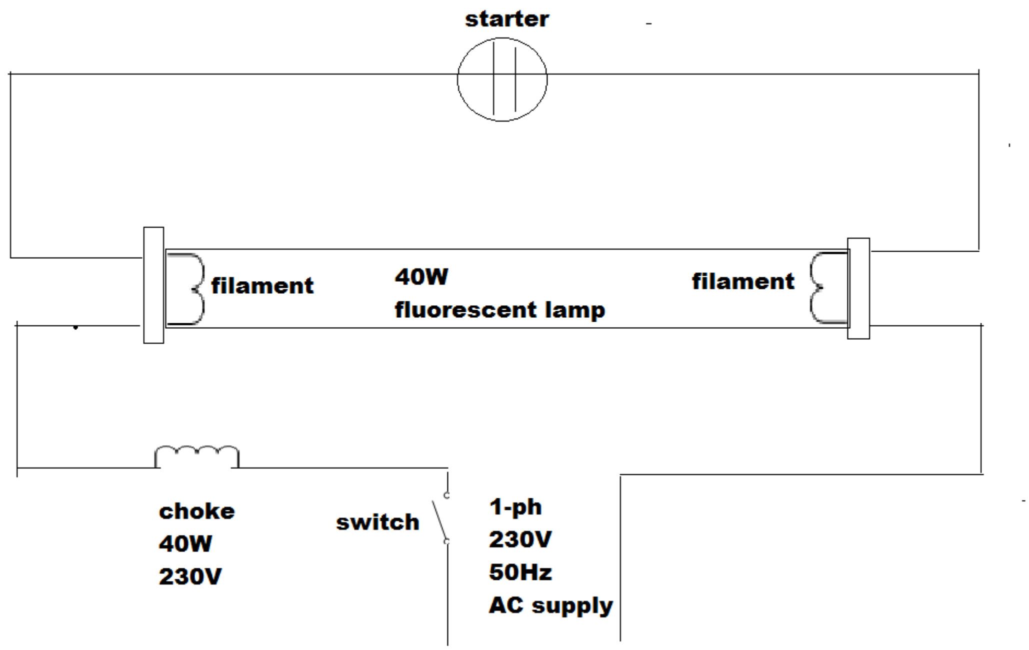


Figure – A.2.2Fluorescent lamp wiring

Corridor wiring:

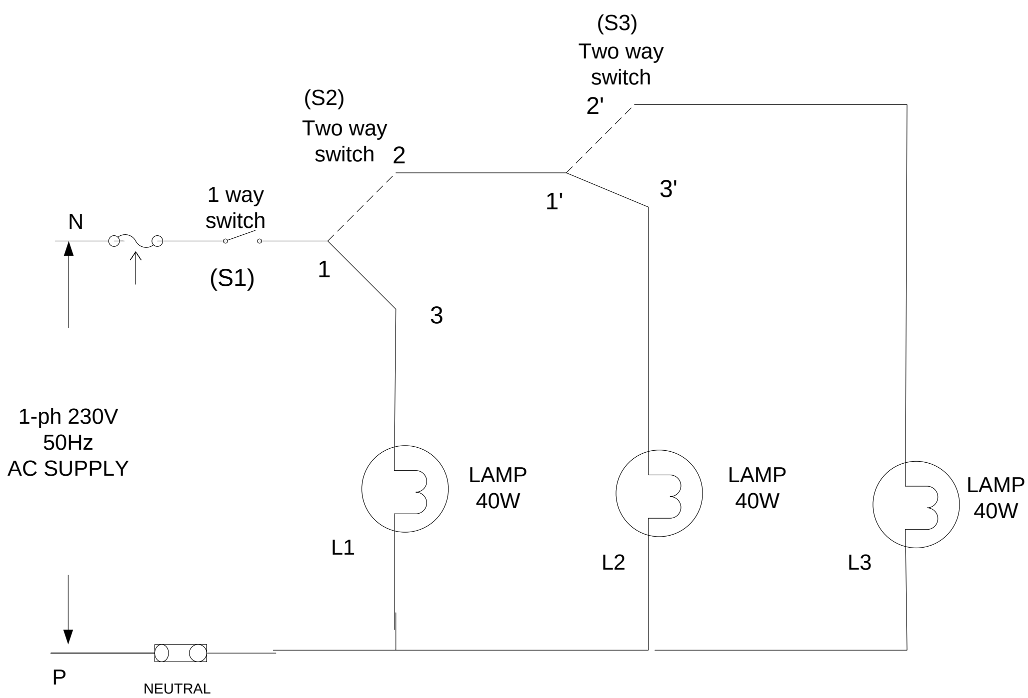


Figure – A.2.3 Corridor wiring

2. A.4 PROCEDURE

Staircase wiring:

i. Give the connections as per the circuit diagram.
ii. Verify the connection
iii. Switch on the supply
iv. Verify the conditions

Fluorescent lamp wiring:

i. Give the connections as per the circuit diagram
ii. Fix the tube holder and the choke in the tube.
iii. The phase wire is connected to the choke and neutral directly to the tube.
iv. Connect the starter in series with the tube.
v. Switch on the supply and check the fluorescent lamp lighting.

Corridor wiring:

i. Follow the same procedure as staircase wiring.

2. A.5 TABULAR COLUMN:

Staircase wiring:

Position switches		Condition lamp
S1	S2	

Corridor wiring:

S1	S2	S3	L1	L2	L3
OFF	X	X			
ON	1-3	1’-3’			
ON	1-2	1’-3’			
OFF	1-2	1’-2’			

2. A.6 RESULT:

2. A.7 PRE LAB VIVA QUESTIONS:

1. What is the use of choke?
2. What is the use of starter?
3. Name the gas present inside the tube light.
4. What types of switches are used for staircase wiring?
5. What is present inside the starter?

2. A.8 POST LAB VIVA QUESTIONS:

1. Mention the types of wiring used in homes?
2. What the power consumption is of commonly called zero watt lamp?
3. What is the usual power factor of Fluorescent lamp and incandescence lamp?
4. Mention the types of lamps
5. Mention the types of switches

EXPERIMENT – 2 (B)

RESIDENTIAL HOUSE WIRING

2. B.1 AIM:

To implement residential house wiring using switches, fuse, indicator, lamp and energy meter.

2. B.2 APPARATUS:

S.No	Components	Range	Quantity
1	Switch	SPST	3
2	Incandescent lamp	40W	2
3	Lamp holder	-	2
4	Indicator	-	1
5	Socket	10A	1
6	Wire	-	As required
7	Energy meter	1-ph, 300V, 16A,750rev, 50Hz	1

2. B.3 CIRCUIT DIAGRAM:

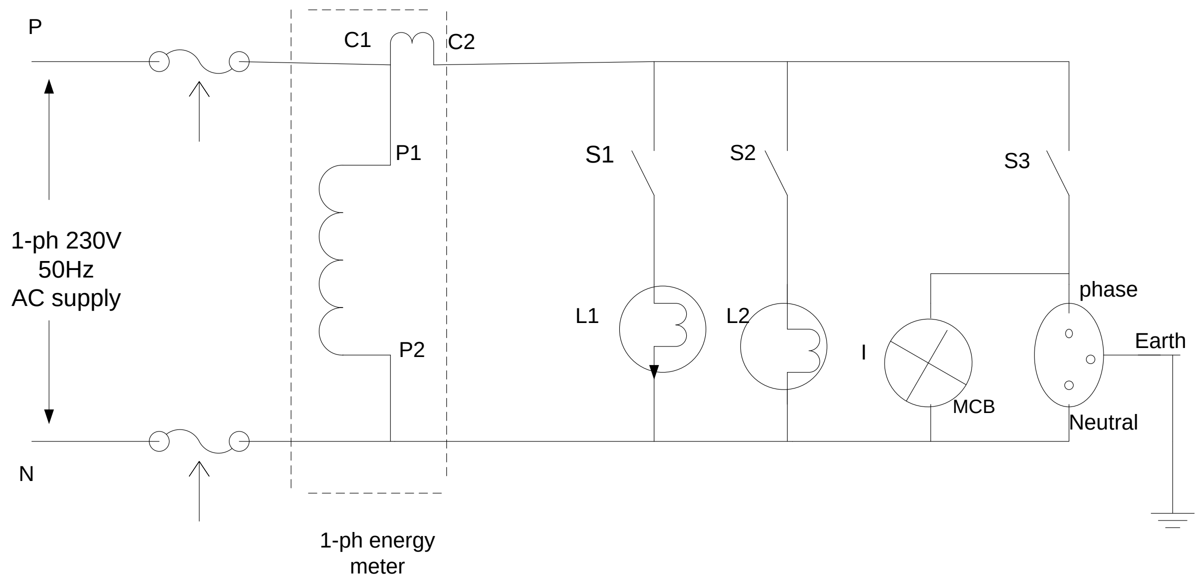


Figure: 2.B.1 Circuit diagram for residential house wiring

2. B.4 PROCEDURE:

1. Study the given wiring diagram.
2. Make the location points for energy meter, main witch box, Switchboard, and lamp.
3. The lines for wiring on the wooden board.
4. Place the wires along with the line and fix.
5. Fix the bulb holder, switches and socket in marked positions on the wooden board.
6. Connect the energy meter and main switch box in marked positions on the wooden board.
7. Give a supply to the wires circuit.
8. Test the working of light and socket

2. B.5 RESULT:

2. B.6 PRELAB VIVA QUESTIONS:

1. Why the tester glows in line not in neutral?
2. What do the three holes in a socket represent?
3. What is the difference between earth and neutral?
4. Mention the type of fuses.
5. What is the unit of Energy?

2. B.7 POSTLAB VIVA QUESTIONS:

1. What type of supply is given to houses?
2. Explain the working of energy meter
3. How does an LED work?
4. Explain the working of incandescence lamp
5. What is meant by earthing?

EXPERIMENT– 3

SOLDERING PRACTICE

3.1 AIM:

To practice soldering and de-soldering for the electronic circuit by assembling and disassembling the resistors and capacitor in the given printed circuit board (PCB).

3.2 APPARATUS:

S. No.	Equipment	Range	Quantity
1	PCB board for given circuit	-	1
2	Soldering iron	(10W or 35W)	1
3	Solder	(60/40 grade)	1
4	Copper plate	-	1
5	Connecting wires	-	-
6	Lead	-	-
7	Nose plier	-	-

3.3 CIRCUIT DIAGRAM:

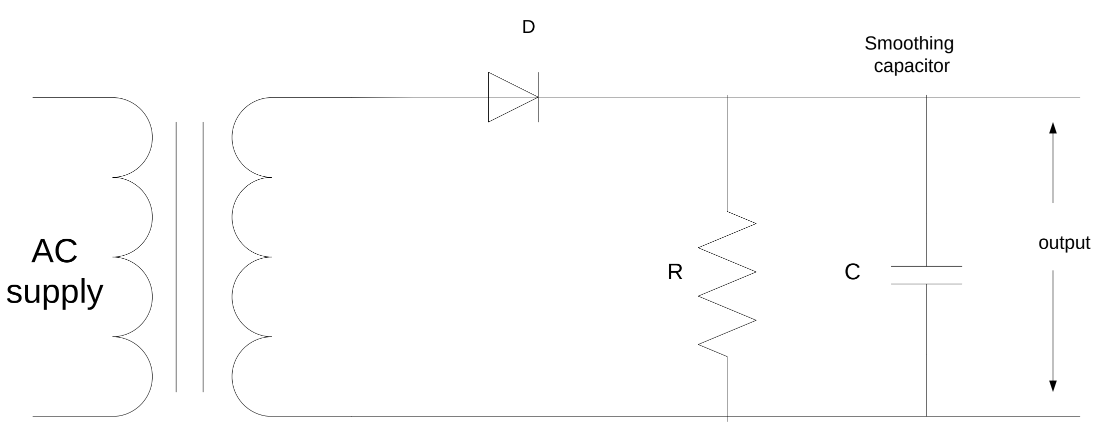


Figure: 3.1 Soldering and de-soldering

3.4 PROCEDURE:

Soldering:

1. Clean the given PCB board

2. Clean the tip of soldering iron before heating
3. Heat the soldering rod and apply solder to the tip as soon as it is hot to melt on it
4. Solder the components as the given circuit diagram.
5. Trim the excess components.

De-soldering:

1. Hold the component to be unsoldered by nose plier.
2. Place the tip of soldering iron on the joint until the solder is melt
3. When the solder is melted, remove the component with the tweezers and brush away the molten solder.
4. Clean the components so that they can be used for other circuits.

3.5 RESULT:

3.6 PRELAB VIVA QUESTIONS:

1. What is soldering?
2. What is the purpose of lead in soldering?
3. What is the use of nose plier?
4. What is flux?

3.7 POSTLAB VIVA QUESTIONS:

1. What are the tools are required in soldering?
2. What is the difference between welding and soldering?
3. What are the available flux forms?
4. What is shelf life of flux?

EXPERIMENT – 4

MEASURMENT OF POWER CONSUMED BY A FLUORESCENT LAMP

4.1 AIM:

To obtain power consumed and power factor of a fluorescent lamp, operated at different voltages.

4.2 APPARATUS:

S.No	Apparatus Name	Type	Range
1	Fluorescent Lamp	-	
2	Choke	-	
3	Starter	-	
4	Ammeter	MI	(0-10) A
5	Voltmeter	MI	(0-300) V
6	Wattmeter	UPF	600 V, 10 A
7	Variac	-	(230/0-270) V, 10A

4.3 THEORY:

A fluorescent lamp is a low pressure mercury discharge lamp with internal surface coated with suitable fluorescent material. This lamp consists of a glass tube provided at both ends with caps having two pins and oxide coated tungsten filament. Tube contains argon and krypton gas to facilitate starting with small quantity mercury under low pressure. Fluorescent material, when subjected to electro-magnetic radiation of particular wavelength produced by the discharge through mercury vapors, gets excited and in turn gives out radiations at some other wavelength which fall under visible spectrum. Thus the secondary radiations from fluorescent powder increase the efficiency of the lamp. Power Factor (P.F.) of the lamp is somewhat low is about 0.5 lagging due to the inclusion of the choke. A condenser, if connected across the supply may improve the P.F. to about 0.95 lagging. The light output is a function of its supply voltage. At reduced supply voltage, the lamp may click a start but may fail to hold because of non-availability of reduced holding voltage across the tube. Higher normal voltage reduces the useful life of the tube light to very great extent. If applied voltage of a fluorescent lamp is V, line current is I and input power is $P = VI\cos\phi$ where $\cos\phi = \left(P/VI\right)$ power factor of fluorescent lamp.

4.4 CIRCUIT DIAGRAM:

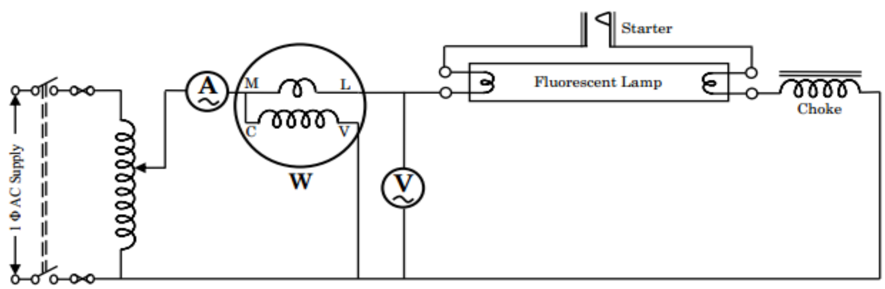


Figure: 4.1 Circuit formeasurement of power consumed by a fluorescent lamp

4.5 PROCEDURE:

1. Connect the circuit as shown in Fig.
2. Keep the variac in minimum or zero position.
3. Switch ON the ac supply and increase gradually till the lamp strikes.
4. Note down the reading of striking voltage.
5. Increase the applied voltage to the rated value step by step and note down the applied voltage, line current and power input to the lamp.
6. Now decrease applied voltage step by step till lamp extinguishes and note down applied voltage, line current and power input to lamp in each step. Note down the extinguishing voltage.
7. Switch OFF the power supply and disconnect the circuit from the supply.

4.6 TABULAR COLUMN:

S.No	Applied voltage increasing			
	Striking voltage (volts)			
	Applied Voltage	**Line Current**	**Power Input**	**Power Factor**
1				
2				
3				

4.7 RESULT:

4.8 PRELAB VIVA QUESTIONS:

1. What is a florescent lamp?
2. Explain the working of florescent lamp?
3. What is the composition of inert gases used in filament lamp?
4. Why filament is in coil shape?

4.9 POSTLAB VIVA QUESTIONS

1. What is the power factor of a lamp?
2. What is the function of starter? What is the function of choke?
3. Can we use fluorescent lamp in DC?
4. Filament of lamp is made by….?

EXPERIMENT – 5

OHM'S LAW, KCL AND KVL

5.1 AIM:

a) To verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL) in a Passive Resistive Network.

b) To verify Ohm's law for a given resistive network.

5.2 STATEMENT:

Kirchhoff's voltage law states that "The sum of all voltages or potential differences in an electrical circuit loop is 0".

$$\sum_k V_k = 0$$

Kirchhoff's Current Law (KCL) states that "The sum of all currents that enter an electrical circuit junction is 0". The currents enter the junction have positive sign and the currents that leave the junction have a negative sign.

$$\sum_k I_k = 0$$

Ohms law states that "current is directly proportional to voltage at constant temperature"

$$V \propto I$$

5.3 APPARATUS:

S. No	Name of Component	Range	Type	Quantity
1	RPS			
2	Ammeter			
3	Voltmeter			
4	Resistors			
5	Bread Board	-	-	01
6	Connecting Wires	-	-	As required

5.4 CIRCUIT DIAGRAM:

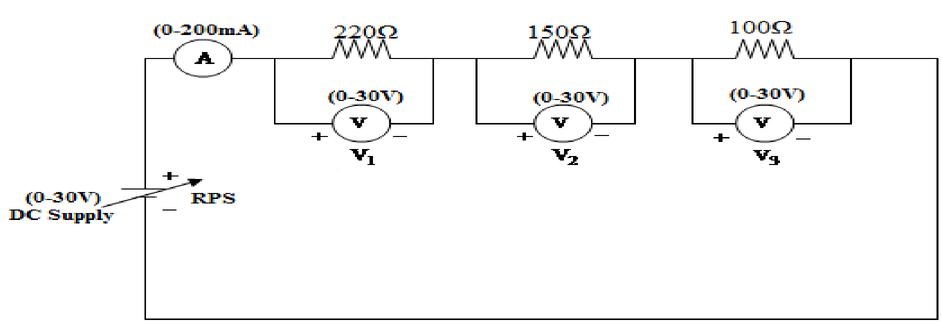


Figure: 5.1 Verification of KVL

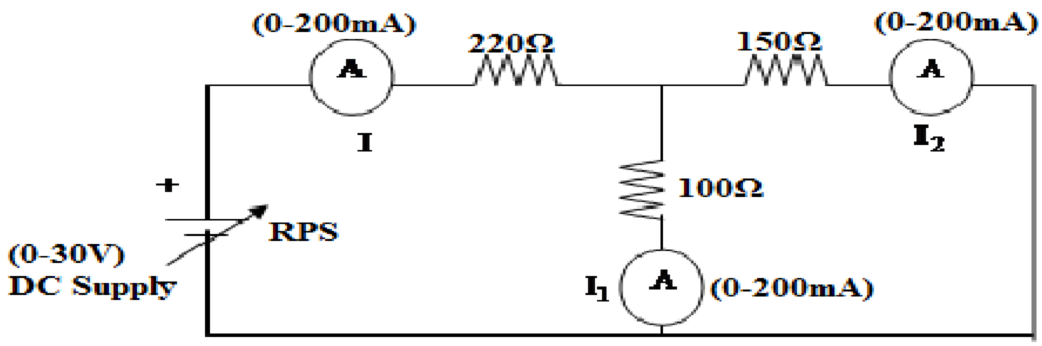


Figure: 5.2 Verification of KCL

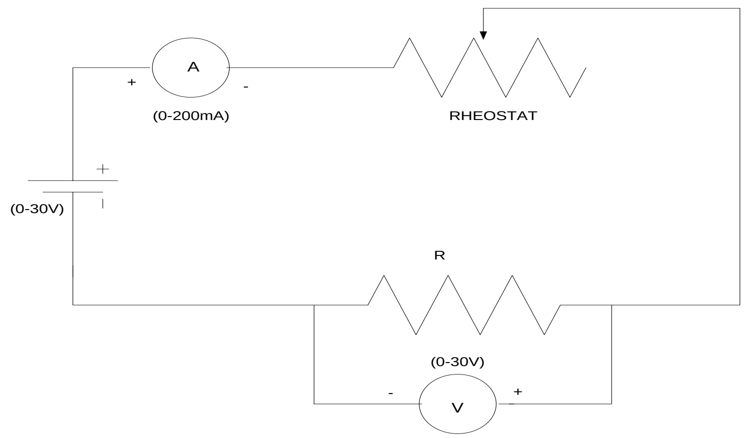


Figure: 5.3 Verification of Ohms Law

5.5 PROCEDURE:

To Verify KVL

1. Connect the circuit diagram as shown in figure.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the voltmeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of voltmeters.
6. Sum up the voltmeter readings (voltage drops), that should be equal to applied voltage.
7. Thus KVL is verified practically.

To Verify KCL

1. Connect the circuit diagram as shown in figure.
2. Switch ON the supply to RPS.
3. Apply the voltage (say 5v) and note the Ammeter readings.
4. Gradually increase the supply voltage in steps.
5. Note the readings of Ammeters.
6. Sum up the Ammeter readings (I_1 and I_2), that should be equal to total current (I).
7. Thus KCL is Verified practically

OHMS LAW:

1. Make the connections as per circuit diagram.
2. Switch ON the power supply to RPS and apply a voltage (say 10V) and take the reading of voltmeter and ammeter.
3. Adjust the rheostat in steps and take down the readings of ammeter and voltmeter.
4. Plot a graph with V along x-axis and I along y-axis.
5. The graph will be a straight line which verifies Ohm's law.
6. Determine the slope of the V-I graph. The reciprocal of the slope gives resistance of the wire.

OBSERVATIONS:

For KVL

Applied Voltage V (volts)	V_1 (volts)		V_2 (volts)		V_3 (volts)		$V_1+V_2+V_3$ (volts)	
	Theoritical	Practical	Theoritical	Practical	Theoritical	Practical	Theoritical	Practical

For KCL

Applied O Voltage V (volts)	I(A)		I_1 (A)		I_2 (A)		I_1+I_2 (A)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical

OHMS LAW:

S.No	VOLTAGE(V)	CURRENT(mA)

5.6 RESULT:

5.7 PRELAB VIVA QUESTIONS:

1. State KVL?
2. State KCL?
3. What are limitations of Ohm’s law.
4. What are applications of Ohm’s law.
5. State ohm’s law?

5.8 POSTLAB VIVA QUESTIONS:

1. What do you mean by junction?
2. What is the color coding of resistors?
3. What are the precautions to be taken while doing the experiment?
4. What do you mean by a loop?
5. What is the condition of ohm's law?

EXPERIMENT – 6

DESIGN OF SMALL TRANSFORMER

6.1 AIM:

To study the design concepts and assembly of small transformer

a) To wind the single phase 230V/12V-0-12V, 3A shell type transformer
b) To check the continuity and operation without vibration.
c) To measure the rated voltage and rated current on full load in secondary winding.

6.2 APPARATUS:

- Stampings/lamination
- Melinex insulating sheet
- Thin insulating paper
- Plastic or Bakelite former
- Small bolts and nuts for clamping stampings
- Super enamelled copper winding wire
- Cotton and empire tapes
- Coil winding machine

6.3 THEORY:

A transformer is a static device which transforms power from one circuit to another circuit at thesame frequency. It consists of two coil windings on a core made of magnetic material. ACvoltage is applied to one of the coils is called the primary coil. The other coil, from which outputis taken, is known as the secondary coil.
The relation between primary and secondary voltage (V_1, V_2); currents (I_1,I_2), number ofturns (N_1,N_2) respectively, is given by,

$$\frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}$$

CORE:

AC supply voltage is applied to the primary winding; therefore, the flux flowing through the core is alternating. To reduce the eddy current loss, the core is made of lamination. The thickness of laminations or stamping varies from 0.35mm - 0.55 mm. The laminations are insulated from each other by the thin coat of insulating varnish. For good magnetic characteristics, cold rolled silicon steel is used. Silicon content may be of the order of 3 or 4%.

WINDINGS:

In the case of small transformers, coils are usually would with round wire in the form of a bobbin, in the same ways as cotton thread wound on a spool. For small transformers of low voltage such as 230V, about 5 to 8 turns per volt may be taken for primary winding, depending on the size of the transformer. Secondary number of turns can be obtained by the relationship.

$$N_2 = \frac{V_2}{V_1} \times N_1$$

The primary current can be calculated with the help of the given volt-ampere rating of the transformer.
Primary current I_1 = Volt-ampere rating / V1
Secondary current I_2 can be calculated from the relation:

$$I_2 = \frac{N_2}{N_1} \times I_1$$

MELINEX INSULATIN SHEET:

Melinex is a dimensionally stable polyester film with high tensile strength which offers good resistance to tearing temperature and attack by most common chemicals and solvents without greatly restricting the acoustic performance of the material which it encloses. It is used in facing of mineral fiber and foam insulation for a variety of end users. Eg. Acoustic insulation above perforated and slotted ceiling- sound absorption in air conditioning systems various thermal insulation applications etc. Particularly it is good when a high degree of resistance to chemicals and/or solvents is required.

Its benefits are it is acoustically permeable, highly Resistant to many chemicals solvents fire and water vapour, excellent containment medium for glass and mineral fibres, resilient to tearing, no special adhesives required.

6.4 PROCEDURE:

1. Select the size of the core and the type of the stamping (i.e.) for the shell type transformer, the combination of ‘E’ and ‘I’.
2. Select the suitable size of the conductor for windings, as explained above.
3. Wrap the transformer with melinex insulation sheet.
4. Wind the primary winding or the transformer preferably with the help of winding machine.
5. After every 2 or 3 layers of primary winding, use a layer of thin insulating paper.
6. After completing the primary winding, warp with melinex sheet.
7. Wind the secondary turns.
8. Bring out taps at suitable number of turns for 12-0-12 volts.
9. Wrap with empire or cotton tape for insulation and mechanical protection.
10. Assemble the core with winding as shown in the figures.
11. Clamp / bolt the core.

6.5 MODEL CALCULATIONS:

For Primary Winding
No. of turns per volt = 6 turns
No. of turns per 230V = 230 x 6= 1380 turns

Conductors Size
Amps per sq.mm = 3 Amps/sq.mm
As per the table shown in text book
The size of the conductor = 18 SWG is preferable.

For Secondary Winding
No. of turns per volt = 6 turns
No. of turns per 12 volt = 12 x 6 = 72 turns

Conductor Size

Secondary current $I_2 = \frac{N_2}{N_1} \times I_1$

$$= \frac{72}{1380} \times 3 = 0.15652$$

As per the table shown in the text book,

The size of the conductor $N_2 = \frac{I_2}{I_1} \times N_1$

$$= \frac{0.1562}{3} \times 1 = 0.152$$

6.6 TABULAR COLUMN:

Voltages(V)			No. of turns	Current (A)	Size of wire (mm)
Winding	**Designed**	**actual**			
Primary					
Secondary					

6.7 RESULT:

6.8 PRE LAB VIVA QUESTIONS

1. What is a choke?
2. Where is choke used?
3. Explain the detailed design of choke.
4. Mention few applications of choke
5. Explain the difference between core and shell type transformer

6.9 POST LAB VIVA QUESTIONS

1. Explain the various losses in transformer?
2. Why the core of a transformer in laminated?
3. What are the various parts of a transformer?
4. Which winding should be wound first HV or LV? Why?
5. What is meant by SWG?

EXPERIMENT – 7

DETERMINATION OF CIRCUIT IMPEDANCE

7.1 AIM:

To calculate and verify the impedance and current of RL, RC and RLC series circuits.

7.2 APPARATUS:

S.No	Name of Component	Range	Quantity
1	Capacitor	1μF	1
2	Inductor	100mH	1
3	Resistor	1kΩ, 100Ω	1
4	CRO	-	1

7.3 THEORY:

- Impedance is the total measure of opposition to electric current and is the complex (vector) sum of (real) resistance and (imaginary) reactance.
- Power is defined as the rate of flow of energy past a given point.
- In alternating current circuits, energy storage elements such as inductors and capacitors cause periodic reversals of energy flow. The portion of power flow averaged over a complete cycle of the AC waveform that results in net transfer of energy in one direction is known as real power.
- The portion of power flow due to stored energy which returns to the source in each cycle is known as reactive power.
- The ratio between real power and apparent power in a circuit is called the power factor. Where the waveforms are purely sinusoidal, the power factor is the cosine of the phase angle (φ) between the current and voltage sinusoid waveforms

7.4 CIRCUIT DIAGRAM:

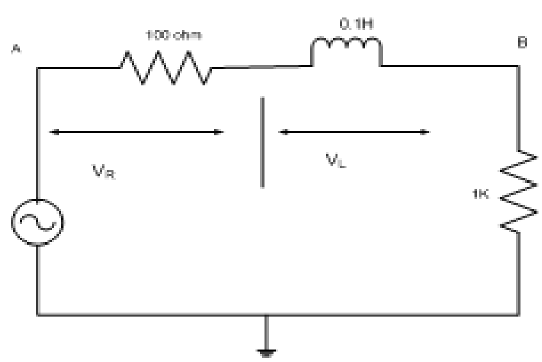


Figure: 7.1 Circuit Impedence of RL Circuit

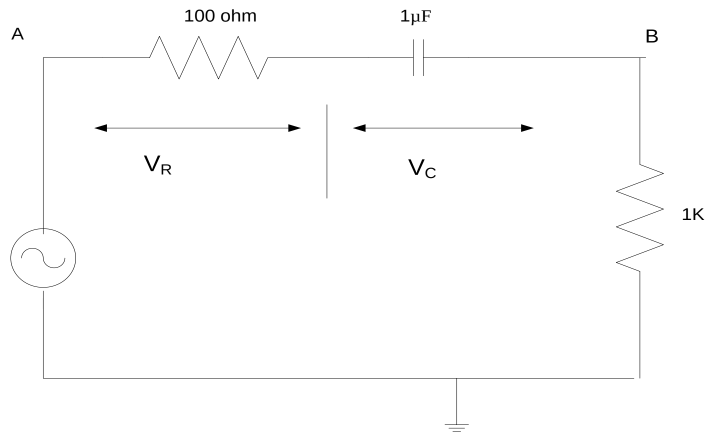


Figure: 7.2circuit Impedence of RC Circuit

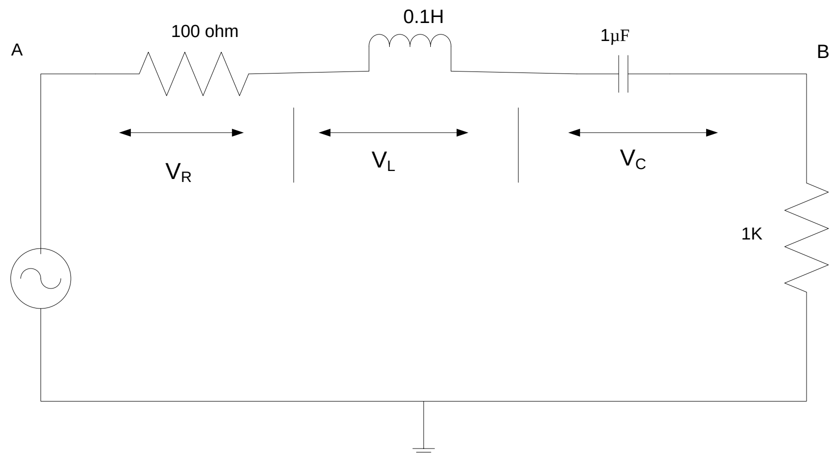


Figure: 7.3 Circuit Impedence of RLC Circuit

7.5 PROCEDURE:

1. Connect the circuit as shown in the circuit diagram of figure.
2. Using figure 10.1 with E, R , L Measure the current and voltage flowing throw resistor and inductor.
3. Calculate the impedance value of RL circuit theoretically and practically.
4. Similarly using figure 10.2 with E, R , C Measure the current and voltage flowing throw resistor and capacitor.
5. Calculate the impedance value of RC circuit theoretically and practically.
6. Similarly using figure 10.3 with E, R, L, C Measure the current and voltage flowing throw resistor and capacitor.
7. Calculate the impedance value of RLC circuit theoretically and practically.

7.6 TABULAR COLUMN:

RL CIRCUIT

V_R(VOLTS)	V_L (VOLTS)	I(AMPS)	IMPEDANCE

RC CIRCUIT

V_R(VOLTS)	V_C (VOLTS)	I(AMPS)	IMPEDANCE

RLC CIRCUIT

V_R(VOLTS)	V_L (VOLTS)	V_C (VOLTS)	I(AMPS)	IMPEDANCE

7.6 CALCULATIONS:

RL circuit:

$Z=R+jX_L$

$X_L=2\Pi fL$ (where f=50Hz)

RC circuit:

$Z=R+jX_C$

$X_C= 2\Pi fL$ (where f=50Hz)

RLC circuit:

$Z=R+j(X_L-X_C)$

$X_C= 2\Pi fL$ (where f=50Hz)

Current I=V/Z

7.7 RESULT:

7.8 PRELAB VIVA QUESTIONS:

1. What is power factor?
2. What is apparant power?
3. What is the phase angle of series RL circuit?
4. What is the phase angle of series RC circuit?

7.9 POSTLAB VIVA QUESTIONS:

1. Define phase angle?
2. How do you calculate impedance of RL circuit?
3. What is reactive power?
4. What are units of active reactive and apparent power?

EXPERIMENT – 8

STUDY OF CONSTANT CURRENT SOURCE

8.1 AIM:

To develop a circuit which provides substantially constant current using a low voltage input source.

8.2 APPARATUS:

S.NO	APPARATUS NAME	RANGE	QUANTITY
1	Resistor	39Ω,10kΩ	2
2	Transistor	BC547B	1
3	Diode	1N4007	2
4	Circuit board	-	1
5	Connecting wires	-	-
6	LED	-	-

8.3 CIRCUIT DIAGRAM:

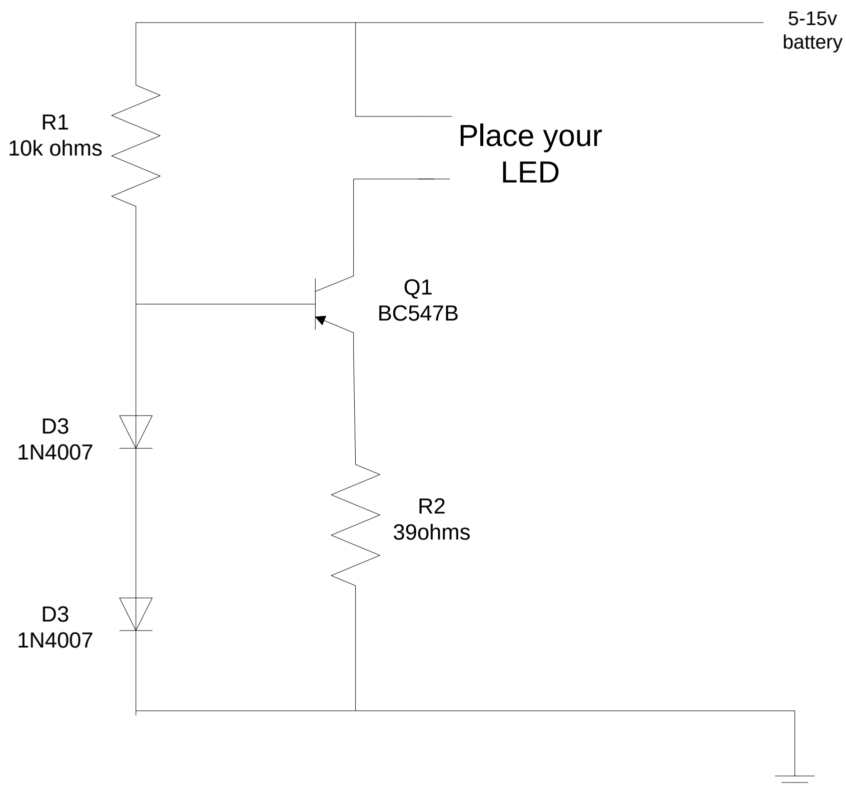


Figure: 8.1 Circuit diagram to study constant current source

8.4 PROCEDURE:

1. Connect the circuit as shown.
2. Add a voltage source and LED in the specified position.
3. The input of the constant-current source can be between 5V and 15V DC.
4. Do not exceed the input voltage 0.7V for the circuit.
5. The LED will try to get the maximum available current, what is 20mA, if the 20mA are reached the voltage will go down to the voltage which the LED need to have a current of 20mA and stay there.

8.5 RESULT:

8.6 PRELAB VIVA QUESTIONS:

1. What is an LED driver?
2. What are active elements?
3. A practical current source can also be represented as?
4. In a constant voltage DC circuit, when the resistance increases, the current will

8.7 POSTLAB VIVA QUESTIONS:

1. What is the application of constant current source?
2. What is the allowable range of an LED?
3. Which material we use in LED?
4. Why do not LED starts to glow immediately when you provide the forwarding bias to that?

EXPERIMENT – 9

MEASURMENT OF ELECTRICAL PARAMETERS

9.1 AIM:

To measure the electrical quantities like voltage, current, power and power factor in RLC series circuit.

9.2 APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	Ammeter	(0-10A)	MI	1
2	Load	Variable	RLC	1
3	Volt meter	(0-300V)	MI	1
4	Watt meter	300V, 10A	UPF	1
5	Autotransformer	1KVA 230/(0-240) V, 10A	1PH	1

9.3 CIRCUIT DIAGRAM:

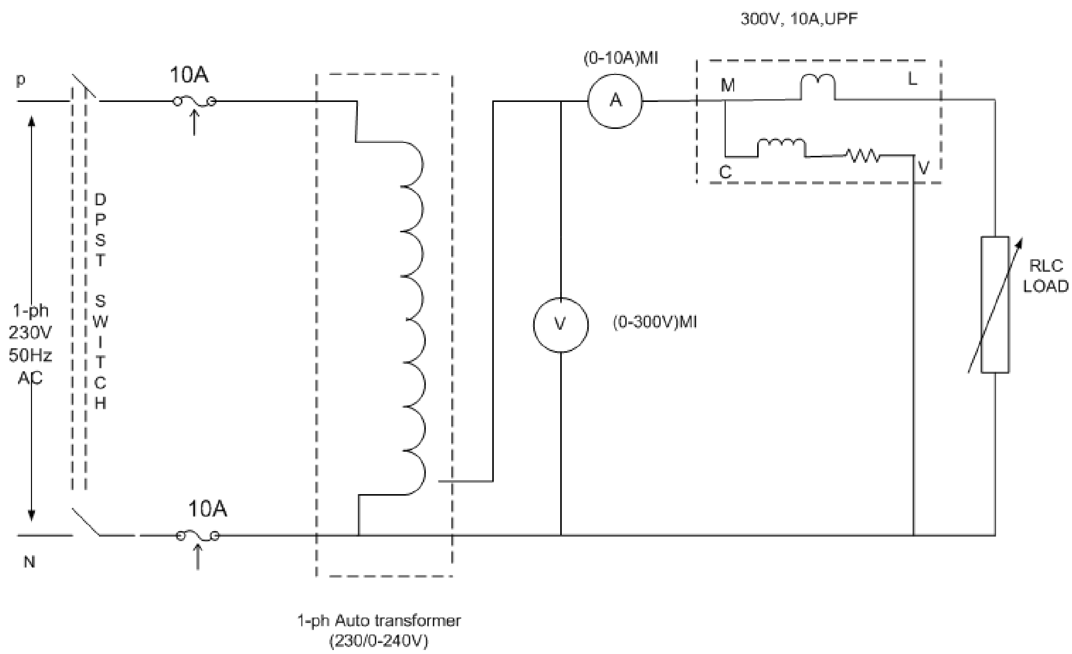


Figure: .1Circuit Diagram for Measurement of Voltage, Current, Power and Power Factor in RLC Series Circuit.

9.4 PROCEDURE:

1. Connections are given as per the circuit diagram
2. Set the rated voltage by adjusting Auto transformer
3. Observe the meter readings for various loading conditions.
4. Calculate the error and plot the graph between %error and current value.

9.5 CALCULATIONS:

Apparent Power = VI (Voltmeter reading x Ammeter reading)

Real Power = VI Cos Φ (Watt meter reading)

Power factor (Cos Φ) = Real Power / Apparent Power

Indicated Power = Observed reading X Multiplying factor

Actual Power = Voltmeter reading x Ammeter reading x Power factor

% Error = (Indicated Power –Actual Power) x100 /Actual Power

9.6 TABULAR COLUMN:

S.No	Voltmeter (V)	Ammeter(A)	WATT Meter (W)		Power Factor
			Observed	Indicated	

9.7 RESULT:

9.8 PRE LABVIVA QUESTIONS

1. Define unit charge?
2. Define electric potential difference?
3. Define current in terms of charge?
4. Define power factor?
5. What is meant by potential and potential difference?

9.9 POSTLAB VIVA QUESTIONS

1. What is the unit for voltage current and resistance power?
2. Define one volt, one ampere, one ohm and one watt.
3. What is the power factor of pure R, pure L and pure C circuits?
4. Draw impedance triangle.
5. Mention the types of power in ac circuit.

EXPERIMENT – 10

MEASUREMENT OF ELECTRICAL ENERGY

10.1 AIM:

To measure electrical energy using single phase energy meter.

10.2 APPARATUS:

S. No.	Equipment	Range	Type	Quantity
1	Ammeter	(0-10)A	MI	1
2	Load	-	lamp	1
3	Volt meter	(0-300)V	MI	1
4	Watt meter	300V, 10A	UPF	1
5	Autotransformer	1KVA 230/(0-240) V, 10A	1PH	1

10.3 CIRCUIT DIAGRAM:

(A) 1-Φ ENERGY METER

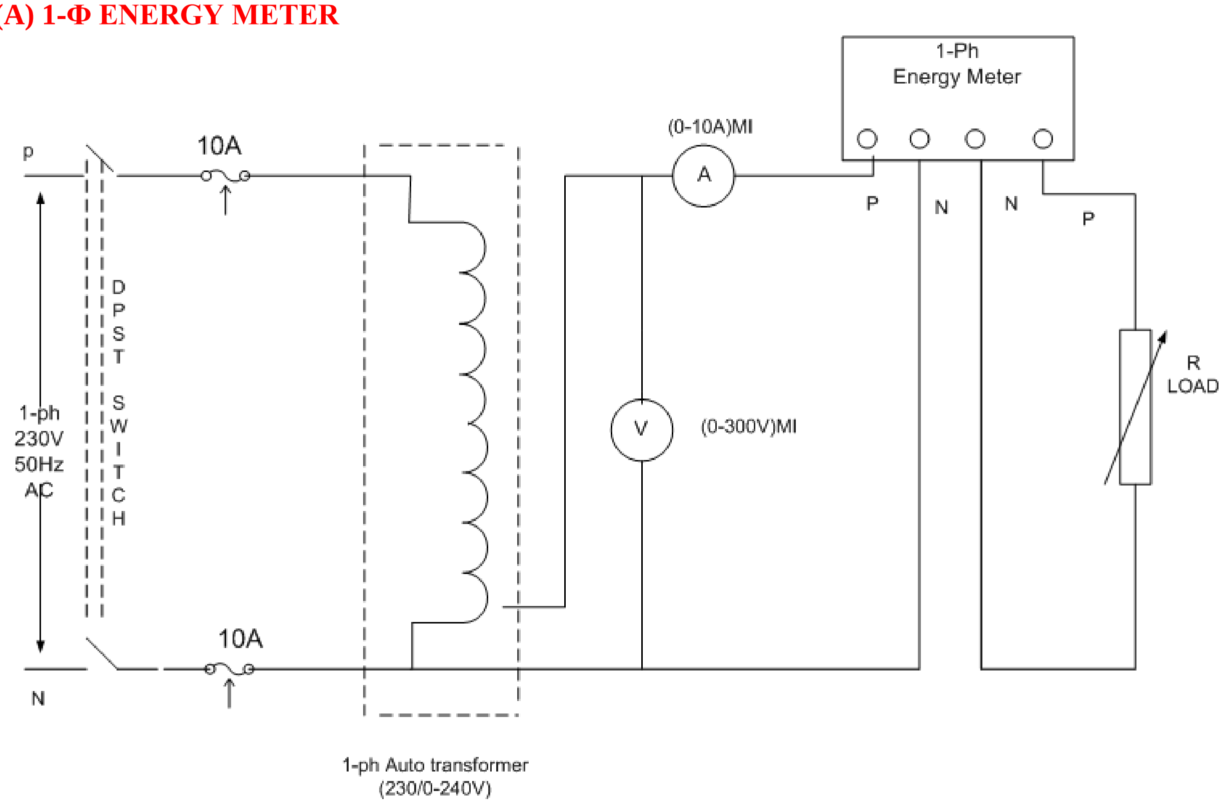


Figure: 10.1 1-ph Energy Meter

10.4 PROCEDURE:

1. Connections are made as per circuit diagram.
2. Supply is switched on and load is applied and Ammeter, Voltmeter readings and Time taken by the discs for particular number of revolution are noted using stopwatch.
3. Step 2 is repeated for various load conditions.
4. % Error is calculated.

10.5 MODEL CALCULATIONS:

Formulae Used (1-ΦEnergyMeter)

Using energy meter constant 750 revolutions = 1kWh

1 revolution = 1 $\times$ 1000 $\times$ 3600 / 750 = 4800 W-s

For n revolution energy (E_I) = n $\times$ 4800 W-s

Calculated energy E = (V $\times$ I) $\times$ T W-s

Where V – load voltage

I – load current

T – Time taken for n revolution in seconds

$$\%error = \frac{(E_I - E_a)}{E_I} \times 100$$

10.6 TABULAR COLUMN:

(a) 1-Φ energy meter

S.NO	VOLTMETER (V)	AMMETER (A)	TIME TAKEN for 5rev(sec)	CALCULATED ENERGY (E_a)	INDICATED ENERGY(E_I)	%Error

10.7 RESULT:

10.8 PRE LAB VIVA QUESTIONS

1. Define energy.

2. Mention the unit for energy
3. What type of instrument is energy meter?
4. Explain the working of energy meter.
5. Mention the types of energy meter.

10.9 POST LAB VIVA QUESTIONS

1. How current coil is connected in induction type energy meter?
2. How voltage coil is connected in induction type energy meter?
3. What does one unit refer to?
4. How is energy meter connected?
5. What may be the reason for the energy meter to rotate too fast or too slow?

EXPERIMENT - 11

AVERAGE VALUE, RMS VALUE, FORM FACTOR, PEAK FACTOR OF SINUSOIDAL WAVE, SQUARE WAVE

11.1 AIM:

To determine the average value, RMS value, form factor, peak factor of sinusoidal wave, square wave.

11.2 APPARATUS

S. No	Name	Range	Quantity
1	Resistors	100Ω	2 Nos
2	Inductor	1 mH	1 No
3	Function Generator		1 No
4	Multimeter		1 No
5	CRO		1 No

11.3 THEORY:

In alternating current (AC, also ac) the movement (or flow) of electric charge periodically reverses direction. An electric charge would for instance move forward, then backward, then forward, then backward, over and over again. In direct current (DC), the movement (or flow) of electric charge is only in one direction.

Average value: Average value of an alternating quantity is expressed as the ratio of area covered by wave form to distance of the wave form.

Root Mean Square (RMS) Value: The RMS value of an alternating current is expressed by that steady DC current which when flowing through a given circuit for given time produces same heat as produced by that AC through the sane circuit for the same time period. In the common case of alternating current when I(t) is a sinusoidal current, as is approximately true for mains power, the RMS value is easy to calculate from the continuous case equation above. If we define Ip to be the peak current, then in general form

$$I_{\mathrm{RMS}} = \sqrt{\frac{1}{T_2 - T_1}\int_{T_1}^{T_2} (I_{\mathrm{p}}\sin(\omega t))^2 dt}.$$

Where t is time and ω is the angular frequency ($\omega = 2\pi/T$, where T is the period of the wave).

For a sinusoidal voltage,

$$V_{\mathrm{rms}} = \frac{V_{\mathrm{peak}}}{\sqrt{2}}.$$

The factor is called the crest factor, which varies for different waveforms. For a triangle wave form centered about zero.

$$V_{\mathrm{rms}} = \frac{V_{\mathrm{peak}}}{\sqrt{3}}.$$

For a square wave form centered about zero

RMS (Root Mean Square) value of an ac wave is the mean of the root of the square of the voltages at different instants. For an ac wave it will be 1/ √2 times the peak value.

11.4 CIRCUIT DIAGRAM:

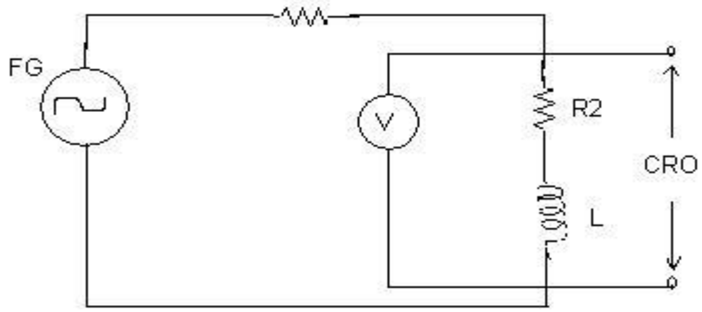


Fig – 11.1 Basic Circuit

11.5 PROCEDURE:

1. Connect the circuit as shown in the circuit diagram of fig. 11.1.
2. Set the value of frequency say 100 Hz in the function generator.
3. Adjust the ground of channel 1 and 2 of Cathode Ray Oscilloscope and then set it into DC mode.
4. Connect CRO across the load in DC mode and observe the waveform. Adjust the DC offset of function generator.
5. Note down the amplitude and frequency.
6. Set the multimeter into AC mode and measure input voltage and voltage across point AB. This value gives RMS value of sinusoidal AC.
7. Calculate the average value.
8. Repeat experiment for different frequency and different peak to peak voltage.

9. Measure the RMS and Average value of DC signal also where instead of function generator you can use DC supply.

11.5 OBSERVATIONS & CALCULATIONS:

Peak value (V)	RMS value (V)	Average value (V)

11.6 PRECAUTIONS:

1. Check for proper connections before switching ON the supply
2. Make sure of proper color coding of resistors
3. The terminal of the resistance should be properly connected

11.7 RESULT:

(B) AVERAGE VALUE, RMS VALUE, FORM FACTOR, PEAK FACTOR OF SINUSOIDAL WAVE, SQUARE WAVE USING DIGITAL SIMULATION

11.8 AIM:

To determine the average value, RMS value, form factor, peak factor of sinusoidal wave, square wave.

11.9 APPARATUS:

S. No	SOFTWARE USED	DESKTOP QUANTITY
1	MATLAB	36

11.10 CIRCUIT DIAGRAM:

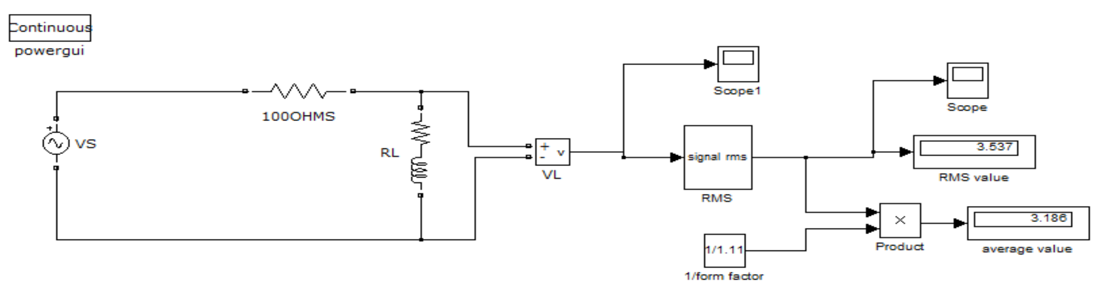


Fig – 4.2 MATLAB Simulink circuit

11.11 PROCEDURE:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink.
2. Measure the Peak value of the voltage obtained
3. Verify with the theoretical results obtained with practical results

11.12 OBSERVATIONS & CALCULATIONS:

Peak value (V)	RMS value (V)	Average value (V)

11.13 RESULT:

11.14 PRE LAB VIVA QUESTIONS:

1. What is complex wave?
2. Define Instantaneous value.
3. Why RMS value is not calculated for DC quantity?
4. Define RMS Value.
5. What is the expression for form factor and peak factor?

11.15 POST LAB VIVA QUESTIONS:

1. What is RMS value of Sin wave?
2. Why RMS value is specified for alternating Quantity?
3. Why average value is calculated for half cycle for a sine wave?
4. Define form factor and peak factor for an alternating wave.

EXPERIMENT – 12

(A) VERIFICATION OF SERIES RESONANCE

12.1 AIM:

To design the resonant frequency, quality factor and band width of a series resonant circuit.

12.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Signal generator			
2	Required resistors			
3	Required Inductors			
4	Required capacitors			
5	CRO probes			
6	Connecting wires			

12.3 CIRCUIT DIAGRAM:

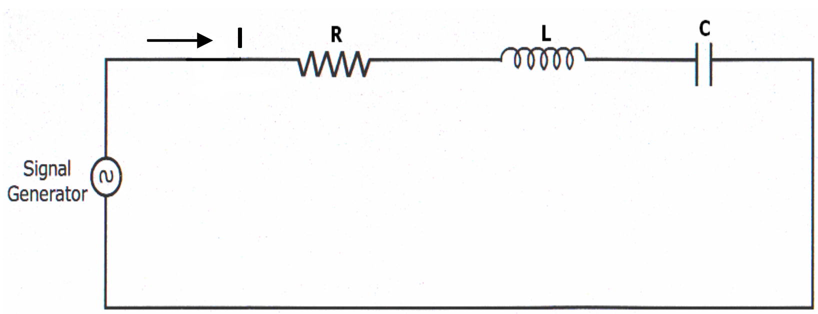


Fig – 12.1 Series Resonance

12.4 PROCEDURE:

1. Connect the circuit as shown in fig.12.1.
2. Set the voltage of the signal from function generator to 10V.
3. Vary the frequency of the signal in steps and note down the magnitude of response on CRO respectively (response wave form is observed across element R).
4. Form the observation table between the frequency and magnitude of response in CRO firstly for series resonance circuit.
5. Draw a graph between frequency and magnitude of response on the semi-log sheet and determine the resonant frequency, quality factor and bandwidth for series circuit.

12.5 THEORETICAL CALCULATIONS: Series Resonance

Resonant Frequency $(f_r) = 1/(2\pi\sqrt{LC})$

Lower cut off frequency $(f_1) = f_r - R/4\pi L$

Upper cut off frequency $(f_2) = f_r + R/4\pi L$

Quality factor $Q_r = \omega_r L/R = 1/\omega_r RC$

Band Width $f_2 - f_1 = R/2\pi L$

12.6 TABULAR COLUMN:

S.No.	Frequency *(Hz)*	Magnitude of response
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

12.7 MODEL GRAPH:

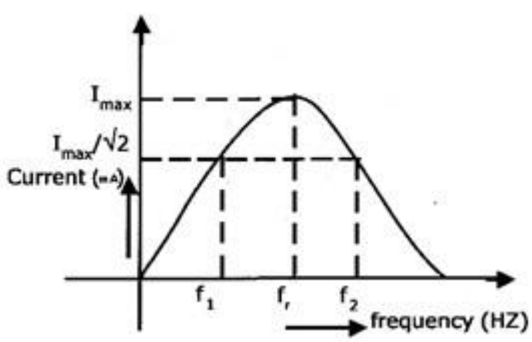


Fig – 12.2 Series Resonance

12.8 RESULT:

(B) DESIGN AND SIMULATION OF SERIES RESONANCE CIRCUIT.

12.9 AIM:

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

12.10 SOFTWARE REQUIRED:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

12.11 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

12.12 CIRCUIT DIAGRAM:

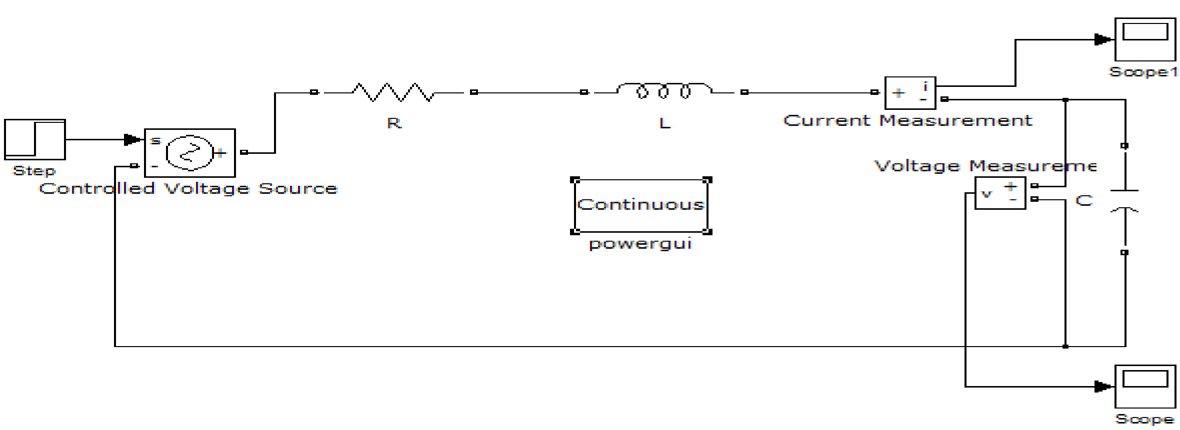


Fig – 12.3 Series Resonance simulation diagram

12.13 PROCEDURE:

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

12.14 MODEL GRAPH FOR SERIES RESONANCE

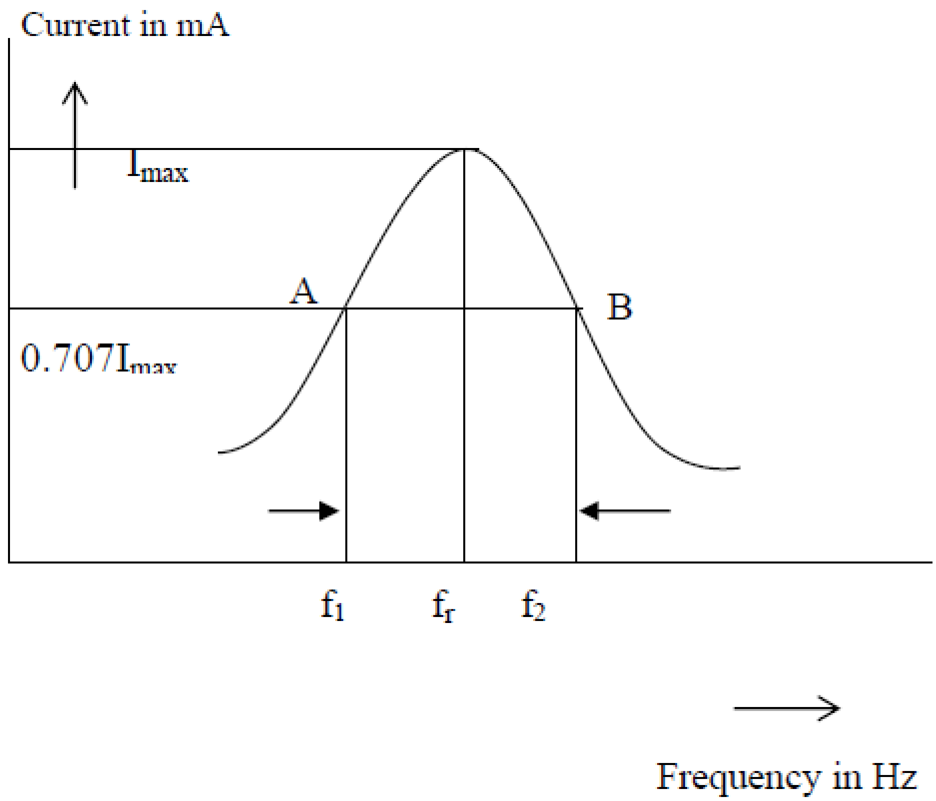


Fig – 12.4 Series Resonance Model graph

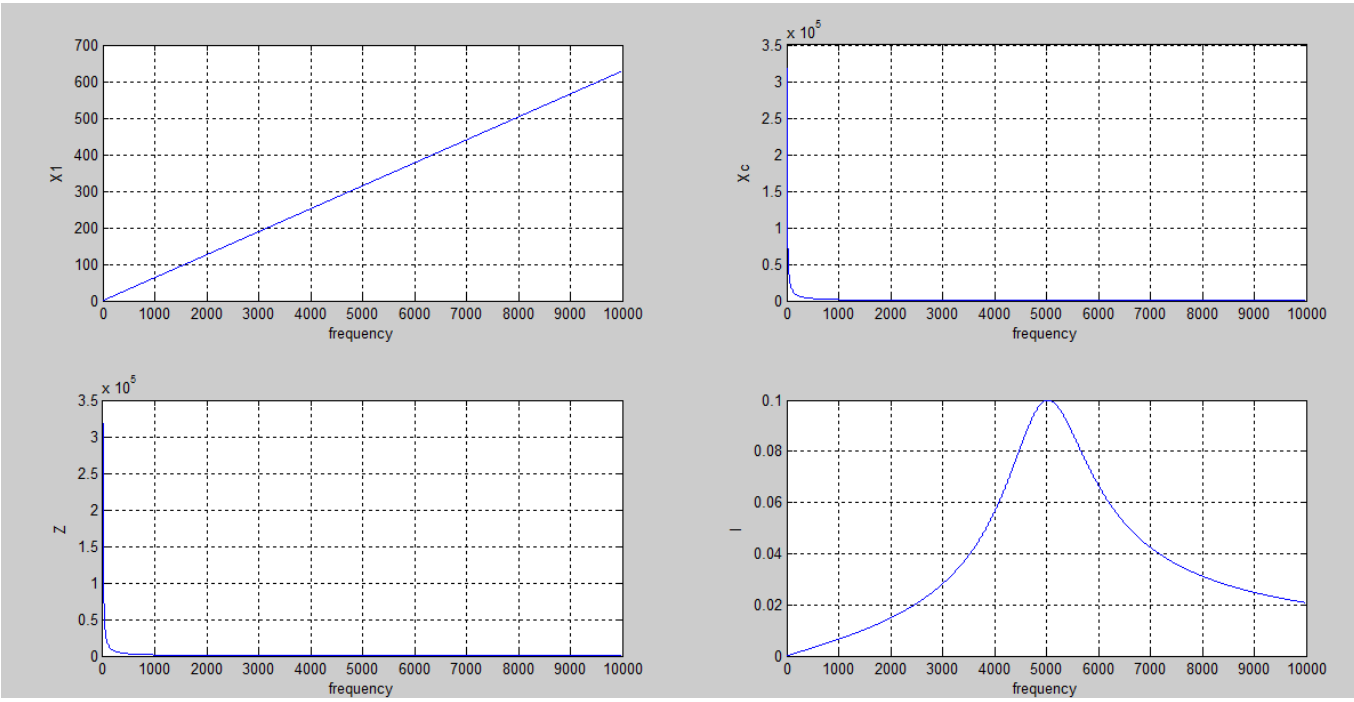
12.14 %PROGRAM TO FIND THE SERIES RESONANCE

```
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');
```

12.15 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
```



12.16 PRE LAB 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?

12.17 LAB ASSIGNMENT:

1. Give the expression for quality factor.
2. Give the application of series resonance circuit.

12.18 POST LAB VIVA QUESTIONS:

1. Define series resonance.
2. Define magnification.
3. What is power factor under resonant condition?

EXPERIMENT – 13

(A) VERIFICATION OF PARALLEL RESONANCE

13.1 AIM:

To design the resonant frequency, quality factor and band width of a parallel resonant circuit.

13.2 APPARATUS:

S. No.	Name of the Equipment	Range	Type	Quantity
1	Signal generator			
2	Required resistors			
3	Required Inductors			
4	Required capacitors			
5	CRO probes			
6	Connecting wires			

13.3 CIRCUIT DIAGRAM:

Signal Generator

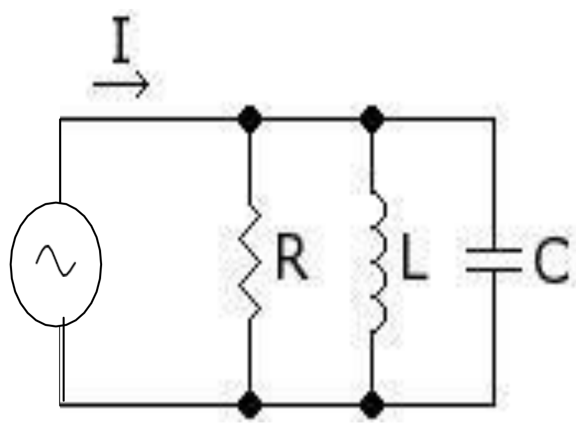


Fig – 13.1 Parallel Resonance

13.4 PROCEDURE:

1. Connect the circuit as shown in fig.13.1 for parallel resonant circuit.
2. Set the voltage of the signal from function generator to 10V.
3. Vary the frequency of the signal in steps and note down the magnitude of response on CRO respectively (response wave form is observed across element R)
4. Form the observation table between the frequency and magnitude of response in CRO for parallel resonance circuit.
5. Draw a graph between frequency and magnitude of response on the semi-log sheet and determine the resonant frequency, quality factor and bandwidth for parallel resonance circuit.

13.5 THEORETICAL CALCULATIONS:

Parallel Resonance

Resonant Frequency (fr) = 1/(2 π √LC)

Lower cut off frequency (f1) =fr-1/4 π RC

Upper cut off frequency (f2) = fr+1/4 π RC

Quality factor Q_r = ω_rCR = f_r/B.W

Band Width f2-f1 = 1/2 π RC

13.6 TABULAR COLUMN:

S.No.	Frequency (Hz)	Magnitude of response
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

13.7 MODEL GRAPH:

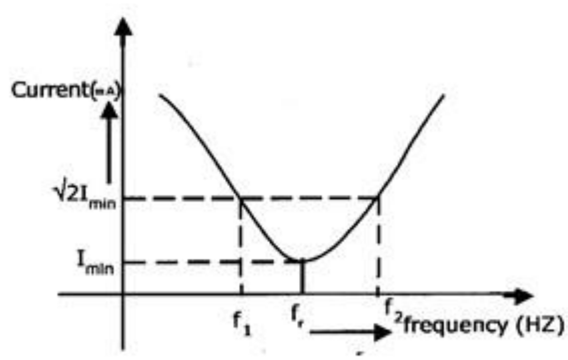


Fig – 13.2. Parallel Resonance

13.8 RESULT

(B) DESIGN AND SIMULATION OF PARALLEL RESONANCE CIRCUIT.

13.9 AIM:

To plot the magnitude of current for various frequencies for the given RLC parallel circuit.

13.10 SOFTWARE REQUIRED:

S. No	SOFTWARE USED	DESK TOP QUANTITY
1	MATLAB	36

13.11 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

$Z = R + j\,(X_L – X_C)$

Where $X_L = \omega L$

$X_C = 1/\omega C$

At resonance, $X_L = X_C$ 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.

13.12 PROCEDURE:

1. Open a new MATLAB/SIMULINK model.
2. Connect the circuit as shown in the figure 13.3.
3. Simulate the circuit.
4. By double clicking the powergui, plot the value of current for the different values of frequencies.

13.13 SIMULATION DIAGRAM FOR PARALLEL RESONANCE:

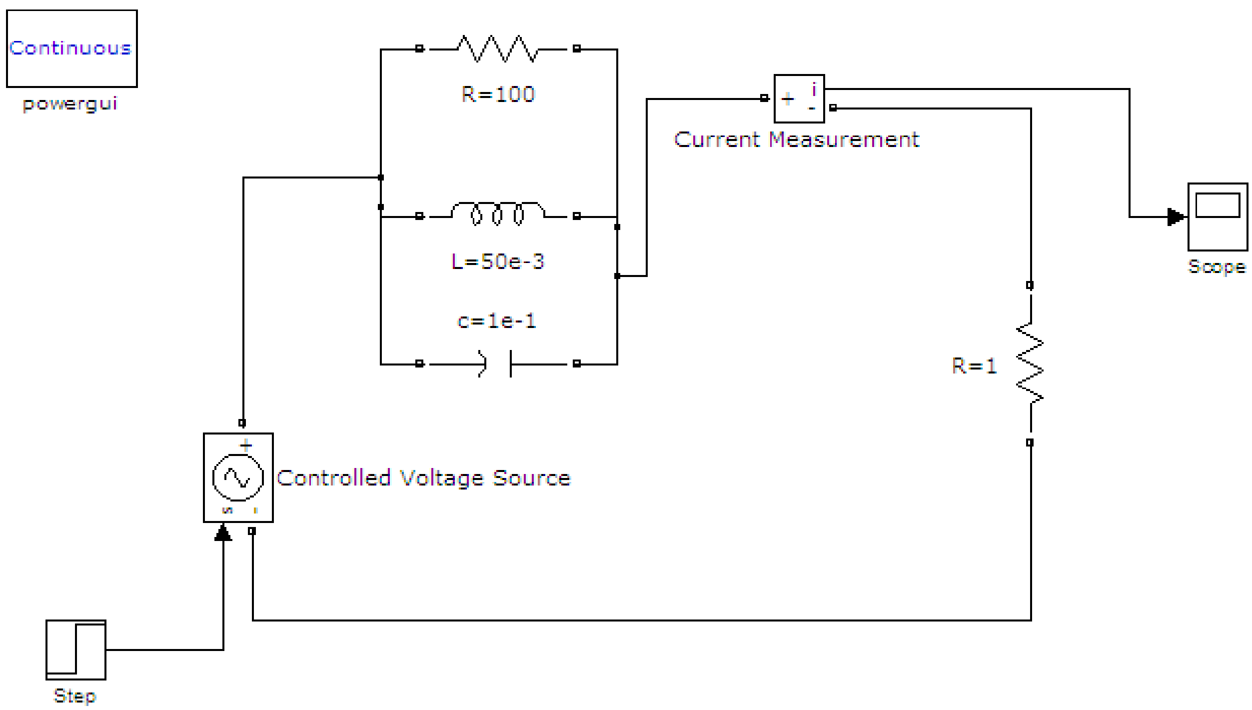
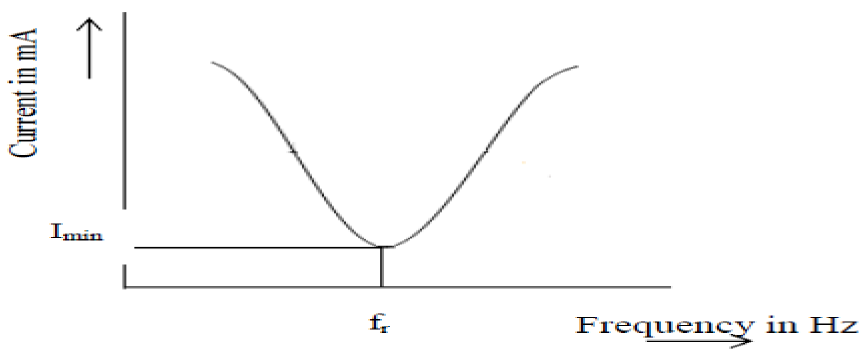


Fig – 13.3 Parallel Resonance

13.14 MODEL GRAPH FOR PARALLEL RESONANCE



To obtain the graphs of frequency vs. BL , frequency vs. BC , frequency vs. admittance and frequency vs. current vary frequency in steps for the given circuit and find the resonant frequency and check by theoretical calculations.

R = 1000W, C = 400 m F, L = 1 H, V = 50V vary frequency in steps of 1 Hz using Matlab.

13.15 PROGRAM TO FIND THE PARALLEL 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=0:2:50;
xl=2*pi*f*l;
xc=(1./(2*pi*f*c));
b1=1./xl;
bc=1./xc;
b=b1-bc;
g=1/r;
y=sqrt((g^2)+(b.^2));
i=v*y;
%plotting the graph
subplot(2,2,1);
plot(f,b1);
grid;
xlabel('frequency');
ylabel('B1');
subplot(2,2,2);
plot(f,bc);
grid;
xlabel('frequency');
ylabel('Bc');
subplot(2,2,3);
plot(f,y);
grid;
xlabel('frequency');
ylabel('Y');
subplot(2,2,4);
plot(f,i);
```

```
grid;
xlabel('frequency');
ylabel('I');
```

13.16 PRE LAB VIVA QUESTIONS:

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

13.17 LAB ASSIGNMENT:

1. Give the expression for band width.
2. Give the application of parallel resonance circuit.

13.18 POST LAB VIVA QUESTIONS:

1. What is the difference between series and parallel resonance?
2. What do you observe from the parallel resonance graphs?

EXPERIMENT – 14 (A)

STUDY OF EARTHING

14. A.1 AIM:

To study about earthing and its types.

14. A.2 THEORY:

Earthing / Grounding:

Earthing or grounding is the term used for electrical connection to the general mass of earth. Equipment or a system is said to be earthed when it is effectively connected to the ground with a conducting object. Earthing provides protection to personal and equipment by ensuring operation of the protective gear and isolation of faulty circuit during-

- Insulation failure
- Accidental contact
- Lightning strike

Earthing is necessary for proper functioning of certain equipments. Earthing is done also for preventing the operating personal from hazardous shocks caused by the damage of the heating appliances.

Need of Good Earthing:

1. To save human life from danger of electrical shock or death by blowing a fuse i.e. to provide an alternative path for the fault current to flow so that it will not endanger the user.
2. To protect buildings, machinery & appliances under fault conditions i.e. To ensure that all exposed conductive parts do not reach a dangerous potential.
3. To provide safe path to dissipate lighting and short circuit currents.
4. To provide stable platform for operation of sensitive electronic equipments i.e. to maintain the voltage at any part of an electrical system at a know value so as to prevent over current or excessive voltage on the appliances or equipment.
5. To provide protection against static electricity from friction.

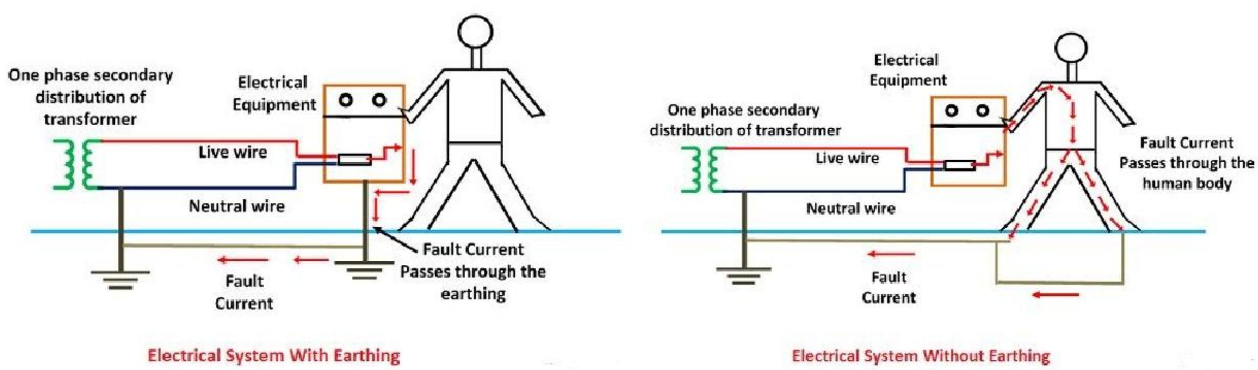


Fig – A.14.1 With and without earthing

Types of Earthing:

There are various ways of doing Earthing:

1. Conventional Earthing
    a. Pipe Earthing
    b. GI Plat Earthing
    c. Cast Iron plat Earthing
    d. Copper plat Earthing
2. Maintenance Free Earthing

Conventional Earthing:

The Conventional system of earthing calls for digging of a large pit into which a GI pipe or a copper plate is positioned amidst layers of carcoal and salt. It is cumbersome to install only one or two pits in a day.

The Conventional system of GI pipe Earthing or copper plate Eathing requires maintenance and pouring of water at regular interval.

Maintenance free earthing:

It is a new type of earthing system which is ready made, standardized, and scientifically developed.

Advantages of Maintenance Free Earthing:

1. Maintenance Free: No need to pour water at regular interval-except in study soil.
2. Consistency: Maintain stable and consistent earth resistance around the year.
3. More Surface Area: The conductive compound creates a conductive zone, which provides the increased surface area for peak current dissipation. And also get stable reference point.
4. Low earth resistance. Highly conductive. Carries high peak current repeatedly.
5. No corrosion. Eco Friendly.
6. Long Life.
7. Easy Installation.

Pipe Earthing:

Pipe earthing is done by permanently placing a pipe in wet ground. The pipe can be made of steel, galvanized iron or cast iron. Usually GI pipes having a length of 2.5m and an internal diameter of 38mm are used. The pipe should into be painted or coated with any non-conducting material.

The figure shows an illustration of a typical pipe electrode. The pipe should be placed at least 1.25m below the ground level and it should be surrounded by alternate layers of charcoal and salt for a distance of around 15cm. This is to maintain the moisture level and to obtain electrode and it should be carried in a GI pipe at a depth of 60cm below the ground level. A funnel with a wire mech should be provided to pour water into the sump. Three or four bucket of water should be poured in a few days particularly during summer season. This is to keep the surroundings of the electrode permanently moist.

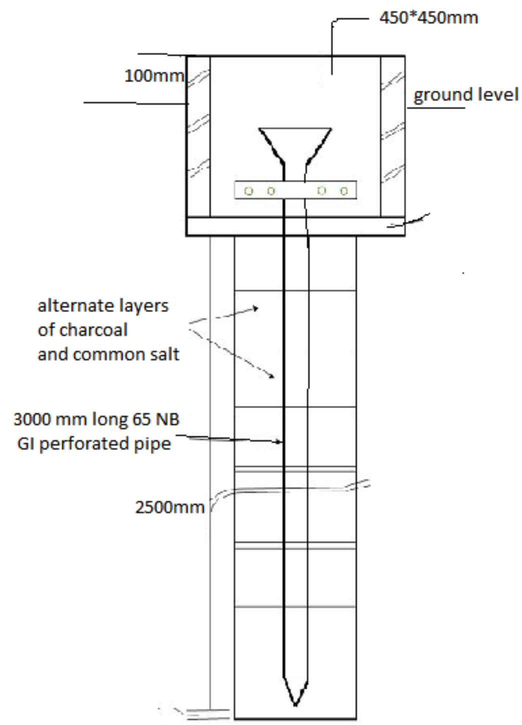


Figure – A.14.2 Pipe Earthing

Plate earthing:

A typical illustration of plate earthing is shown in figure. The plate electrode should have a minimum dimension of 600 x 600 x 3.15mm for copper plate or 600 x 600 x 6.3mm for GI plates. The plate electrode should be placed 1.5m below the ground level. Bolts and nuts should be of the same material as that of the plate by means of bolts and nuts. The bolts and nuts should be of the same material as that of the plate. The earth conductor should be carried in a GI pipe buried 60 cm below the ground level. The plate electrode should be surrounded by a layer of charcoal to reduce the earth resistance. A separate GI pipe with funnel and wire mesh attached is provided to pour water into the sump.

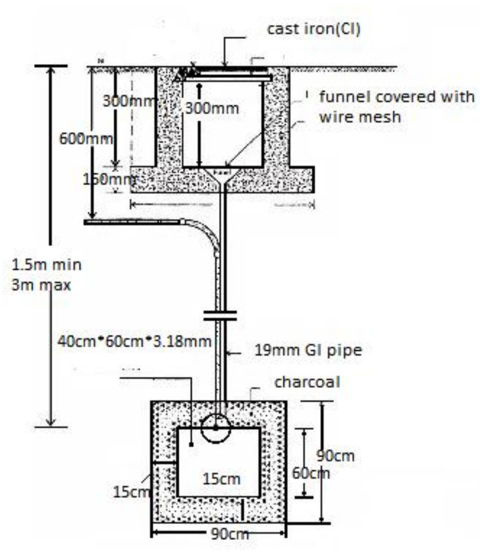


Figure: A.14.3Plate earthing

14. A.3 RESULT:

14. A.4 PRELABVIVA QUESTIONS

1. What is meant by earthing?
2. Mention the types of earthing?
3. On what factor the size of ground wire depends?
4. What is the purpose of providing grounding to the circuit?
5. What are the components of earthing system?

14. A.5 POSTLAB VIVA QUESTIONS

1. What are various types of earthing used?
2. What is difference between grounding and earthing?
3. What is specification of GI earth plate?
4. What are the materials used for earthing?
5. What are the dangers of not earthing a supply system?

EXPERIMENT – 14 (B)

MEASURMENT OF EARTH RESISTANCE AND EARTH POTENTIAL

14. B.1 AIM:

To measure the earth resistance using megger earth tester.

14.B.2 APPARATUS:

S. No	Equipment	Range	Quantity
1	Megger earth tester – 1	(0-100)Ω	Hammer – 1
5	Connecting wires	-	-

14. B.3 THEORY:

The megger is a portable instrument used to measure insulation resistance. The megger consists of a hand-driven DC generator and a direct reading ohm meter. The moving element of the ohm meter consists of two coils, A and B, which are rigidly mounted to a pivoted central shaft and are free to rotate over a C-shaped core. These coils are connected by means of flexible leads. The moving element may point in any meter position when the generator is not in operation. As current provided by the hand-driven generator flows through Coil B, the coil will tend to set itself at right angles to the field of the permanent magnet. With the test terminals open, giving an infinite resistance, no current flows in Coil A. Thereby, Coil B will govern the motion of the rotating element, causing it to move to the extreme counter-clockwise position, which is marked as infinite resistance. Coil A is wound in a manner to produce a clockwise torque on the moving element. With the terminal marked "line" and "earth" shorted, giving a zero resistance, the current flow through the Coil A is sufficient to produce enough torque to overcome the torque of Coil B. The pointer then protects Coil A from excessive current flow in this condition.

When an unknown resistance is connected across the test terminals, line and earth, the opposing torques of Coils A and B balance each other so that the instrument pointer comes to rest at some point on the scale. The scale is calibrated such that the pointer directly indicates the value of resistance being measured.

14. B.4 CIRCUIT DIAGRAM:

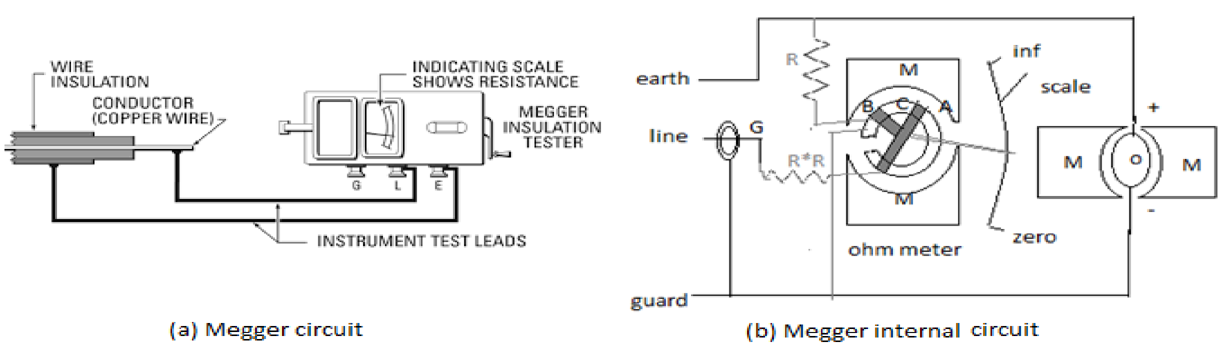


Figure: B.14.1 Megger Circuit

14. B.5 PROCEDURE:

1. Connection are given as per the circuit diagram
2. Connect together the terminals PI and CI by closing the switch provided and connect them to the electrode or metal structure to be tested.
3. Keep the lead used for this connection as short as possible, as its resistance is included in the measurement.
4. Connect terminals marked P2 and C2 to two temporary earth spikes driven into the ground.
5. Rotate the handle provided in the megger at about 160 rpm.
6. Measure the resistance of the electrode under test.
7. Repeat the test by placing the electrodes at different spacing.

14. B.6 TABULAR COLUMN:

S. No	Distance between two earth electrodes	Resistance (ohms)

14. B.7 RESULT:

14. B.8 PRELAB VIVA QUESTIONS:

1. What is difference between megger and earth tester?
2. What are the types of megger?
3. What is megger?
4. Explain the working of megger.
5. Explain the use of megger.

14. B.9 POSTLAB VIVA QUESTIONS:

1. What is the normal value of earth resistance?
2. What is the resistance of human body?
3. How much current or voltage can a normal human withstand?
4. How the earth electrode is made up of?
5. How can we minimize the earth resistance?