A Laboratory Manual

for

Basic Electrical and Electronics

(312020)

Semester - III

“K-SCHEME”

(Diploma in Mechanical Engineering)
(AE/ AL/ CH/ ME/ PG/ PO)

Prepared by

Bharati Vidyapeeth's Institute of Technology, Navi Mumbai

‘K’ Scheme Curriculum

Certificate

This is to certify that Mr. / Ms. ………………………………………………… Roll No………….. of Third Semester of Diploma in ………………….. ………………………………………………………………………. of Institute …………………………………………………………………………………… (Code……………….) has completed the term work satisfactorily in course **Basic Electrical and Electronics (312020)** for the academic year 20……….to 20…..... as prescribed in the curriculum.

Place : .... Enrollment No : ....

Date : .... Exam. Seat No : ....

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome- based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practical to ***focus*** on the ***outcomes,*** rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

In today's world most of the consumer appliances are based on electronic circuits and devices. The foundation for working of computer or any of its peripherals are based on electronics. This course has been designed to develop skills to understand and test simple electronic components and circuits. After studying this course students will develop an insight to identify, build and troubleshoot simple electronic circuits.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Programme Outcomes (POs) to be achieved through Practical of this Course

PO1	**Basic and Discipline specific knowledge :** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
PO2	**Problem analysis :** Identify and analyses well-defined engineering problems using codified standard methods.
PO3	**Design/ development of solutions :** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
PO4	**Engineering Tools, Experimentation and Testing :** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
PO5	**Engineering practices for society, sustainability, and environment :** Apply appropriate technology in context of society, sustainability, environment, and ethical practices.
PO6	**Project Management :** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
PO7	**Life-long learning :** Ability to analyses individual needs and engage in updating in the context of technological changes.

Practical Course Outcome Matrix

Sr. No.	Title of the Experiment	CO1	CO2	CO3	CO4
1.	*Voltage and Current measurement	✓	–	–	–
2.	*Power measurement of single phase circuit	✓	–	–	–
3.	Energy measurement	✓	–	–	–
4.	AC signal parameters	✓	–	–	–
5.	* Line and Phase voltage measurement of star - delta connection circuit	✓	–	–	–
6.	*Battery Testing	✓	–	–	–
7.	* Input and output quantities of Single phase transformer	–	✓	–	–
8.	Continuity test of transformer primary and secondary windings	–	✓	–	–
9.	Auto transformer	–	✓	–	–
10.	* Single phase induction motor	–	✓	–	–
11.	* Electrical wire specifications	–	✓	–	–
12.	* Electrical Swichboard assembly	–	✓	–	–
13.	* Passive electronic components	–	–	✓	–
14.	* Resistors in series and parallel connections	–	–	✓	–
15.	* LCR-Q meter	–	–	✓	–
16	* Active electronic components	–	–	✓	–
17	* P N Junction diode	–	–	–	✓
18	* Seven- segment display	–	–	–	✓
19	Built/ Test Half Wave Rectifier	–	–	–	✓
20	Bridge Rectifier	–	–	–	✓
21	Testing of NPN transistor.	–	–	–	✓
22	* Soldering and De soldering	–	–	–	✓
23	Zener diode	–	–	–	✓
24	* Three terminal voltage regulators	–	–	–	✓

'' Marked Practical (LLOs) Are mandatory.*

Guidelines to Teachers

The experiments are developed such that the major practical learning outcomes are achieved. Each experiment is designed to achieve the course outcomes mentioned in the curriculum.

1. For incidental writing on the day of each practical session every student should maintain a dated log book for the whole semester, apart from this laboratory manual which s/he has to submit for assessment to the teacher in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters which is not mentioned in the printed practical.
3. For difficult practical, if required, teacher could provide the demonstration of the practical emphasizing the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. Teacher shall ensure that required equipments are in working condition before start of experiment.
7. Explain the prerequisite concepts before start of experiment.
8. Teacher shall assess the performance of the students continuously as per the norms of MSBTE.
9. Teacher may provide additional knowledge and skills to the students that are not included in the manual but are expected from students by the industries.
10. Teacher may suggest additional related literature of technical papers/ Reference books.
11. During assessment the teacher is expected to ask questions to the students to ensure that the learning outcomes are satisfied.
12. The assessment of experiments should be on a regular basis.

Instructions for Students

1. Listen carefully to all the information regarding curriculum, its course outcomes, and major learning outcomes, equipments and instruments in the laboratory, method of assessment.
2. Read the write-up of each experiment to be performed, a day in advance
3. Organize the work in group and record all the observation.
4. Understand the practical implication of the experiments.
5. Students should not hesitate to ask any question while performing the experiment.
6. Students should develop troubleshooting and maintenance skills
7. Students should develop the habit of discussion about experiments that is performed to enhance the understanding and sharing of knowledge.
8. Students to attend the practical class regularly and complete the laboratory work during the stipulated hours and submit the manuals for assessment regularly.
9. Students shall refer to technical magazines, refer websites, proceedings of seminars, related to scope of the course and enhance the knowledge and skills.
10. Student should develop self-learning methods.

Contents Page

List of Practical's and Progressive Assessment Sheet

Practical No. 1 : Voltage and Current Measurement

(I) Title : Measure voltage and current in single phase AC circuit with resistive load.

(II) Aim

(i) To measure the voltage, current in a single phase AC circuit with resistive load.
(ii) To have the concept of unity power factor (UPF) load.
(iii) To understand the working of a wattmeter as a power measuring device.

(III) Course Level Learning Outcome (COs)

CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.

(IV) Theory

(a) Voltage : Voltage, also called electromotive force, is a quantitative expression of the potential difference in charge between two points in an electrical field. It's unit is volt.

(b) Current : Electric Current is the rate of flow of electrons in a conductor. The SI Unit of electric current is the Ampere.

(c) Variac or Variable Autotransformer : Variable autotransformers provide variable AC supply from a constant AC source. Popularly known as variac, it is commonly used in schools and colleges. Apart from this, they're commonly used for matching impedance in an audio system where they attach speakers to a regulated supply of voltage. Variacs can best be described as tapped inductors, where the "tap" is a conductive slider that moves along the length of the inductor. The inductor is shaped like a doughnut (toroid) with wire wrapped radially through the center hole and around the toroid. Unlike a transformer with isolated input and output windings, variacs have a single winding that serves as both the input and output source. The slider is an arm equipped with a carbon contact that rotates on an axle located at the axis of the toroid (i.e. through the doughnut hole). The enamel insulation of the winding wire is removed where the carbon contact touches the winding, so that the contact forms a circuit through part of the winding, just like the carbon brush of an electric motor forms a circuit through the commutator and through the armature winding. Just like a potentiometer, variacs divide voltage by dividing the impedance between the inputs into two parts. The fraction of the divided input impedance connected to the output determines the output voltage. While a potentiometer uses a resistance as the divided impedance, the variac instead uses an inductance. This provides much higher efficiency than a resistance, eliminating the power lost in heating the resistance. Using a variac, almost all of the power consumed is delivered to the load connected to the output. Of course, there is some heating due to the resistance of the winding wire, and the magnetic coupling between the input and output is far from perfect, but still an inductive voltage divider is much more efficient than a resistive voltage divider.

(d) Resistive Load : An electrical load that consumes electrical energy and convert it into thermal or heat and light energy form is known as Resistive load. As the name suggests Resistive load resist the flow of current through it due to its large resistance and hence convert that Electrical energy into heat or light energy.

Examples of Resistive load : Incandescent bulb, Electric heater, Electric iron and any electrical load that consists only heating elements, etc..

Properties of Resistive Load

- It consumes only Active power.
- In pure Resistive load, current and voltage waveform become exactly in phase with each other. So the phase difference between voltage and current will be zero.
- Hence power factor of pure resistive load become unity (1).
- In case of Resistive load, Power always flows from source to load.

(V) Circuit Diagram

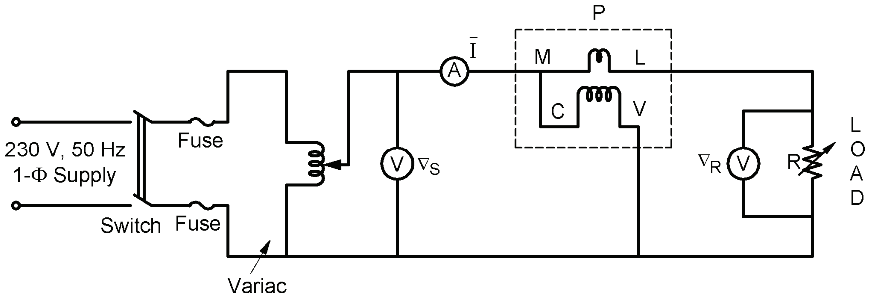

Fig. 1.1

(VI) Phasor Diagram

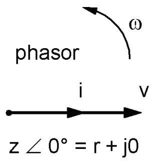

Fig. 1.2

(VII) Procedure

(i) Make the connection as per circuit diagram.
(ii) Put on the power supply.
(iii) Set the variac voltage.
(iv) Switch on the resistive load.
(v) Take the reading of voltmeter and ammeter.
(vi) Now reset the variac voltage to 0 V.
(vii) Put off the load and power supply.

(VIII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			
5			
6			
7			
8			

(IX) Actual Procedure followed

(X) Results

Sr. No.	Voltage(V)	Current(I)	Resistance (Ω)

Calculation

(XI) Precautions and Discussions

(i) We should not touch any of the electrical devices while doing the experiment.

(ii) Variac voltage must be taken down to 0V after doing the experiment otherwise chances of getting electric shock will be increased.

(iii) Reading must be taken without parallax error.

(XII) Interpretation of Results (Giving meaning to the results)

(XIII) Conclusions (Actions to be taken based on the interpretations)

(XIV) Practical Related Questions (Provide space for answers)

(1) Draw circuit diagram, phasor diagram and waveform for single phase circuit with resistive load.

(2) Write equation for voltage and current

[Space for Answers]

(XV) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XVI) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	**40%**
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 2 : Power Measurement of Single Phase Circuit

(I) Title : Measure power in single phase AC circuit with resistive load.

(II) Aim

(i) To measure the power in a single phase AC circuit with resistive load.

(ii) To have the concept of unity power factor (UPF) load.

(iii) To understand the working of a wattmeter as a power measuring device.

(III) Course Level Learning Outcome (COs)

CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.

(IV) Theory

(a) Voltage : Voltage, also called electromotive force, is a quantitative expression of the potential difference in charge between two points in an electrical field. It’s unit is volt.

(b) Current : Electric Current is the rate of flow of electrons in a conductor. The SI Unit of electric current is the Ampere.

(c) Power : Electric power is the rate at which work is done or energy is transformed into an electrical circuit. The active power is that amount of the total electric power in an AC electric circuit which actually consumed or utilized. It is also called as true power or real power. The active power is measured in Watts (W)

(d) Power Factor : It is the ratio of the actual electrical power dissipated by an AC circuit to the product of the r.m.s. values of current and voltage. Power factor is defined as the cosine of the angle between voltage and current. Power factor is the measure of how effectively the incoming power is used in an electrical system. A high power factor indicates that the power supplied to the electrical system is effectively used. A system with low power factor doesn’t effectively consume the incoming electric supply and results in losses. There is no power factor involved in DC circuits due to zero frequency. But, in AC circuits, the value of power factor always lies between 0 and 1.

(e) Multiplying Factor : The multiplication factor in a wattmeter is the ratio of the power measured to the product of the current and voltage applied to the circuit. It is typically expressed as a dimensionless number, and is used to convert the measured electrical power in watts to the actual power being consumed or generated by the circuit. The multiplication factor is determined by the design and calibration of the wattmeter and can vary depending on the type and range of the meter. Multiplication factor for a wattmeter is that parameter by virtue of which you can use small scaled wattmeter to get the power readings upto Multiplication factor times(multiplied) the smallest scale possible for the given wattmeter. It allows you to measure power upto 4–6 times the power a wattmeter can measure for the smallest scale.

(f) Variac or Variable Autotransformer : Variable autotransformers provide variable AC supply from a constant AC source. Popularly known as variac, it is commonly used in schools and colleges. Apart from this, they're commonly used for matching impedance in an audio system where they attach speakers to a regulated supply of voltage. Variacs can best be described as tapped inductors, where the "tap" is a conductive slider that moves along the length of the inductor. The inductor is shaped like a doughnut (toroid) with wire wrapped radially through the center hole and around the toroid. Unlike a transformer with isolated input and output windings, variacs have a single winding that serves as both the input and output source. The slider is an arm equipped with a carbon contact that rotates on an axle located at the axis of the toroid (i.e. through the doughnut hole). The enamel insulation of the winding wire is removed where the carbon contact touches the winding, so that the contact forms a circuit through part of the winding, just like the carbon brush of an electric motor forms a circuit through the commutator and through the armature winding. Just like a potentiometer, variacs divide voltage by dividing the impedance between the inputs into two parts. The fraction of the divided input impedance connected to the output determines the output voltage. While a potentiometer uses a resistance as the divided impedance, the variac instead uses an inductance. This provides much higher efficiency than a resistance, eliminating the power lost in heating the resistance. Using a variac, almost all of the power consumed is delivered to the load connected to the output. Of course, there is some heating due to the resistance of the winding wire, and the magnetic coupling between the input and output is far from perfect, but still an inductive voltage divider is much more efficient than a resistive voltage divider.

(g) **Resistive Load :** An electrical load that consumes electrical energy and convert it into thermal or heat and light energy form is known as Resistive load. As the name suggests Resistive load resist the flow of current through it due to its large resistance and hence convert that Electrical energy into heat or light energy.

Examples of Resistive load : Incandescent bulb, Electric heater, Electric iron and any electrical load that consists only heating elements, etc.

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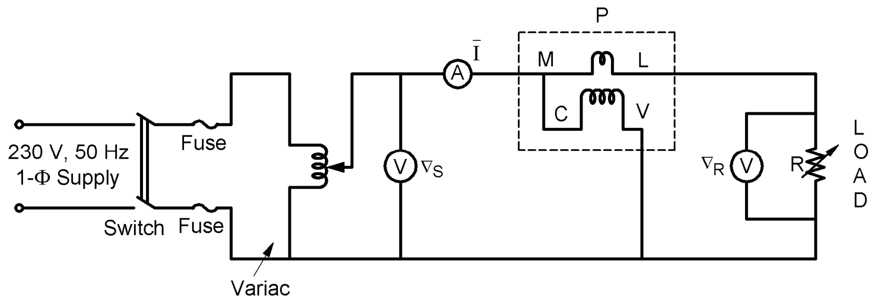
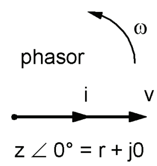
- In case of Resistive load, Power always flows from source to load.

(V) Circuit Diagram



Phasor Diagram :



(VI) Procedure

(i) Make the connection as per circuit diagram.

(ii) Put on the power supply.

(iii) Set the variac voltage.

(iv) Switch on the resistive load.

(v) Take the reading of voltmeter, ammeter and wattmeter.

(vi) Now reset the variac voltage to 0V.

(vii) Put off the load and power supply.

(VII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			
5			
6			
7			
8			

(VIII) Actual Procedure followed

(IX) Results

Sr. No.	Supply voltage (V)	Current (A)	Power (W)	Resistance (Ω)	Power Factor (cos ϕ)	Phase Angle (ϕ)

Calculation

(X) Precautions and Discussions

(i) We should not touch any of the electrical devices while doing the experiment.

(ii) Variac voltage must be taken down to 0V after doing the experiment otherwise chances of getting electric shock will be increased.

(iii) Reading must be taken without parallax error.

(XI) Interpretation of Results (Giving meaning to the results)

(XII) Conclusions (Actions to be taken based on the interpretations)

(XIII) Practical Related Questions (Provide space for answers)

(1) Define power for purely resistive circuit.

(2) Write equation for voltage, current and power.

[Space for Answers]

(XIV) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XV) Assessment Scheme

	Performance Indicators	Weightage
	Process related (15 Marks)	**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 3 : Energy Measurement

(I) Aim : Measure Energy consumed by given equipment using energy meter.

(II) Course Level Learning Outcome (COs)

CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.

(III) Theory

In the energy meter, current coil carries current proportional to the load current. Where as the pressure coil carries current proportional to supply voltage.

Average deflecting torque e(Td) ∝ Average Power

$$Td \propto VI \cos \phi$$

$$Td = K_1 VI \cos\phi \qquad \ldots(i)$$

consider the resistive load, then Cosϕ = 1

The breaking torque(T_b) is proportional to the disc speed N

then,

$$Tb \propto N$$

$$Tb = K_2 N \qquad \ldots(ii)$$

The disc achieves steady speed N, when Breaking torque (T_b) is equal to the deflecting torque (T_d) thus, from equation (i) and (ii)

$$K_2 N = K_1 VI \cos\phi$$

Multiplying both side by time t, then

$K_2Nt = K_1VI \cos\phi t$ since the product N*t represents the number of revolution of the disc in time t and the product P*t represents the energy passing through the meter in time t. Therefore, the number of revolution of the disc is proportional to the energy passing through the meter.

(IV) Resources Required

Sr. No.	Name	Specification	Quantity
1	Energy Meter	Analog, 230V, (5-10)A, 50Hz, 1200r/Kw-h	1 Nos.
2	Stop Watch	Digital Type	1 Nos.
3	Load Unit	Resistive Type.	1 KW.
4	Connecting Wires	PVC Insulated Copper	As per requirement
5	Wattmeter	(0-400)W, (5A/10A), UPF	1 Nos.

(V) Procedure

(i) Connect all the instruments as per circuit diagram.

(ii) Make sure i.e all instruments are showing zero error.

(iii) Start the power supply and start the stop watch simultaneously.

(iv) Note down the energy meter reading and calculate theoretical energy from the readings shown in wattmeter.

(v) Calculate the percentage of error.

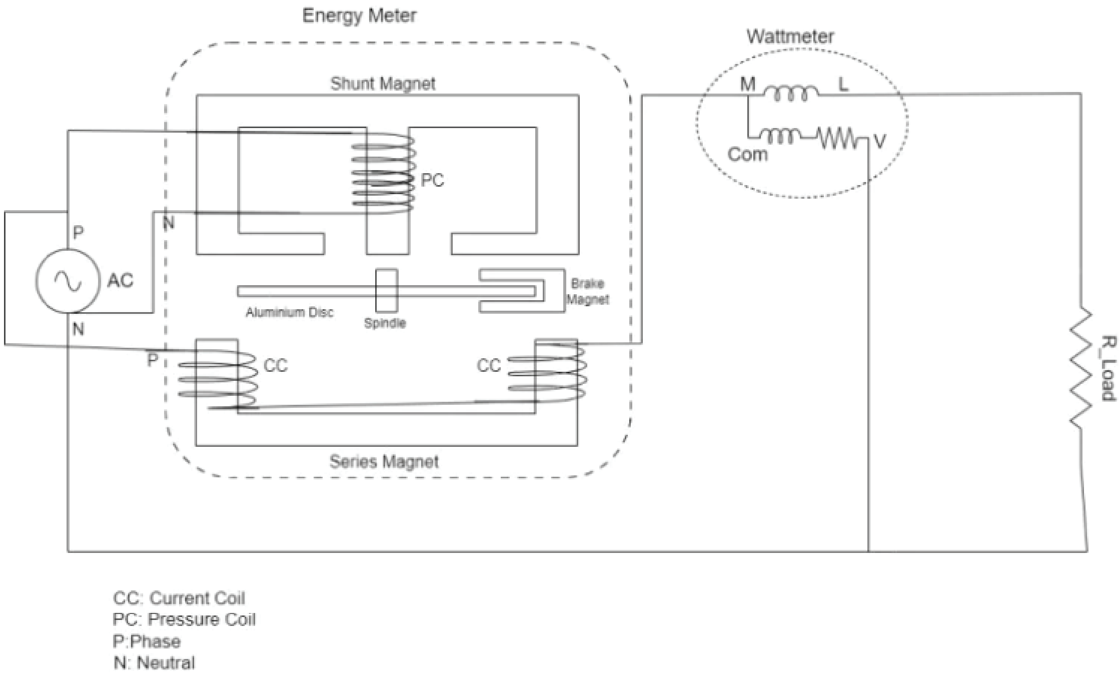
(VI) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
3			
4			
5			
6			
7			
8			

(VII)Actual Procedure followed

(VIII) Circuit diagram



(IX) Observation Table

Sl. No.	Power in Watts	Time observed in consuming 0.1 units energy (in Hour) (a)	Previous reading of energy meters (b)	Successive reading of energy meters (c)	Difference reading of energy meters d=(c-b)	Wattmeter reading(in Kw) (e)	Theoretical Energy (in Kwh) (f=a*e)	% Error [(d-f)/d]*100
1								
2								
3								
4								
5								
6								
7								

(X) Precautions and Discussions

(i) We should not touch any of the electrical devices while doing the experiment.

(ii) Variac voltage must be taken down to 0V after doing the experiment otherwise chances of getting electric shock will be increased.

(iii) Reading must be taken without parallax error.

(XI) Interpretation of Results (Giving meaning to the results)

(XII) Conclusions (Actions to be taken based on the interpretations)

(XIII) Practical Related Questions (Provide space for answers)

(1) What is the most common type of single phase energy meter?

(2) What is the purpose of an electricity meter?

(3) What is the standard frequency of a single phase power system?

[Space for Answers]

(XIV) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XV) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
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4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 4 : AC Signal Parameters

(I) Aim

Measure average value, peak value and RMS value of AC waveform using CRO./ DSO LLO 4.2 Measure time and frequency of AC waveform using CRO./ DSO

(II) Industry/Employer Expected Outcome(s)

- Use electrical equipment efficiently for different electronic engineering application.
- Use single phase AC supply for Electrical and electronic equipments.

(III) Course Level Learning Outcome (COs)

CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.

(IV) Laboratory Learning Outcome(s)

LLO 4.1 Measure average value, peak value and RMS value of AC waveform using CRO./ DSO

LLO 4.2 Measure time and frequency of AC waveform using CRO./ DSO

(V) Relevant Affective Domain Related Outcome(s)

Follow safety electrical rules for safe practices.

(VI) Relevant Theoretical Background

Waveform : The shape of the curve obtained by plotting the instantaneous values of voltage or current as ordinate against time is called its waveform.

Time period (T) : The time taken in seconds to complete one cycle of an alternating quantity is called its time period. It is generally represented by *T*. Unit of time period is seconds.

$$T = \frac{1}{f}$$

Frequency (F): The number of cycles that occur in one second is called the frequency (*f*) of the alternating quantity.

$$F = \frac{1}{T}$$

Amplitude : The maximum value (positive or negative) attained by an alternating quantity is called its amplitude or peak value. The amplitude of an alternating voltage or current is designated by ***Vm*** or ***Im*** respectively.

Average Value : The average value of a alternating quantity is equal to the average of all its instantaneous values over a period of time.

$$V_{avg} = 0.637 \times V_{max}$$

Peak Value : It is the maximum value attained by an alternating quantity. The peak or maximum value of an alternating voltage or current is represented by V_m or I_m.

R.M.S Value : The effective or R.M.S. value of an alternating current is that steady current (d.c.) which when flowing through a given resistance for a given time produces the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time.

$$V_{rms} = 0.707 \times V_{max}$$

(VII) Actual Circuit Diagram used in Laboratory with Equipment Specifications

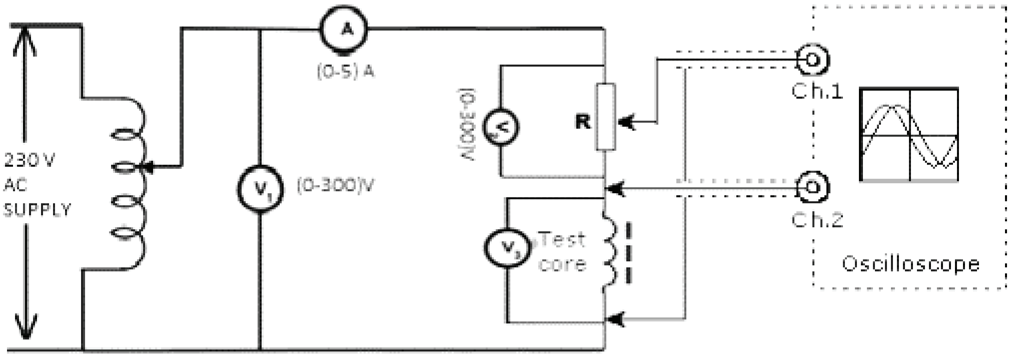


Fig. 4.1

(VIII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Rheostat	Suitable Rheostat	1
2	Inductor	Suitable Inductor	1
3	Voltmeter	Suitable Voltmeter	1
4	Ammeter	Suitable Ammeter	1
5	CRO	With 2 attenuator probes	1

(IX) Precautions to be followed

(1) All electrical connections should be neat and tight.
(2) Check the power supply before connection.
(3) Connect ammeter in series.
(4) Connect voltmeter in parallel.
(5) Do not give high voltage to CRO.

(X) Procedure

(1) Connect the circuit as per circuit diagram.
(2) Connect the CRO for observing current and voltage waveform.
(3) Repeat step 2 for different input voltages.

(XI) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			
5			
6			
7			
8			

(XII) Actual Procedure followed

(XIII) Observations

(1) Time period of AC waveform (T) = ……………….. division ,

(2) Time per division = ………………..

(3) Peak value of ac waveform = ……………….. Division

(4) Volt per division = ………………..

(5) Average value of ac waveform = ……………….. Division

Calculations

(1) Time period of ac waveform (T) = ……………….. division × …………….. Time per division = ……….. Seconds

(2) Frequency …………………………… Hertz

(3) Peak value of ac waveform = …………… division × ………… volt per division = …………… volts.

(4) R.M.S. value of ac waveform = Peak value × 0.707 = …………… Volts

(5) Average value of ac waveform = Peak value × 0.637 = …………… Volts

(XIV) Results

(1) Time period …………………………… seconds

(2) Frequency …………………………… Hertz

(3) Peak value : …………………………… volts

(4) R.M.S. value : …………………………… volts

(5) Average value : …………………………… volts

(XV) Interpretation of Results (Giving meaning to the results)

(XVI) Conclusions (Actions to be taken based on the interpretations)

(XVII) Practical Related Questions (Provide space for answers)

Define waveform, instantaneous value, cycle, amplitude, time period, frequency, angular frequency, R.M.S. value, average value, peak value

[Space for Answers]

(XVIII) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XIX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 5 : Line and Phase Voltage Measurement of Star-delta Connection Circuit

(I) Aim : Make a star and delta connection to measure line and phase voltage.

(II) Course Level Learning Outcome (COs)

CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.

(III) Minimum Theoretical Background

Three-phase balanced networks are used in the power industry for reasons of economy and performance. Three-phase generators and motors run smoothly, with no torque pulsations, unlike single phase machines. In addition balanced three phase systems may be operated as three wire or four wire systems, with much less copper needed for the power delivered as compared with three single phase.

(IV) Circuit diagram

Star connected load

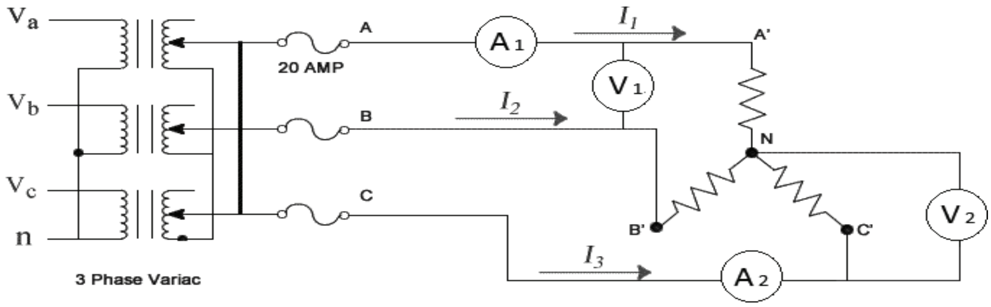


Fig. 5.1

Delta connected load

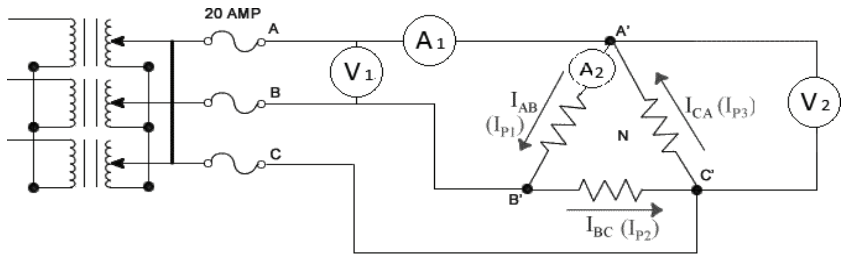


Fig. 5.2

(V) Resources Required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity	Remark
1	Three phase variac	Suitable three phase variac	1	
2	Three phase load	Suitable Three phase load	1	
3	Ammeter	Suitable ammeter	2	
4	Voltmeter	Suitable voltmeter	2	

(VI) Procedure

Star Connected load

(1) Connect thee three-phase star circuit as shown in figure.

(2) Switch on three phase supply and adjust dimmerstat to obtain required voltage at output.

(3) Measure line current (A_1), phase current (A_2), phase voltage (V_2), line voltage (V_1).

(4) Repeat 3 and 4 for different input voltages.

Delta Connected load

(1) Connect the three-phase Delta circuit as shown in figure.

(2) Switch on three phase supply and adjust dimmerstat to obtain required voltage at output.

(3) Measure line current (A_1), phase current (A_2), phase voltage (V_2), line voltage (V_1).

(4) Repeat 3 and 4 for different input voltages.

(VII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			
5			
6			
7			
8			

(VIII) Actual Procedure followed

(IX) Observation table

Star connected load

Sr. No.	Line voltage V_L	Phase voltage – V_{ph}	Ratio V_L/V_{ph}	Line current -I_L	Phase current-I_{ph}	Ratio I_L/I_{ph}
1.						
2.						
3.						
4.						

Delta connected load

Sr. No.	Line voltage V_L	Phase voltage – V_{ph}	Ratio V_L/V_{ph}	Line current -I_L	Phase current-I_{ph}	Ratio I_L/I_{ph}
1.						
2.						
3.						
4.						

(X) Interpretation of Results (Giving meaning to the results)

(XI) Conclusions (Actions to be taken based on the interpretations)

(XII) Practical Related Questions

Note : Below give are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

(1) State relation between line voltage and line current in star connection.
(2) Write relation for power drawn in three phase star connected load.
(3) State meaning of balanced load.
(4) State meaning of unbalanced load.
(5) Write value of neutral current and neutral voltage in balanced load.

[Space for Answers]

(XIII) References/Suggestions for further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XIV) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 6 : Battery Testing

(I) Aim : Test given battery using digital multimeter

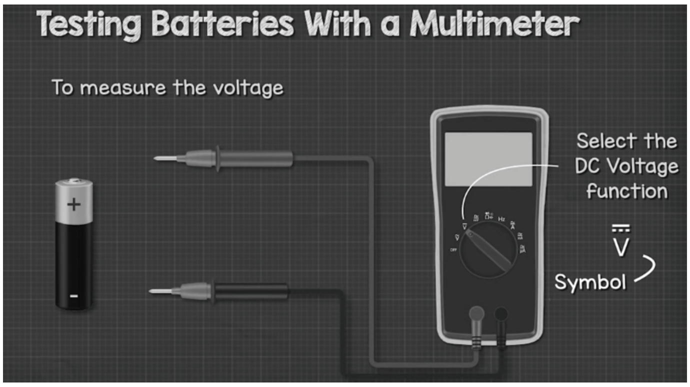
(II) Course Level Learning Outcome (COs)

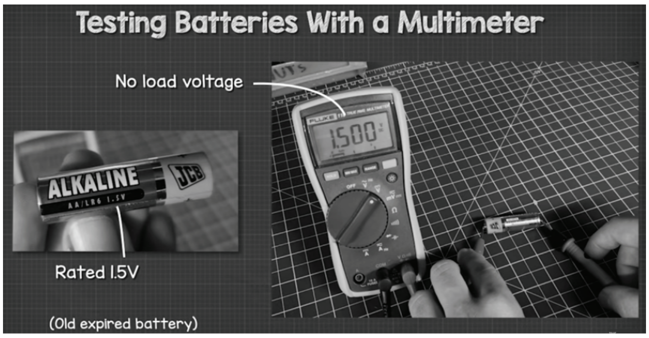
CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.

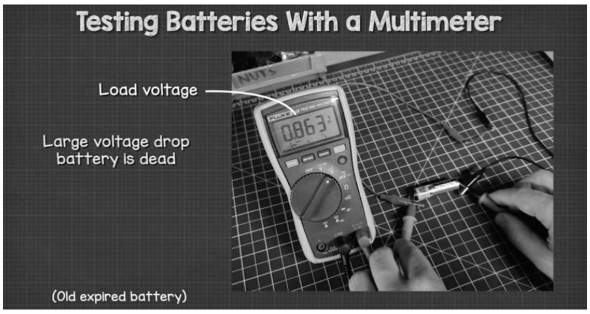
(III) Minimum Theoretical Background

Connect the red measurement probe (positive) of the multimeter to the positive terminal of the battery and the black measurement probe (negative) to the negative terminal of the battery. DC volts and use the voltage just above the voltage you would expect.

(IV) Circuit Diagram







(V) Resources Required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Digital Multimeter		1
2	Battery		1

(VI) Procedure

Using a 12V battery multimeter for measurement can be done following these steps :

(1) Preparation : Ensure that your multimeter is correctly set to voltage measurement mode and adjust the measurement range to the nearest range around 12V.

(2) Connect the battery : Connect the red measurement probe (positive) of the multimeter to the positive terminal of the battery and the black measurement probe (negative) to the negative terminal of the battery.

(3) Read the voltage : Observe the reading on the multimeter, which will display the battery voltage. Typically, a 12V battery should read around 13V when fully charged, as the voltage tends to be slightly higher when charging.

(4) **Disconnect :** After completing the measurement, first remove the black measurement probe from the negative terminal of the battery, then remove the red measurement probe from the positive terminal of the battery.

It's important to ensure correct polarity connection of the multimeter probes before measurement to avoid short circuits or other accidents. Also, if you're not familiar with the operation, it's advisable to read the user manual of the multimeter or consult a professional for more detailed guidance.

(VII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(VIII) Actual Procedure followed

(IX) Observation table

Sr. No.	Rated voltage	Measured voltage
1		
2		
3		

(X) Interpretation of Results (Giving meaning to the results)

(XI) Conclusions (Actions to be taken based on the interpretations)

(XII) Practical Related Questions

(1) How battery is connected to digital multimer during testing

[Space for Answers]

(XIII) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 7 : *Input and Output Quantities of Single Phase Transformer

(I) Aim : Connect Single phase transformer for measuring input and output quantities and Determine its turns ratio

(II) Practical Significance

A single phase Transformer is used for changing voltage levels in electronic circuits. Mostly electronic devices/ circuits are energized with DC supply. To lower the voltage level of AC supply voltage transformer is used and this lowered AC voltage level further rectified to DC supply. Voltage ratio of a transformer decides increasing or decreasing voltage level.

(III) Industry/Employer Expected Outcome(s)

Determine voltage and current ratio of single phase transformer.

(IV) Course Level Learning Outcome (COs)

CO2 - Use of Transformer and Electric motors for given applications.

(V) Laboratory Learning Outcome(s)

LLO 7.1 Connect Single phase transformer for measuring input and output quantities

LLO 7.2 Determine its turns ratio

(VI) Relevant Affective Domain Related Outcome(s)

Follow safety electrical rules for safe practices.

(VII) Relevant Theoretical Background

Voltage ratio : The voltage ratio of a transformer is equal to the ratio of primary voltage and secondary voltage

$$\text{Voltage ratio} = \frac{Vp}{Vs}$$

Where V_p = Primary voltage

V_s = secondary voltage

Current ratio : The current ratio of a transformer is equal to the ratio of secondary current and primary current

$$\text{Current ratio} = \frac{Is}{Ip}$$

Turns ratio : The voltage ratio of a transformer is equal to the ratio of primary voltage and secondary voltage

$$\text{Turns ratio} = \frac{Np}{Ns}$$

Where N_p = Primary turns

N_s = secondary turns

(VIII) Actual Circuit Diagram used in Laboratory with Equipment Specifications

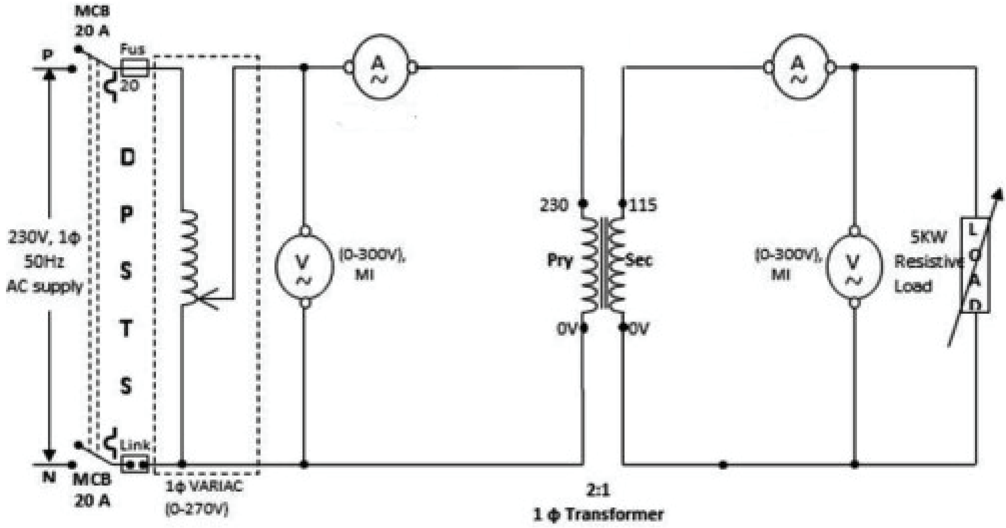


Fig. 7.1

(IX) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Ammeter	0-10 A AC	2
2	Voltmeter	0-300 V AC	2
3	Single Phase Transformer	1 kVA 230/115 V single phase transformer	1
4	Resistive load	Single phase 230V, 15 A Resistive load	1

(X) Precautions to be followed

(1) All electrical connections should be neat and tight.

(2) Check the power supply before connection.

(XI) Procedure

(1) Connect the circuit as per circuit diagram.

(2) Switch on power supply.

(3) Note down reading of ammeter and voltmeter.

(4) Calculate current and voltage ratio

(XII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(XIII) Actual Procedure followed

(XIV) Observations and Calculations

Sr. No.	Primary Voltage (Vp)	Secondary Voltage (Vs)	Primary Current (Ip)	Secondary Current (Is)	Voltage Ratio = (Vp/Vs)	Current Ratio = (Ip/Is)	Turns ratio =Np/Ns (calculated)
1							
2							
3							
4							

(XV) Results

Voltage Ratio is ……………………….. and current ratio is ……………………….. for given transformer

(XVI) Interpretation of Results

(XVII) Conclusions and Recommendations

(XVIII) Practical Related Questions (Provide space for answers)

(1) Define transformer.
(2) Define voltage ratio.
(3) Define current ratio and turns ratio.
(4) Define transformation ratio.
(5) State EMF equation of single phase transformer.
(6) Define step up and step down transformer.
(7) Give applications of step up and step down transformer.

Space for Answers]

(XIX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 8 : Continuity Test of Transformer Primary and Secondary Windings

(I) Aim : Test primary and secondary winding to measure continuity of transformer.

(II) Practical Significance

A single phase Transformer is used for changing voltage levels in electronic circuits. Mostly electronic devices/ circuits are energized with DC supply. To lower the voltage level of AC supply voltage transformer is used and this lowered AC voltage level further rectified to DC supply. Voltage ratio of a transformer decides increasing or decreasing voltage level.

(III) Industry/Employer Expected Outcome(s)

Test Continuity of transformer primary and secondary windings

(IV) Course Level Learning Outcome (COs)

CO2 - Use of Transformer and Electric motors for given applications.

(V) Laboratory Learning Outcome(s)

LLO Connect Single phase transformer for testing continuity

(VI) Relevant Affective Domain Related Outcome(s)

Follow safety electrical rules for safe practices.

(VII) Actual Circuit Diagram used in Laboratory with Equipment Specifications

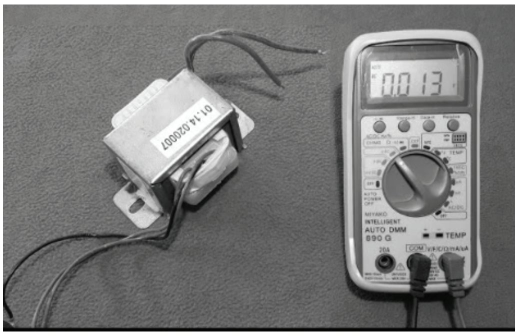


Fig. 6.1

(VIII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Multimeter	0-10 A AC	2
2	Single Phase Transformer	1 kVA 230/115 V single phase transformer	1

(IX) Precautions to be followed

(1) All electrical connections should be neat and tight.

(2) Check the power supply before connection.

(X) Procedure

(1) Set the multimeter to the "ohms" setting.

(2) Touch one lead of the multimeter to one end of the primary winding and touch the other lead of the multimeter to the other end of the primary winding.

(3) Check the reading on the multimeter. The resistance should be low, indicating that there is continuity between the two leads. If there is no continuity, then the transformer is faulty and should be replaced.

(4) Touch one lead of the multimeter to one end of the secondary winding and touch the other lead of the multimeter to the other end of the secondary winding.

(5) Check the reading on the multimeter. The resistance should be low, indicating that there is continuity between the two leads. If there is no continuity, then the transformer is faulty and should be replaced.

(XI) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(XII) Actual Procedure followed

(XIII) Observations

Sr. No.		Primary winding	Secondary winding
1	Continuity(Yes/No)		

(XIV) Results

Continuity Test :..................(Yes/No)

(XV) Interpretation of Results

(XVI) Conclusions and Recommendations

(XVII) Practical Related Questions (Provide space for answers)

(1) Is it necessary for a transformer to have continuity?

Space for Answers]

(VIII) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XIX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 9 : Auto Transformer

(I) Aim : Measure output voltage of auto transformer

(II) Practical Significance

A single phase Transformer is used for changing voltage levels in electronic circuits. Mostly electronic devices/ circuits are energized with DC supply. To lower the voltage level of AC supply voltage transformer is used and this lowered AC voltage level further rectified to DC supply. Voltage ratio of a transformer decides increasing or decreasing voltage level.

(III) Industry/Employer Expected Outcome(s)

Determine output voltage of Auto transformer

(IV) Course Level Learning Outcome(s)

CO2 - Use of Transformer and Electric motors for given applications.

(V) Laboratory Learning Outcome(s)

Measure output voltage of auto transformer

(VI) Relevant Affective Domain Related Outcome(s)

Follow safety electrical rules for safe practices.

(VII) Relevant Theoretical Background

There is a special type of transformer which physically has only one winding. Functionally, though, the one winding serves as both the primary and secondary. This type of transformer is called an autotransformer. When an autotransformer is used to step up the voltage, part of the single winding acts as the primary and the entire winding acts as the secondary. When an autotransformer is used to step down the voltage, the entire winding acts as the primary and part of the winding acts as the secondary

The action of the autotransformer is basically the same as the standard two-winding transformer. Power is transferred from the primary to the secondary by the changing magnetic field. The amount of step-up or step-down in voltage depends on the turns ratio between the primary and secondary, with each winding considered as separate, even though some turns are common to both the primary and secondary.

Voltage ratio : The voltage ratio of a transformer is equal to the ratio of primary voltage and secondary voltage

$$\text{Voltage ratio} = \frac{Vp}{Vs}$$

Where V_p = Primary voltage V_s = secondary voltage

Current ratio : The current ratio of a transformer is equal to the ratio of secondary current and primary current

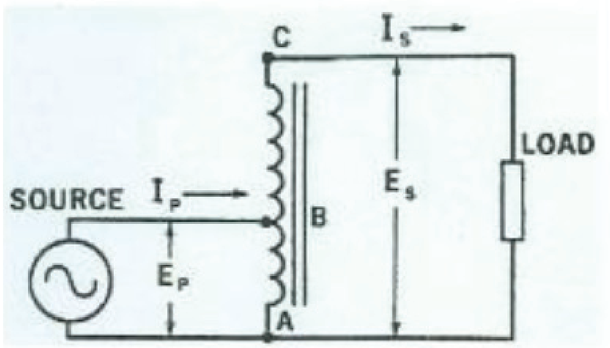
$$\text{Current ratio} = \frac{Is}{Ip}$$

Turns ratio : The voltage ratio of a transformer is equal to the ratio of primary voltage and secondary voltage

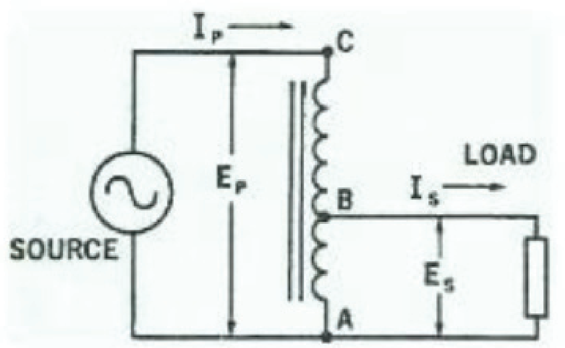
$$\text{Turns ratio} = \frac{Np}{Ns}$$

Where N_p = Primary turns N_s = secondary turns

(VIII) Actual Circuit Diagram used in Laboratory with Equipment Specifications



(a) Step-up



(b) Step-down

(IX) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Ammeter	0-10 A AC	2
2	Voltmeter	0-300 V AC	2
3	Auto Transformer	1 kVA 230/115 V single phase transformer	1
4	Resistive load	Single phase 230V, 15 A Resistive load	1

(X) Precautions to be followed

(1) All electrical connections should be neat and tight.

(2) Check the power supply before connection.

(XI) Procedure

(1) Connect the circuit as per circuit diagram.

(2) Switch on power supply.

(3) Note down reading of voltmeter.

(XII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(XIII) Actual Procedure followed

....

....

....

....

....

....

(XIV) Observations and Calculations

Sr. No.	Primary Voltage (Vp)	Secondary Voltage (Vs)	Primary Current (Ip)	Secondary Current (Is)	Voltage Ratio = (Vp/Vs)	Current Ratio = (Ip/Is)	Turns ratio =Np/Ns (calculated)
1							
2							
3							
4							

(XV) Results

Voltage Ratio is ……………………….. and current ratio is ……………………….. for given transformer

(XVI) Interpretation of Results

(XVII) Conclusions and Recommendations

(XVIII) Practical Related Questions (Provide space for answers)

(1) Define Autotransformer.
(2) Define voltage ratio.
(3) Define current ratio and turns ratio.
(4) Define transformation ratio.
(6) Define step up and step down transformer.

Space for Answers]

(XIX) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 10 : Single Phase Induction Motor

(I) Aim : Identify parts of single phase induction motor

(II) Minimum Theorotical Background

Single-Phase Squirrel Cage Induction Motor: Single-phase squirrel cage induction motors works on the same principle on which the poly-phase (Two or three phase) induction motor works, i.e. "whenever a short circuited conductor or coil is placed in a rotating magnetic field, the conductor tends to move." The magnetic field produced by the stator current is fixed in space instead of rotating, but its magnitude is changing sinusoidally. Such a field is equivalent to two field equal and opposite in magnitude, rotating in opposite direction at equal speed, each being half of the maximum value of alternating field. So the single-phase motors are not self-start in first instance and are made self-start by splitting the magnetic field produced into two fields having an angle of phase difference between them. Different methods are adopted to make the single-phase motors self-start.

(III) Circuit Diagram

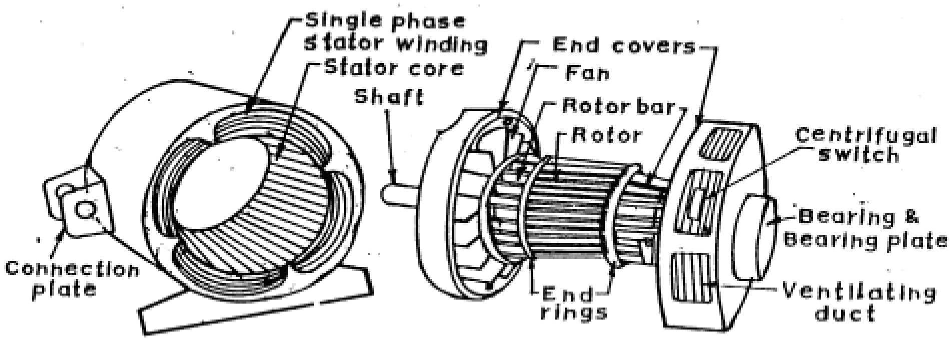


Fig. 10.1 : Different parts of a single phase squirrel cage induction motor

Description of Different Parts of Motors: The following are the main parts of single phase and three-phase induction motors, described in brief. For detailed study, you may refer to unit no. 03 of block no.04.

(i) **Stator Frame (Body) :** The stator frame or body is made up of close-grained alloy cast iron. All the different parts of the induction motor detailed below will be accommodated in the frame of the motor depending upon the type of motor. Centrifugal switch and capacitors are the parts pertaining to the singlephase induction motors only. Rest of the parts are common to both the motors.

(ii) **Stator :** As the name indicates, it is the stationary part of the induction motor and made of silicon steel strips of thickness, varying from 0.3 to 1.35 mm. These strips are combined together, which are called laminated strips and the combination is known as laminated core. These laminated stampings/strips are slotted to receive the winding. These slots may be of open or semi-closed types, to facilitate the winding. The same stator can be used for single-phase induction motors also. If the stator carries three-phase winding and is fed from threephase electric supply, it is known as three phase stator where as the stator carries single winding is known as single phase stator.

(iii) **Rotor :** The rotor is the rotating part of the motor and made of silicon steel strips. The thickness of these strips varies from 0.3 to 1.35 mm, as in case of stator. These strips are clamped together to form rotor core, called as laminated core. This laminated core is slotted to totally closed type, to receive rotor winding. In large capacity motors thick aluminum bars are inserted and are short-circuited with end rings. Now a day, melted aluminum is filled in these slots, which works as short-circuited winding. This winding is known as squirrel cage winding.

(iv) **End Covers :** As the name indicates these covers are used to cover the ends of the motor and are made of cast iron. These end covers are fitted with the stator frame with the help of nuts and bolts. The ball bearings are fitted in the end covers to keep the rotor exactly in the centre of the stator, so that it can move freely.

(v) Shaft and Bearings : Mostly ball bearings are used in large capacity motors where as the bush bearings is used in small capacity motors because the noise level is high in ball bearing as compare to bush bearings. The main purpose of bearings is to keep the rotor exactly in centre and ensure free movement for the rotor. The shaft is a long circular bar, made of mild steel. The rotor assembly and cooling fan is securely keyed to the shaft of the motor.

(vi) Cooling Fan : In general, the fan is used to cool down the temperature. When the motor runs on load, the heat is produced in the motor winding as well as in the core due to copper and iron losses respectively. So, the fan serves the purpose of transferring the heat from inside to outside of the motor by forced air circulation. It sucks the air from the atmosphere through the air ducts and discharge back to atmosphere after cooling the winding and core of the motor. In large capacity

(vii) Winding : The winding of induction motor is the main part of the motor. In below standard and low capacity motors, it may have aluminum winding but normally it is made up of copper. The type of winding depends upon the speed, type of supply (Single phase or three phase) and type of starting device used especially in case of single phase winding.

(viii) Centrifugal Switch : As the name indicates, it is a switch, which switch-on and switch-off on the principle of centrifugal forces. When the motor is at standstill position, the switch contacts remains closed, keeping the starting winding in the circuit and it cut-off the starting winding out of circuit when the motor attains more than the 80 % of the rated speed. When the motor is switched off, the starting winding is again inserted into the circuit by switching on the centrifugal switch. ix) Capacitor:- Capacitor works as a starting device in single-phase induction motors by producing an angle of phase displacement between the starting and running winding of the motor.

(IV) Procedure

Observe the following constructional features of the motor.

(i) Stator and stator winding.

(ii) Rotor and rotor bars short-circuited with the end rings.

(iii) Stator core and rotor laminated insulated core riveted and pressed together to make single unit.

(iv) Type of stator frame (Enclosure).

(v) In case of the single-phase induction motor, the construction of centrifugal switch.

(vi) Identification of starting and running winding.

(vii) Starting mechanism used such as capacitor etc. and its capacity.

(viii) Terminal box and plate must be observed carefully and note down its various features such as number of phases (Single or three phase), B.H.P capacity, speed of motor and connections of winding etc.

(V) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(VI) Actual Procedure followed

(VII) Observation table

Sr. No.	Different parts of Induction motor	Function of each part
1		
2		
3		

(VIII) Interpretation of Results (Giving meaning to the results)

(IX) Conclusions (Actions to be taken based on the interpretations)

(X) Practical Related Questions

(1) State working principle of single phase induction motor.

(2) List different parts of single phase induction motor

[Space for Answers]

(XI) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 11 : *Electrical Wire Specifications

(I) Aim : Select the suitable gauge of wire for given electrical application.

(II) Course Level Learning Outcome(s)

CO2 - Use of Transformer and Electric motors for given applications.

(III) Theory

The diameter or cross-sectional area of a wire is commonly expressed as a "wire gauge," which is the standard unit of measurement for this characteristic. In most cases, this is how the correct wire size is arrived at. A smaller gauge number indicates a smaller wire, and a larger gauge number indicates a larger wire. The American Wire Gauge or AWG, the British Standard Wire Gauge or BSWG, and the International Standard Wire Gauge or SWG are just a few of the many wire gauge systems in use today (SWG). However, the AWG is by far the most popular system in the Americas.

The maximum current that will be passing through the wire, as well as the total length of the wire run, must be calculated before selecting the appropriate wire gauge. You can use these numbers to look up the appropriate wire size in a wire gauge table.

The gauge of wire, its corresponding diameter, and the maximum current it can carry are all typically listed in wire gauge tables. The wire's resistance and the voltage drop along a given length of wire are also listed in some tables.

The following is a sample table of AWG wire gauges :

AWG	Diameter (inches)	Maximum current (amps)
20	0.032	11
18	0.040	16
16	0.051	22
14	0.064	30
12	0.081	41
10	0.102	55
8	0.128	73
6	0.162	92
4	0.204	116
2	0.258	154
1	0.289	176
0	0.325	200
00	0.365	225
000	0.410	250

(IV) Procedure

To determine the appropriate wire gauge size from this table, locate the maximum current that will be flowing through your wire and read across the row.

A 12 AWG wire, for instance, would be required to power a 20-amp circuit.

(1) Determine the length of the wire that will be used. Longer wires will have more resistance and will require a larger wire gauge size to compensate for this.

(2) Calculate the acceptable level of voltage drop that is allowed. This will depend on the application and the specific electrical components being used.

(3) Use a wire gauge chart to find the appropriate wire gauge size based on the current, length, and voltage drop requirements.

(V) Observation Table

AWG	Diameter	Maximum Current

(VI) Interpretation of Results (Giving meaning to the results)

(VII) Conclusions (Actions to be taken based on the interpretations)

(VIII) Practical Related Questions

(1) What type of wire insulation is best?

(2) How flexible should the wire be?

[Space for Answers]

(IX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		60%
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	100%

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 12 : *Electrical Switchboard Assembly

(I) Aim : Build the switch board for given requirement by connecting suitable coloured wire to respective terminals.

(II) Course Level Learning Outcome(s)

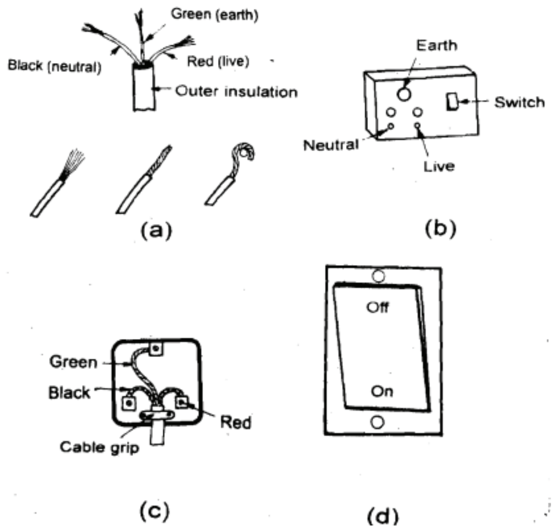
CO2 - Use of Transformer and Electric motors for given applications.

(III) Resources Required

Wooden or plastic box (30cm x 15cm x 4cm), good quality 5m three-core L electric wire of 20 gauge, 2 two-in-one (5A and 15A) sockets, 1 three-pin plug - (15A); 2 switches (15 A), half meter single core electric wire of gauge 22.

(IV) Theory

These two wires are insulated from each other. One of these wires is called the live (L) wire and another is called the neutral (N) wire. The electric supply is AC (alternating current) and the live wire is alternately at positive and negative potential of 220V with respect to the neutral wire. The potential of the neutral wire is zero because it is earthed at the local electric sub-station. Therefore, when an electrical appliance is plugged to AC mains, charge flows from the live wire, through the appliance to the neutral wire when the live wire is at positive potential and vice-versa when the live wire is at negative potential. The electrical connection to the mains of the physics laboratory is also provided through a two-core heavy cable. The electricity supplied is used for lighting, running electrical and electronic equipment etc. You will note that the laboratory electrical wiring has many sockets (in addition to light and fan points) at various points on the walls.



(V) Procedure

To connect a three-way wire with black, green, white, and red wires to a two-way wire with only black and red wires, you will need to make some modifications to the wiring. Here's a step-by-step guide on how to do it :

(1) Identify the wires : In the three-way wire, the black wire is the hot wire, the white wire is the neutral wire, the green wire is the ground wire, and the red wire is one of the traveler wires. In the two-way wire, the black wire is the hot wire, and the red wire is the switched wire.

(2) Turn off the power : Before working on any electrical connections, make sure to turn off the power to the circuit at the breaker box. This will ensure your safety during the installation process.

(3) Connect the hot wires : Start by connecting the black wire from the three-way wire to the black wire from the two-way wire. You can use a wire nut to secure the connection. This will provide power to both switches.

(4) **Connect the switched wire :** Take the red wire from the two-way wire and connect it to the red wire from the three-way wire. Again, use a wire nut to secure the connection. This will allow the two-way switch to control the power to the lights.

(5) **Ground the switches :** Connect the green wire from the three-way wire to the grounding screw on both switches. This will provide a safe path for electrical currents in case of a fault.

(6) **Neutrals and travelers :** Since the two-way switch does not require a neutral wire, you can cap off the white wire from the three-way wire with a wire nut. The travelers (red and white wires) from the three-way wire should be connected to the corresponding terminals on the three-way switches.

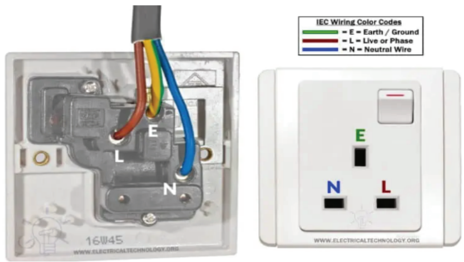
(7) **Secure the connections :** Once all the connections are made, double-check them to ensure they are secure and properly insulated. Use electrical tape or wire nuts to cover any exposed wires.

(8) **Restore power and test :** After completing the connections, turn the power back on at the breaker box. Test the switches to make sure they are functioning correctly and controlling the lights as desired.

Wiring a 3-Pin Socket

Follow the following simple steps to wire a BS-1363 switched socket wall outlet.

- First of all, turn off the main breaker or related MCB in the main distribution board or consumer unit and make sure the main supply is switched off.
- If you want to upgrade an already installed 1, gang, 3-pin socket, then loosen the tightly fitted screw on the front side of the wall socket. It will help to release the front cover from the mounting box. This way, the socket can be eased from the mounting box. **Note:** Ignore step 2 if you want to install a fully new 1-gang, three-pin power socket (wall outlet) instead of replacing or upgrading 1-gang, 3-pin socket.
- If you want to connect a new 3-pin socket, just connect the "Earth" as Green with Yellow stripe color wire into the "E" screw terminal (which indicates Earthing & Grounding).
- Now connect the "Neutral" as Blue color wire into the "N" screw terminal slot (which indicates Neutral).
- Finally, connect the "Live" as Brown color wire into the "L" screw terminal (which indicates live or phase).
- If you want to modify/upgrade the older socket outlet, just loosen the Live "L", Neutral "N" and Earth "E" screw terminals in the previous socket and replaces the related wires in the new 3-pin power socket (Brown for Live "L", Blue for Neutral "N" and Green or Green with Yellow stripe for Earth "E").
- As a final step, tighten the screws and replace the front/back cover of the three-pin socket. Make sure all the wires and screws are perfectly tightened as loose connection may lead to catching a hazardous fire due to arcing and overheating or even electric shock with serious injuries. In addition, no wires or naked strands should be hanging out from the socket or screw terminals. Now, carefully push back the 3-pin socket outlet into the mounting box to place it over perfectly in the box slot.



- You have done. Restore the power back by turning ON the main switch or related circuit breaker in the consumer unit and test if it is working perfectly.

(VI) Instruction & Safety Precautions

- Always disconnect the power supply and ensure it is off before servicing, repairing, or installing electrical equipment. To do this, switch off the main switch in the main consumer unit or distribution board.

- Never stand on or touch wet or metal parts when repairing or installing electrical equipment.
- Read all cautions and instructions carefully and follow them strictly when following this tutorial or performing any practical work related to electrical tasks.
- Always use the correct size of cable and wire, suitable outlets and switches, and the appropriate size of circuit breakers. You can use a Wire and Cable size calculator to determine the correct gauge size.
- Never attempt to work with electricity without proper guidance and care, as it can be dangerous and even fatal. Perform installation and repair work in the presence of experienced individuals with extensive knowledge of electrical work.
- Doing your own electrical work is dangerous and may be illegal in some cases. Contact a licensed electrician or the electric power supply provider before making any changes or modifications in electrical wiring installations.
- The author is not liable for any losses, injuries, or damages resulting from the display or use of this information, or from attempting any circuit in the wrong format. Be cautious, as electricity is extremely dangerous.

(VII)Actual Experimental Set up used in laboratory

(VIII) Conclusions (Actions to be taken based on the interpretations)

(IX) Practical Related Questions

(1) What are the colour of three wire switches?

(2) What do the 4 color wires mean?

[Space for Answers]

(X) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………………… (2) …………………………………………………………

(3) ………………………………………………………… (4) …………………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 13 : Passive Electronic Components

(I) Aim : Identify Passive electronic components on given electronics circuit

(II) Practical Significance

In industries, to build any hardware, it is necessary to identify electronic component, their terminals, values and packaging. Depending on application appropriate components need to be selected for better performance. In this experiment student will identify active and passive electronic components on the basis of physical verification and basic knowledge about the components. Multimeter /LCR-Q meter are used to verify the components value.

(III) Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system':***

(i) Identify electronic components. (ii) Calculate/ Measure value of component.

(IV) Relevant Course Outcome(s)

CO3 - Suggest suitable electronic component for given mechanical engineering application.

(V) Practical Outcome

To identify passive Electronic components in a given circuit.

- Identify passive electronic components in the given circuit
- Identify component, terminals and packaging of a component.
- Measure/ Calculate the values of given components.

(VI) Relevant Affective Domain Related Outcome(s)

- Handle components and instruments with care.
- Work in team.

(VII) Minimum Theoretical Background

Passive Components: Those devices or components which do not require external source for their operation are called Passive Components. A passive component does not provide any power gain to a circuit.

Example : Resistor, Capacitor and Inductor

(VIII) Practical Circuit diagram

(a) Sample

Figure 13.1 : Passive Components and Active Components

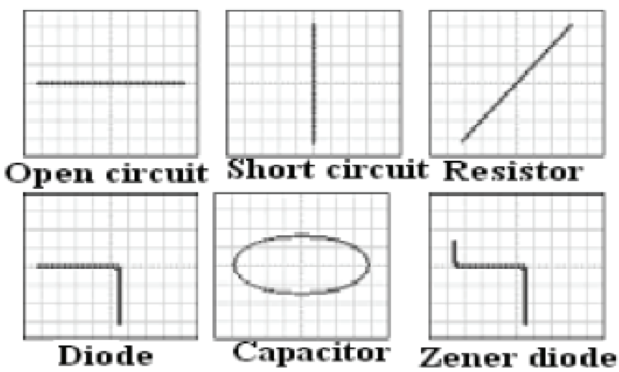


Figure 13.2 : Testing components on CRO

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory : NA

(IX) Resources required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Digital Multimeter / LCR-Q meter / CRO	3 ½ Digit DMM 20MHz Dual Trace Dual Beam CRO LCR/Q meter	1 No. each
2	Electronic Components	Resistors, Capacitors, inductors, PN junction diode, Zener diode, LED, BJT	l0 No.
3	Any other		

(X) Precautions

(1) Care should be taken while handling terminals of components.

(2) Select proper range & mode of ammeter and voltmeter.

(3) Connect probes of measuring instrument tightly to terminals of a component.

Procedure Part I

Passive Components:(Using Multimeter)

(1) Identify each terminal of the given component.

(2) Select the proper range and position of various knobs of multimeter / LCR-Q to test the given component.

(3) Observe the value of the given component on the multimeter / LCR-Q meter.

(4) Compare the obtained value with its theoretical value.

Passive Components : (Using CRO)

(1) Switch on CRO.
(2) Select component test mode on CRO.
(3) Ensure short stable horizontal line on screen.
(4) Connect the probe to CRO.
(5) Perform open circuit test by keeping two terminals open. Observe waveform on the screen as shown in above figure.
(6) Perform short circuit test by shorting two terminals. Observe waveform on the screen as shown in above figure.
(7) Connect resistance component in terminals of probe.
(8) Observe waveform on the screen as shown in above figure.
(9) Repeat procedure step 11 and 12 for other components such as capacitor, diode, Zener diode, inductor.
(10) Switch off the CRO.
(11) Infer from the patterns obtained on the display screen of the CRO.

(XI) Resources Used

Sr. No.	Name of Resource	Board Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

(XII) Actual Procedure Followed

(1) Select the electronic component available in the laboratory.
(2) ……………………………………………………………………………………………………
(3) ……………………………………………………………………………………………………
(4) ……………………………………………………………………………………………………..
(5) ……………………………………………………………………………………………………
(6) ……………………………………………………………………………………………………

(XIII) Precautions

(1) ……………………………………………………………………………………………………
(2) ……………………………………………………………………………………………………

(XIV) Observations and Calculations (use blank sheet provided if space not sufficient)

(a) Identify component by its physical observation.
(b) Label its terminals.

Table 1 : Measure values of components

Component	Measured value	Theoretical value
Resistor	1 2 3	
Inductor	1 2 3	
Capacitor	1 2 3	

(Minimum 3 components for each)

Draw the waveform obtained on CRO for the various components

Open Circuit		**Short Circuit**	
Resistor		**Capacitor**	

(XV) Conclusions (Actions/decisions to be taken based on the interpretation of results).

(XVI) Practical Related Questions

Note : Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

(1) Sketch the given components and label them.

(2) Write the range of the Multimeter used for measuring l KΩ resistor.

(3) ………?

(4) ………?

[Space for Answers]

(XVII) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 14 : Resistors in Series and Parallel

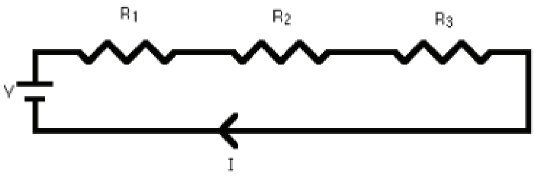
(I) Aim : Measure value of series and parallel combination of resistors.

(II) Objective : To measure value of series and parallel resister.

(III) Apparatus : Resistor Multi meter Bread board

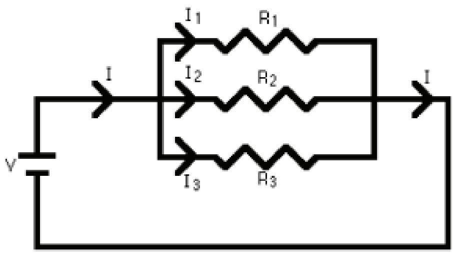
(IV) Theory

(1) We can combine the two or more resistors in series and in parallel. 1) Series Combination The value of series combination of resistors R1, R2 and R3 is



$$Req = R_1 + R_2 + R_3.$$

(2) Parallel Combination The value of parallel resistors R1, R2 and R3 is



$$Req = \frac{1}{R_1+1,R_2+1/R_3.......}$$

So, if we take R1 and R2 then

$$Req = 1/R_1+1/R_2 = R_1+R_2/R_1R_2$$

(V) Procedure

(1) Take three resistors.
(2) Build these three resistors in series on the bread board as shown in circuit diagram.
(3) Take reading on multi meter.
(4) Now, build these three resistors parallel as shown in circuit diagram.

- Take reading on multimeter.

Observation table

Sr. No.	R_1	R_2	R_3	Req (series)	Req (parallel)
1					

(VI) Conclusion

In series combination of three resistors, value $Req = R_1 + R_2 + R_3$.

In parallel combination of two resistors, value $Req = R_1 + R_2 / R_1R_2$

(VIII) Practical Related Questions

Note : Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

(1) Which range has been set on the multimeter for reading ?

(2) How much the maximum resistance can be measured by multimeter ?

(3) Calculate the series combination value theoretically.

(4) Calculate the parallel combination value theoretically ?

(5) .... ?

Space for Answers]

(IX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ……………………………………………………… (2) ………………………………………………………

(3) ……………………………………………………… (4) ………………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 15 : LCR-Q Meter

(I) AIM : Use LCR-Q meter for measuring the value of given Inductor and Capacitors.

(II) Apparatus : LCR-Q METER, power cord, resistor, inductor, capacitor.

(III) Theory

The digital L.C.R. Q meter is used for the measurement of Resistance, Capacitance, Inductance and dissipation factor (Q).It has a rotor switch with the help of which the desired functions can be selected. It has various ranges & the desired ranges can be selected with the help of the range selector switch.

Various Ranges are

(1) 200 μF/ pF / Ohm (2) 2000 Mf/ Pf / Ohm

(3) 20 mH/ RF /Ohms (4) 200mH/ Nf / Kohm

(5) 2H/μF/ nF / Mohm

- The basic principle used in the digital L.C.R Q meter is to measure the voltage across the component and the current passing through the component under the test when the test signal is fed to the component. The measure test signal is applied by an inbuilt oscillator to the components, through a selectable source, (Resistance Rs). Typical test frequency in 100Hz.
- For Inductance measurement, a series of circuit of inductor is assumed, while for a capacitance measurement a parallel circuit of capacitor is assumed for few ranges.
- For impedance measurement, the impedance of component is usually low hence Rs is chosen of much higher. This achieve a constant current device to component .The Rs decides the value of current.

Application of Digital L.C.R Q Meter

(1) Testing of the components L,C&R.

(2) Measure the value of L,C&R.

(3) Obtaining the characteristics of L & C.

(4) Performing Quantity of L & C

For Inductance measurement, a series of circuit of inductor is assumed, while for a capacitance measurement a parallel circuit of capacitor is assumed for few ranges. For impedance measurement, the impedance of component is usually low hence Rs is chosen of much higher. This achieve a constant current device to component. The Rs decides the value of current.

Application Of Digital L.C.R Q Meter

(1) Testing of the components L,C&R.

(2) Measure the value of L,C&R.

(3) Obtaining the characteristics of L & C.

(4) Performing Quantity of L & C

(5) Finding the method Capacitance, Coil, Resistance for circuit designer. Hence, We can study the principle of L.C.R Q meter and its applications.

Specifications

- Display Modes:-1. Direct Measurement 2. Absolute Deviation3. Percentage Deviation
- Test Frequency:-100Hz, 120Hz, 1 KHz.
- Display:-Dual 6.1 ± 2 Display.
- Equivalent Circuit:-Series & Parallel Circuit.
- Zero Correction:-Open and start zeroing.
- Update Rate:-3 Measurements, 1 Sec.

- Auto Power OFF:-About 6 Minutes
- Power Supply:- 9V Battery
- Alarm Rate:- N0, P0, P1, P3, & OFF.

The Measurement ranges for various parameters are -

- Capacitance:-0.1pF to 9999μf.
- Inductance:-0.1μH to 9999μH.
- Resistance/Impedance:-0.0001Ω to 999.9 MΩ.
- Distortion Factor:-0.0001Ω to 999.9MΩ.
- Quality Factor (Q):-0.0001 to 9999
- Relative %:-0.001% to 9999%.Hence,
- We have studied all the specifications for L.C.R Q meter.

(IV) Resources Required

Use LCR-Q meter for measuring the value of given Inductor and Capacitors.

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	LCR-Q meter	LCR/Q meter	1 No. each
2	Electronic Components	Capacitors, inductors.	5 No.
3			

(V) Procedure

For Inductance

(1) Select Parameter L/C.
(2) Select appropriate test frequency of equivalent circuit.
(3) Insert CVT into test component.
(4) The display will show conductance of CVT.
(5) If equivalent circuit LED is flashing, Press equivalent circuit key.
(6) If unit indication LED is flashing then it indicates that the instrument can't measure the value of basic accuracy.

To Measure Capacitance

(1) Select parameter L/C.
(2) Select appropriate test frequency & equivalent circuit.
(3) Insert the CVT into test component fig.
(4) The display will show capacitance of CVT.
(5) If equivalent circuit is flashing, press frequency key

(6) If frequency LED is flashing, press frequency key.

(7) If unit indication LED is flashing then it indicates that the instrument cannot measure components value to basic accuracy

(VI) Observation Table

Sr. No.	Component	Practical Value	Theoretical value
1	Inductor		
2	Capacitor		

(VII) Resources Used

Sr. No.	Name of Resource	Board Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

(VIII) Actual Procedure Followed

(IX) Conclusions (Actions/decisions to be taken based on the interpretation of results).

(X) Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

(1) What is an LCR circuit ? ·

(2) What is an LCR circuit ?

(3) …………………………………………………………………………………………………….. ?

[Space for Answers]

(XI) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XII) Assessment Scheme

	Performance Indicators	Weightage
	Process related (15 Marks)	**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 16 : Active Electronic Components

(I) Practical Significance

In industries, to build any hardware, it is necessary to identify electronic component, their terminals, values and packaging. Depending on application appropriate components need to be selected for better performance. In this experiment student will identify active and passive electronic components on the basis of physical verification and basic knowledge about the components. Multimeter /LCR-Q meter are used to verify the components value.

(II) Relevant Program Outcomes (POs)

PO1. Basic knowledge : An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.

PO4. Engineering Tools : Apply appropriate Technologies and tools with an understanding of the limitations.

(III) Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system':***

(i) Identify electronic components.

(ii) Calculate/ Measure value of component.

(IV) Relevant Course Outcome(s)

CO3 - Suggest suitable electronic component for given mechanical engineering application.

(V) Practical Outcome

To identify active Electronic components in a given circuit.

- Identify active electronic components in the given circuit
- Identify component, terminals and packaging of a component.
- Measure/ Calculate the values of given components.

(VI) Relevant Affective Domain Related Outcome(s)

(1) Handle components and instruments with care.

(2) Work in team.

(VII) Minimum Theoretical Background

Active components: Those devices or components which required external source for their operation is called Active Components. An active component may provide power gain to a circuit.

Example : Diodes & Transistors

(VIII) Practical Circuit diagram

(a) Sample

Figure 1 : Passive Components and Active Components

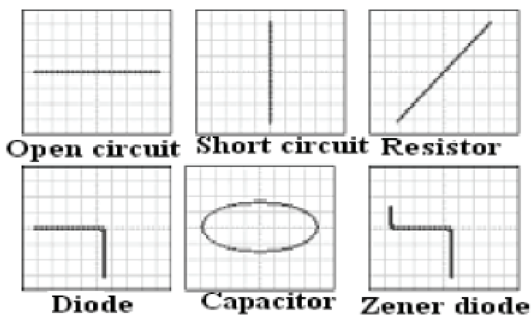


Figure 2: Testing components on CRO

(b) Actual Circuit used in laboratory

(IX) Actual Experimental Set up used in laboratory: NA

(X) Resources required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Digital Multimeter / LCR-Q meter / CRO	3 ½ Digit DMM 20 MHz Dual Trace Dual Beam CRO LCR/Q meter	1 No. each
2	Electronic Components	Resistors, Capacitors, inductors, PN junction diode, Zener diode, LED, BJT	10 No.
3			

(XI) Precautions

(1) Care should be taken while handling terminals of components.

(2) Select proper range & mode of ammeter and voltmeter.

(3) Connect probes of measuring instrument tightly to terminals of a component.

(XII) Procedure Part I

Passive Components

(1) Identify each terminal of the given component.

(2) Select the proper range and position of various knobs of multimeter / LCR-Q to test the given component.

(3) Observe the value of the given component on the multimeter/ LCR-Q meter.
(4) Compare the obtained value with its theoretical value.

Passive /Active Components

(1) Switch on CRO.
(2) Select component test mode on CRO.
(3) Ensure short stable horizontal line on screen.
(4) Connect the probe to CRO.
(5) Perform open circuit test by keeping two terminals open. Observe waveform on the screen as shown in above figure.
(6) Perform short circuit test by shorting two terminals. Observe waveform on the screen as shown in above figure.
(7) Connect resistance component in terminals of probe.
(8) Observe waveform on the screen as shown in above figure.
(9) Repeat procedure step 11 and 12 for other components such as capacitor, diode, Zener diode, inductor.
(10) Switch off the CRO.
(11) Infer from the patterns obtained on the display screen of the CRO.

(XIII) Resources Used

Sr. No.	Name of Resource	Board Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

(XIV) Actual Procedure Followed

(1) Select the electronic component available in the laboratory.
(2) ……………………………………………………………………………………………………
(3) ……………………………………………………………………………………………………
(4) ……………………………………………………………………………………………………
(5) ……………………………………………………………………………………………………
(6) ……………………………………………………………………………………………………

(XV) Precautions

(1) ……………………………………………………………………………………………………
(2) ……………………………………………………………………………………………………

(XVI) Observations and Calculations (use blank sheet provided if space not sufficient)

(a) Identify component by its physical observation.
(b) Label its terminals.

(Minimum 3 components for each)

Draw the waveform obtained on CRO for the various components

Open Circuit		**Short Circuit**	

PN Diode		**Zener**	

(XVII) Results

(XVIII) Interpretation of Results (Give meaning of the above obtained results)

(XIX) Conclusions (Actions/decisions to be taken based on the interpretation of results).

(XX) Practical related Questions

Note : Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

(1) Sketch the given components and label them.

(2) Write the range of the Multimeter used for measuring l0 KΩ resistor.

(3) .... ?

(4) ....?

[Space for Answers]

(XXI) References/Suggestions for further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XXII) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 17 : P N Junction Diode

(I) Aim : Test the PN-junction diodes using digital multimeter.

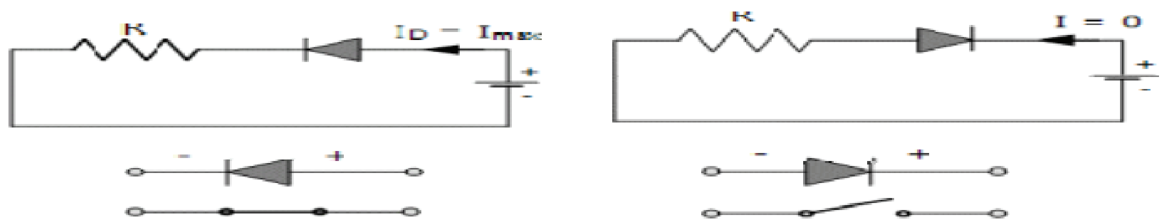
(II) Relevant Course Outcome(s)

CO4 - Use of diodes and transistors as a relevant component in given electric circuits of . mechanical engineering application

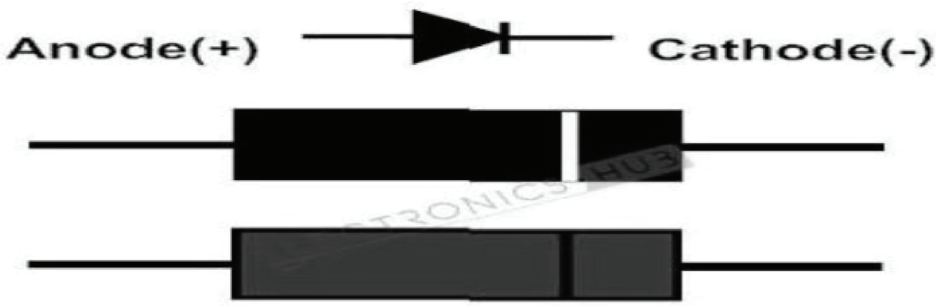
(III) Minimum Theoretical Background

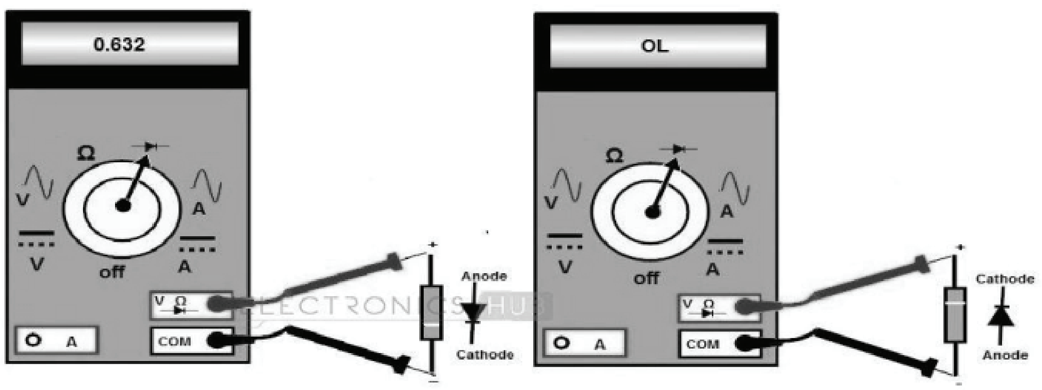
The diode is a two terminal; allows the current only in o in different applications like and so on. When the anode terminal l semiconductor device that e direction. These are found rectifiers, clampers, clippers is made positive with respect to cathode, the diode gets forward-biased and the forward-biased diode volta e drop is typically 0.7V for silicon diodes. The testing of this device is made to know its proper working conditions in forward and reverse bias modes.

(IV) Circuit Diagram



In forwarward mode **In Reverse biased mode**





Diode Mode Testing Procedure

(V) Resources Required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	Digital Multimeter		1
2	Diode		1
3	DC voltage supplier		1
4	1000 Ω resistor		1
5	Bread board		
6	Connecting wires		

(VI) Procedure

(1) Identify the terminals anode and cathode of the diode.

(2) Keep the digital multimeter (DMM) in diode checking mode by rotating the central knob to the lace where the diode symbol is indicated. In this mode multimeter is capable to supply a current of 2mA approximately between the test leads.

(3) Connect the red probe to the anode and black probe to the cathode. This means diode is forward-biased.

(4) Now we connect the red probe to the Cathode and black probe to the anode , This is the condition

(5) Now we observe the reading on n of Reverse biased. the meter display.

(VII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(VIII) Actual Procedure followed

....

....

....

....

....

....

....

....

....

....

(IX) Observation table

Sr. No.	Voltage	Type of diode	Type of connection
1			
2			
3			

(X) Interpretation of Results (Giving meaning to the results)

(XI) Conclusions (Actions to be taken based on the interpretations)

(XII) Practical Related Questions

(1) How diode is connected to digital multimer during testing

(2) Define forward biasing and reverse biasing.

[Space for Answers]

(XIII) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Scale -

X-Axis -

Y-Axis -

Practical No. 18 : *Seven- Segment Display

(I) Practical significance:

Seven segment displays are used in a wide range of devices. Examples include simple calculators, digital clocks, microwave ovens, refrigerators, and plenty of other devices that display numerals. With the express expansion of IoT, segmented displays have also followed suit, as they can be utilized in numerous ways.

(II) Laboratory Learning Outcome(s)

LLO 4.1 a)Identify type of seven segment display (Common anode / Common cathode))

LLO 4.2 b) Testing of seven- segment display.

(III) Relevant Course Outcome(s)

CO4 - Use of diodes and transistors as a relevant component in given electric circuits of . mechanical engineering application

(IV) Relevant Affective Domain Related Outcome(s)

Follow safety electrical rules for safe practices.

(V) Relevant Theoretical Background

Types of 7 segment display are available in market. And they can be used according to the type of application they are as follows-

(1) **Common Cathode display :** In this type of display, cathode terminal of all LED's are connect together. If you want to illuminate a segment of common cathode display then provide power supply to that section and ground the common pin (DP). Following figure shows the internal connection of 7 segment common cathode display.

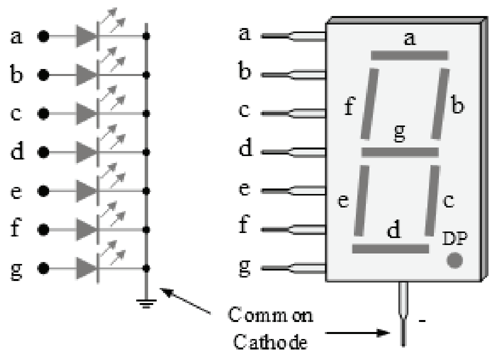


Fig. 18.1 : Circuit Diagram of Common Cathode Seven Segment Display (SSD)

(2) **Common Anode Display :** In this type of display, anode terminal of all LED's are connect together. If you want to illuminate a segment of common anode display then connect that section to ground and provide power supply to common pin (3 and 8 or DP). Following figure shows the internal connection of 7 segment common cathode display.

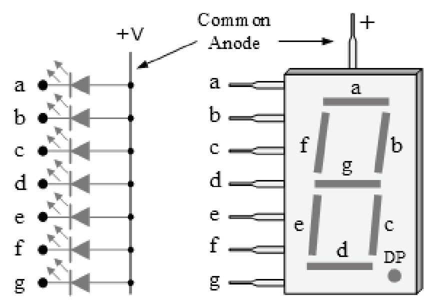
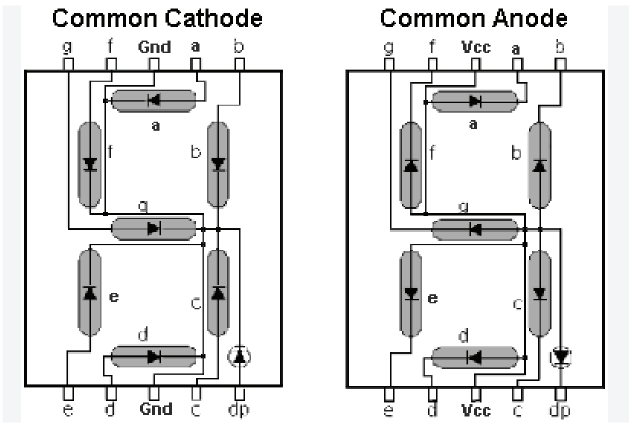


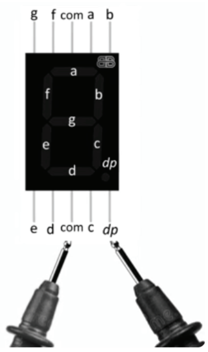
Fig. 18.2 : Circuit Diagram of Common Anode Seven Segment Display (SSD)

Always use a resistor while using 7 segment display to illuminate the specify segments, in both 7 segment, common cathode and anode. Because maximum voltage which it can resist is 2.5V therefore excess voltage may harm the individual segment of display. You can use resistor value of 220 ohm or 330 ohm.

How to identify and check the seven segment display-You have purchase a display from market and you want to confirm whether you have purchase the correct display or your display is working properly or not then you can use the procedure describe below. Suppose you have completely assembled your circuit and through troubleshooting you came to know you have used a incorrect (used common cathode in place of common anode) or faulty display then your time and hard work both will be wasted. So check before you use.

(VI) Actual Circuit Diagram used in Laboratory with Equipment Specifications





(VII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1	7 segment display		1
2	Multimeter		1

(VIII) Procedure

(1) Hold the display in your hand and identify the pin 1.This can be done as shown in figure below.

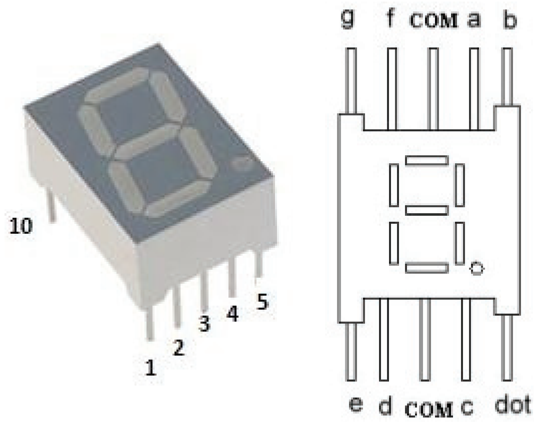


Fig. 18.3 : Image and Pin Diagram of Seven Segment Display (SSD)

(2) Now take multi-meter (Assumption followed red lead for positive and black lead for negative). Set the multi-meter in continuity range.

(3) Check for sound test (touch both the leads together sound will produce). Sometimes it may possible, battery of your multi-meter become weak and we will be not being able to get the display.

(4) Put the Black lead of multi-meter on pin 3 or 8 both are common pin as they are internally connected.

(5) Now put Red lead of multi-meter on any other pin may be 1, 5.

(6) If any of the segment glows then your display is common cathode.

(7) If none of the segment glows than interchange the leads of multi-meter.

(8) Connect the Red lead of multi-meter on pin 3 or pin 8 as both are common pin and internally connected to each other.

(9) Now put the black lead of the multi-meter on other remaining pin. If any of the segment glow than your display is common anode, as in common anode positive pin is common and rest are supplied with negative supply.

(10) Check all segments of both common cathode and anode to ensure your display is working properly.

(11) If none of the segment glows means your 7 segment is faulty.

(IX) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			

(X) Actual Procedure followed

(XI) Observations

Decimal Digit	Individual Segments illuminated						
	a	b	c	d	e	f	g
0	1	1	1	1	1	1	0
1	0	1	1	0	0	0	0
2	1	1	0	1	1	0	1
3	1	1	1	1	0	0	1
4	0	1	1	0	0	1	1
5	1	0	1	1	0	1	1
6	1	0	1	1	1	1	1
7	1	1	1	0	0	0	0
8	1	1	1	1	1	1	1
9	1	1	1	1	0	1	1

Decimal Digit	Individual Segments illuminated						
	a	b	c	d	e	f	g

(XII) Conclusions (Actions to be taken based on the interpretations)

(XIII) Practical Related Questions (Provide space for answers)

(1) What are the real life applications of seven-segment display?

(2) What is the purpose of the 7-segment display?

[Space for Answers]

(XV) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XV) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 19 : Half Wave Rectifier

(I) Practical Significance

Electrical energy is distributed as alternating current because AC Voltage can be increased or decreased with the help of transformers. This allows power to be transmitted through power lines efficiently. AC voltage is represented as sine wave voltage. For certain electronic applications like computers, DC power supply is required. Rectifier is a circuit that converts AC to pulsating DC. The student will be able to analyze the unidirectional behavior of diode for rectification.

(II) Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system':***

(1) Connect Circuits (2) Record measurements.

(3) Observe waveforms (4) Analyze results

(III) Relevant Course Outcome(s)

CO4 - Use of diodes and transistors as a relevant component in given electric circuits of . mechanical engineering application

(IV) Practical Outcome

Convert AC signal into DC signal using Half Wave Rectifier.

(1) Identify terminals of the component.
(2) Mount the circuit components of Half Wave Rectifier.
(3) Use functions of CRO required for Half Wave Rectifier
(4) Evaluate performance of Half Wave Rectifier by observing Output DC voltage waveform

(V) Relevant Affective Domain Related Outcome(s)

(i) Handle equipments and components carefully
(ii) Work in team

(VI) Minimum Theoretical Background

Rectifier is an electronic circuit used for converting a pure AC into a pulsating DC and this process of conversion is known as Rectification. A half wave rectifier uses a single diode to carry out this conversion. During the positive half cycle of the input wave, the diode will be forward biased and it conducts and hence current flows through the load resistor. During the negative half cycle of input wave, the diode will be reverse biased and it is equivalent to an open circuit. Hence current through load resistance is zero. Thus, the rectifier (diode) conducts current during positive half cycle of AC input and does not conduct current during negative half cycle. This is Called **half wave rectification.** Rectifier performance is based on efficiency of DC output.

Ripple factor

Ripple factor is defined as the ratio of the effective value of AC components to the average DC value. It is denoted by the symbol 'y'.

y = –

For Half Wave Rectifier (HWR),

Ripple factor =- ----- 1.21

(VII) Practical Circuit Diagram

(a) Sample

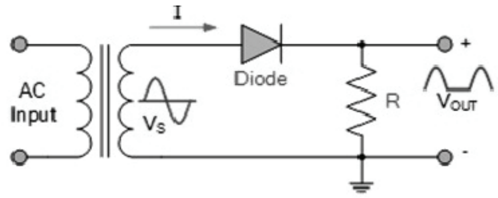


Fig. 19.1 : Half Wave Rectifier

(b) Actual Circuit used in laboratory

(VIII) Actual Experimental set up used in laboratory

(IX) Resources Required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1.	CRO	0-20MHz (Dual Trace)	1
2.	DC Voltmeter	0-20 V	1 No.
3.	DC Ammeter	(0 - 200 mA, 0 - 200 μA)	1 No.
4.	Bread board		1 No.
5.	Transformer	220V/9V AC, 500 mA	1 No.
6.	Diode	1N4001 (or any other equivalent diode)	1 No.
7.	Resistor	L KQ (0.5watts/0.25watts)	1 No.
8.	Connecting wires	Single strand	
9.	CRO Probes		2

(X) Precautions

(1) Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.

(2) While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.

(3) Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

(XI) Procedure

(1) Connect the Electronic circuit for half wave rectifier on bread board as shown in Figure 1.

(2) Connect the primary side of the transformer to AC mains. Connect the CRO probe across the secondary and measure the Vinp-pappearing across diode. Now connect the probes across the resistance R.

(3) Keep CRO in DC mode, adjust the zero de level and measure accurately the peak value of output voltage (Vm)-

(4) Trace the waveforms.

(5) Calculate the average or de value of output voltage and frequency of the waveform

(6) Using a DC voltmeter, measure the DC voltage across the load resistance (Vdc)

(7) Measure the AC voltage across the load resistance by setting multi-meter to AC mode (Vac)-

(8) Calculate Ripple factor.

(XII) Resources Used

Sr. No.	Name of Resource	Board Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

(XIII) Actual Procedure Followed

(1) Connect the electrical circuit as per Circuit used in laboratory.

(2) ....

(3) ....

(4) ....

(5) ....

(6) ....

(7) ....

(XIV) Precautions

(1) ....

(2) ....

(3) ....

Observations and Calculations

(A) Waveform at Secondary of the Transformer (Vs)

Waveform at the output Resistor RL (Vout)

Table 1

Load Resistance (RL)	Vac(V)	Vdc(V)	Ripple Factor *Vac*	Input Signal		Output Signal	
				Vin p-p(V)	Frequency (Hz)	Vin p-p(V)	Frequency (Hz)

(B) Calculation

$\frac{V_m}{Y_{ctc}} = \frac{\quad}{n}$ ……………………… V

Ripple Factor $= \frac{V_{ac}}{V_{de}} =$ ………………………

Theoretical value of Ripple factor = ………………………

(XV) Results

V_{de} calculated = ……………… V

Ripple factor = ………………

(XVI) Interpretation of Results (Give meaning of the above obtained results)

(XVII) Conclusions (Actions/decisions to be taken based on the interpretation of results).

(XVIII) Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

(1) State the effect on output voltage if we replace silicon diode with germanium diode.

(2) If Vcc = 2 V, What will be the value of V_{rn} ?

[Space for Answers]

(XIX) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XX) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Scale -

X-Axis -

Y-Axis -

Practical No. 20 : Bridge Rectifier

(I) Practical Significance

Half-wave rectifier circuit is unsuitable to applications which need a "steady and smooth" de supply voltage since only alternate half cycles are rectified. One method to improve on this is to use every half-cycle of the input voltage instead of every other half-cycle. The circuit which allows us to do this is called a full wave rectifier. Here, unidirectional current flows in the output for both the cycles of input signal and rectifies it. In this experiment students will observe the working of full wave Bridge rectifier.

(II) Relevant Program Outcomes (POs)

PO2. Discipline knowledge : An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

(III) Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***

(1) Connect Circuits (2) Record measurements. (3) Analyze results

(IV) Relevant Course Outcome(s)

CO4 - Use of diodes and transistors as a relevant component in given electric circuits of . mechanical engineering application

(V) Practical Outcome

(1) Convert AC into DC signal through Bridge Rectifier

(2) Convert AC signal into DC signal through Bridge rectifier

(3) Identify terminals of the component.

(4) Connect circuit components of Bridge rectifier and label components. 1v. Use functions of CRO required for Bridge rectifier

(5) Observe performance of full wave Bridge rectifier by Output DC voltage waveform v1. Compare with half wave rectifier.

(VI) Relevant Affective Domain Related Outcome(s)

(i) Handle components and instruments carefully. (ii) Work in a team

(VII) Minimum Theoretical Background

The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge. Bridge rectifiers are type of full-wave rectifier that uses four or more diodes in a bridge circuit configuration to efficiently convert alternating (AC) current to a direct (DC) current.

(VIII) Practical Circuit Diagram

(a) Samplec

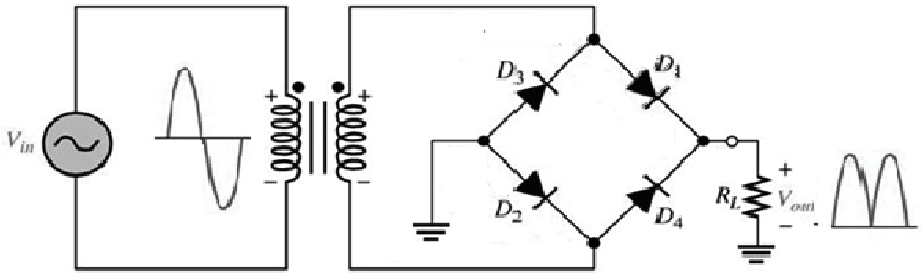


Figure. 1 : Bridge Rectifier

(b) Actual Circuit used in laboratory

(IX) Actual Experimental set-up used in laboratory

(X) Resources Required

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1.	Transformer	220V/12V V AC, 500 mA	1 No.
2.	Resistor	10KΩ	1 No.
3.	Diode	Silicon Diode IN4007	4 No.
4.	Digital Multimeter / CRO	3 /2 digit display/ 0-20 MHz (Dual Trace).	1 No.
5.	Connecting wires	Single Strand	1 No.

(XI) Precautions

(1) Care should be taken while handling terminals of components.
(2) Select proper mode for CRO.
(3) Connect wires tightly while building circuit.
(4) Show the connections to concerned teacher and then switch ON the power supply.

(XII) Procedure

Part I

(1) Connect the Electronic circuit for Bridge rectifier on bread board / kit as shown in circuit diagram (Figure 1).
(2) Connect the primary side of the transformer to AC mains and the secondary side to rectifier input.
(3) Before switching on power supply, check the connection.
(4) Switch ON the power supply and set CRO in DC mode and adjust level accurately.
(5) Using a CRO, measure the maximum voltage Vm of the AC input voltage (at the anode) of the rectifier and AC voltage (at the cathode) at the output of the rectifier.
(6) Using a DC voltmeter, measure the DC voltage at the load resistance.
(7) Observe the Waveforms at the secondary windings of transformer and across load resistance.

Part II

(1) Observe the input and output waveform on CRO.
(2) Observe the difference between Center tapped wave rectifier output waveform and full wave Bridge output waveforms.

(XIII) Resources Used

Sr. No.	Name of Resource	Board Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

(XIV) Actual Procedure Followed

(1) ……………………………………………………………………………………………………..
(2) ……………………………………………………………………………………………………..
(3) ……………………………………………………………………………………………………..
(4) ……………………………………………………………………………………………………..
(5) ……………………………………………………………………………………………………..
(6) ……………………………………………………………………………………………………..

(XV) Precautions

(1) ……………………………………………………………………………………………………..
(2) ……………………………………………………………………………………………………..

Observations and Calculations

Observe the input and output waveform on CRO.

Waveform at the secondary of the transformer														
Waveform at the load resistance														

Measure the d.c. component in the output(Vctc) = V.

Where $Vcc = \frac{2\ V_m}{\pi}$

(XVI) Results

(XVII) Interpretation of results (Give meaning of the above obtained results)

(XVIII) Conclusions (Actions/decisions to be taken based on the interpretation of results)

(XIX) Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

(1) Calculate ripple factor for the circuit.

(2) What is the difference in DC output voltage in half wave and full wave rectifier and Bridge for the same AC input?

[Space for Answers]

(XX) References/Suggestions for Further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XXI) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	40%
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ……………………………………………………… (2) ………………………………………………………

(3) ……………………………………………………… (4) ………………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Scale -

X-Axis -

Y-Axis -

Practical No. 21 : Test Performance of NPN Transistor

(I) Practical Significance

A BJT is commonly used as an amplifier. Common Emitter (CE) mode is the universal mode of operation for a BJT. All types of amplifications can be performed using CE mode with suitable biasing. Common-emitter amplifiers are also used in radio frequency circuits..

(II) Industry/Employer Expected Outcome(s)

Amplifier circuits are used in all electronic equipment used in industries. Employee should be able select suitable type of transistor and configuration for given application.

(III) Course Level Learning Outcome(s)

CO4 - Use of diodes and transistors as a relevant component in given electric circuits of . mechanical engineering application

(IV) Laboratory Learning Outcome(s)

Check the operation of NPN Transistor under CE Configuration.

(V) Relevant Affective Domain Related Outcome(s)

(1) Handle components and equipment carefully. (2) Work in team.

(VI) Relevant Theoretical Background (With diagrams if required)

BJT is called as Bipolar Junction transistor. It has 3 terminals namely emitter, base and collector. It is called bipolar device because current through it is due to free elctrons and holes. A transistor can be in any of the three configurations namely common base, common emitter and common collector.

The relation between of α, β and γ of CB, CE & CC are

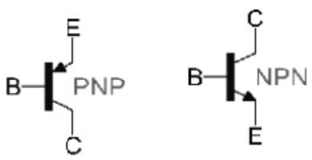
$$\alpha = \beta / 1 + \beta$$

$$\beta = \frac{\alpha}{1-\alpha}$$

$$\gamma = 1 + \beta = \frac{1}{1-\alpha}$$

In CE configuration base will be the input node and collector will be output node. Emitter is common to both input and output and hence the name common emitter configuration. A transistor in CE configuration is used widely as an amplifier

Symbol



Symbol of BJT

Input Characteristics

This curve gives the relationship between input current (I_B) and input voltage (V_{BE}) for constant output voltage (V_{CE}) By varying V_{BE} for constant V_{CE} it may be noted that below knee voltage current is very small. Beyond knee voltage, the base current (I_B) increases with increase in V_{BE} for constant V_{CE}. Input characteristics may be used to determine the value of common emitter transistor a.c. input resistance r_i. It is the ratio of change in base to emitter voltage (ΔV_{BE}) to resulting change in base current (I_B) at a constant collector to emitter voltage (V_{CE}).

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B}$$

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B}$$

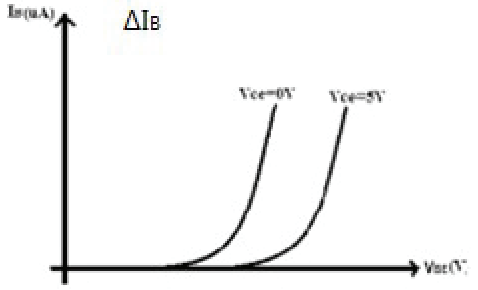


Fig. 21.1 : Input characteristics of BJT in CE mode

Output Characteristic

This curve gives the relationship between output current (I_C) and output voltage (V_{CE}) for constant base current (I_B).

The output characteristics are divided into three regions :

Cut off region : Transistor act as off switch.

Saturation region: Transistor act as on switch.

Active region : Transistor act as amplifier.

Output Characteristic may be used to determine the value of common emitter transistor a.c. output resistance r_o it is the ratio of change in collector to emitter voltage (ΔV_{CE}) to resulting change in collector current (ΔI_C) at a constant base current (I_B)

$$r_o = \frac{\Delta V_{CE}}{\Delta I_C}$$

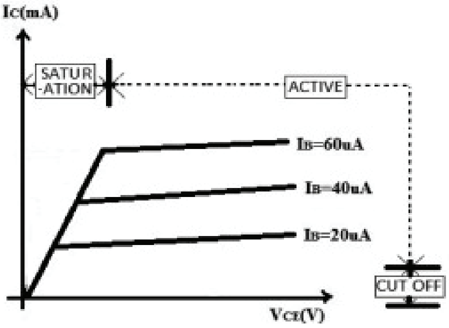


Fig. 21.2 : Output characteristics of BJT in CE mode

(VII) Actual Circuit Diagram used in Laboratory with Equipment Specification

(a) Sample

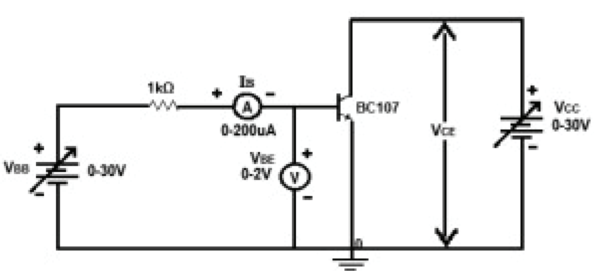


Fig. 21.3 : Circuit diagram for input characteristics

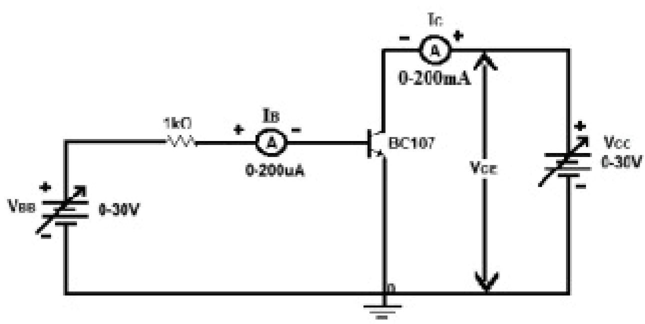


Fig. 21.4 : Circuit diagram for output characteristics

(VIII) Required Resources/Apparatus/Equipment with Specification

S. No	Name of Resource	Suggested Specification	Quantity
1	DC power supply	0-30 V	2 No.
2	DC Voltmeter	(0-2V),(0-20V)	1 No.
3	DC Ammeter	(0-50 milliamps),(0-500 μA)	1 No.
4	Transistor	BC107	1 No.
5	Resistor	1 KΩ	1 No.
6	Any other		

(IX) Precautions to be followed

(1) Care should be taken while handling terminals of components.
(2) Select proper range and mode of ammeter and voltmeter.
(3) Connect wires tightly while building circuit.
(4) Show the connections to concerned teacher and then switch ON the power supply.

(X) Procedure

Part I Input characteristics

(1) Connect the electrical circuit as shown in Fig. 21.3.
(2) Select suitable range of milli-ammeter, voltmeter and power supply.
(3) Switch on the power supply and adjust the voltage $V_{CE} = 2V$ by varying V_{CC}
(4) Vary the input voltage V_{BE} in steps of 0.1V and measure the current I_B for each Step.
(5) Repeat the steps 3 and 4 for V_{CE} values of 5V and 10V.
(6) Tabulate the readings

Part II Output characteristics

(1) Connect ammeter and adjust base current I_B.
(2) Select suitable range of milli-ammeter, voltmeter and power supply.
(3) Switch on the power supply and apply a constant current $I_B = 20\ \mu A$.
(4) Vary V_{CE} from 0 to 10V is steps of 0.5 volts. Measure corresponding collective current I_C for each step.
(5) Repeat steps 9 and 10 for various values of $I_B = 30\ \mu A$ and $40\ \mu A$
(6) Tabulate the readings

Graph

Plot a graph of V_{BE} (V) (X-axis) versus I_B (μA) (Y-axis) for different V_{CE} voltages.

Plot a graph of V_{CE} (V) (X-axis) versus I_C (mA) (Y-axis) for different I_B (μA) currents.

Calculate dynamic input resistance using the formula given below

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B} V_{CE} \Bigg| = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

Calculate dynamic output resistance using the formula given below.

$$r_o = \frac{\Delta V_{CE}}{\Delta I_C\, I_C} \Bigg| = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

(XI) Required Resources/Apparatus/Equipment with Specifications

S. No	Instruments/Components	Suggested broad specification	Quantity
1			
2			
3			
4			

(XII) Actual Procedure followed

(XIII) Observations and Calculations

Table 1 : Input characteristics

S. No.	V_{CE} = ……… V		V_{CE} = ……….. v		V_{CE} = ………. v	
	V_{BE}(V)	I_B (μA)	V_{BE} (V)	I_B (μA)	V_{BE} (V)	I_B (μA)
1.						
2.						
3.						
4.						
5.						
6.						

Table 2 : Output characteristics

S. No.	I_B = ……… μA		I_B = ……….. μA		I_B = ………. μA	
	V_{CE}(V)	I_C (mA)	V_{CE} (V)	I_C (mA)	V_{CE} (V)	I_C (mA)
1.						
2.						
3.						
4.						
5.						
6.						

Calculations

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B} \qquad r_o = \frac{\Delta V_{CE}}{\Delta I_C} \qquad \beta = \frac{I_C}{I_B}$$

(XIV) Results

(1) Input resistance = …………… Ω

(2) Output resistance = …………… Ω

(3) Current amplification factor β = ……………

(XV) Interpretation of Results

(XVI) Conclusions and Recommendations

(XVII) Practical Related Questions

(1) Write the steps to identify emitter, base and collector terminals of given transistor.

(2) State the range of ammeter and voltmeter selected

(3) The BJT has I_B-10 μA, I_{CO}=1 μA what is collector current I_C? (Take value of β obtained from the graph)?

Space for Answers]

(XVIII) Suggested Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	**40%**
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

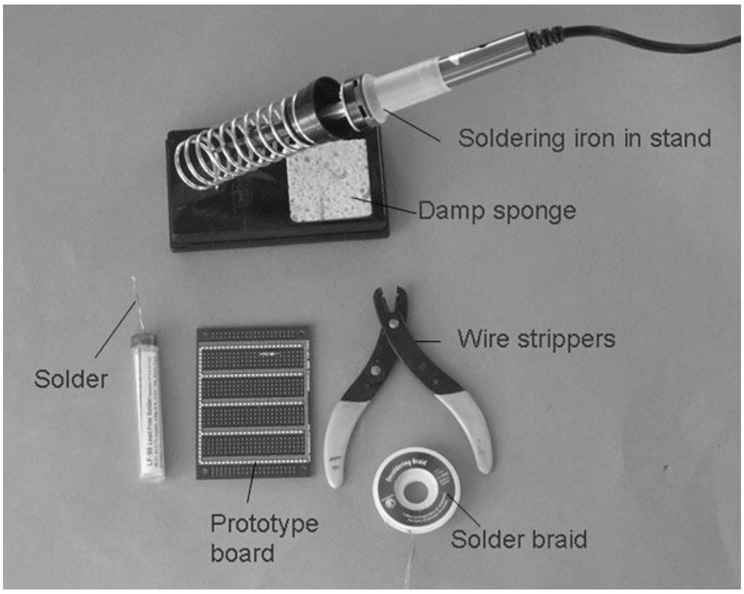
Practical No. 22 : * Soldering and De - soldering

(I) Aim : Soldering and de- soldering given passive active components on PCB

(II) Theory

(III) Soldering Basics

Materials Needed for Soldering



(A) Soldering Iron

- A soldering iron is used to heat the connections to be soldered.
- For electronic circuits, you should use a 25- to 40-watt (W) soldering iron.
- Higher wattage soldering irons are not necessarily hotter; they are just able to heat larger components.
- A 40-W soldering iron makes joints faster than a 25-W soldering iron does.

(B) Solder/Soldering Lead (Rosin Core Solder)

- Solder has a lower melting point than the metals that are being connected do. The solder melts when it is heated by the soldering iron, but the metals being joined will not melt.
- The rosin core acts as a flux. It prevents oxidation of the metals that are being connected, and enhances the ability of the solder to "wet" the surfaces that are being joined.
- Solder that is used to join copper pipes has an acid core, which is appropriate for pipes, but will corrode electronic connections. Use solder that has a rosin core.
- For most electronics work, a solder with a diameter of 0.75 millimeters (mm) to 1.0 mm is best.
- Thicker solder might make soldering small joints difficult and also increases the chances of creating solder bridges between copper pads that are not meant to be connected.
- An alloy of 60/40 (60% tin, 40% lead) is used for most electronics work, but lead-free solders are available as well.

(C) Soldering Stand

- There are a variety of stands available. It is important to always keep the hot iron in its stand when not in use.

(D) Sponge

- The damp sponge is used to clean the tip of the iron.

(E) Solder Braid

- This is used to remove solder.
- To use the braid, place it over the solder to be removed and heat it from above with the iron. The solder will flow into the braid.
- Solder braid is used to extract an electronic component that is soldered onto a board.
- It is also used to reduce the amount of solder on a connection.

(F) Prototype Board

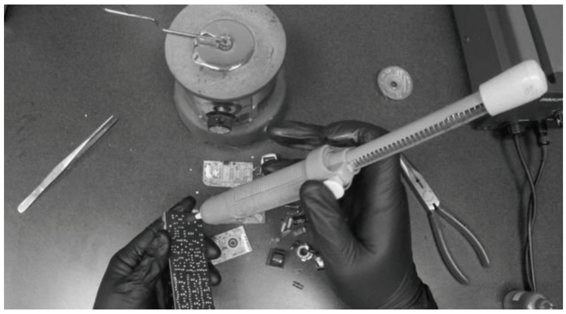
- A prototype board is used to assemble the circuit.
- Prototype boards have copper tracks or pads for connecting components.
- G. Steel wool or Fine Sandpaper
- This is used to clean connections prior to soldering.
- Solder will not flow over a dirty connection.

Desoldering Basics

Materials Needed for Desoldering

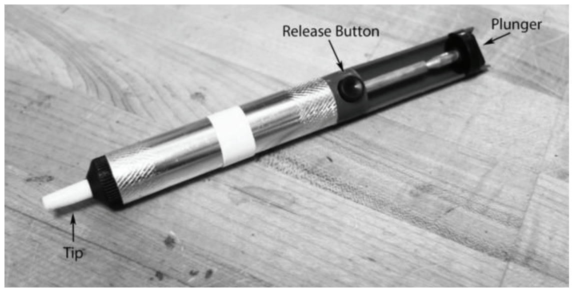
(a) Solder Sucker/ Desoldering Pump

The most commonly used and convenient equipment needed for desoldering is the desoldering pump. A good manual solder sucker like this one works pretty well for selectively removing through holes parts from a PCB. Cheaper and smaller units do not work as well. They're marketed as compact but they don't works as well due to the limited stroke length and smaller cylinders.



Desoldering Process

One of the nicest ways to desolder a component involves using a desoldering pump. A desoldering pump is essentially a small, high pressure vacuum. After heating up the solder, you can use the desoldering pump to suck the solder up and out of the way. Here are the basic steps for using a hand-powered desoldering pump:



(IV) Procedure

(A) Soldering

(1) Solder needs a clean surface on which to adhere.
   - Buff the copper foil of a PC board with steel wool before soldering.
   - Remove any oil, paint, wax, etc. with a solvent, steel wool, or fine sandpaper.

(2) To solder, heat the connection with the tip of the soldering iron for a few seconds, then apply the solder.
   - Heat the connection, not the solder.
   - Hold the soldering iron like a pen, near the base of the handle.
   - Both parts that are being soldered have to be hot to form a good connection.

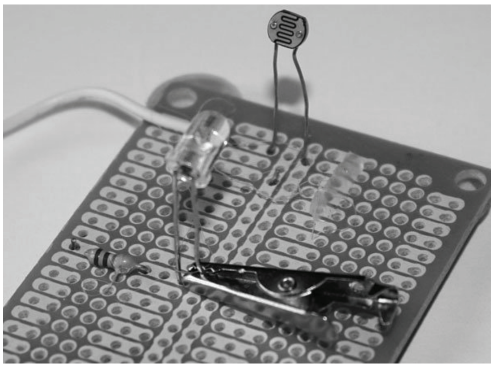
(3) Keep the soldering tip on the connection as the solder is applied.
   - Solder will flow into and around well-heated connections.
   - Use just enough solder to form a strong connection.

(4) Remove the tip from the connection as soon as the solder has flowed where you want it to be. Remove the solder, then the iron.

(5) Don't move the connection while the solder is cooling.

(6) Don't overheat the connection, as this might damage the electrical component you are soldering.

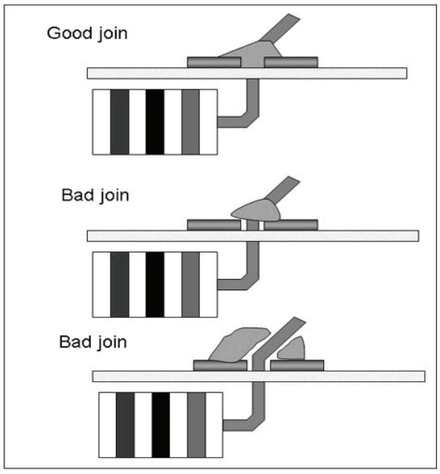
- Transistors and some other components can be damaged by heat when soldering. A crocodile clip can be used as a heat sink to protect these components.



(7) Soldering a connection should take just a few seconds.

(8) Inspect the joint closely. It should look shiny.

- If you are soldering a wire (called the lead) onto a PC board (on the track), it should have a volcano shape.
- If the connection looks bad, reheat it and try again.



(9) Wipe the tip of the iron on a damp sponge to clean it. The tip should now be shiny.

(10) Unplug the soldering iron when it is not in use

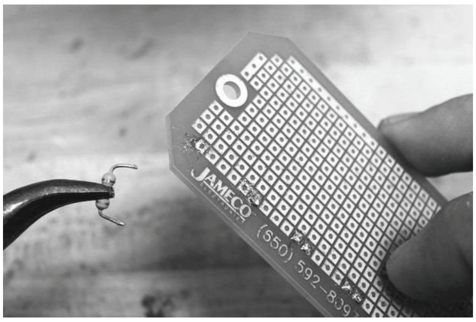
(B) Desoldering

(1) Heat up the solder you want to remove with a soldering iron (some desoldering pumps also come with attached irons).

(2) Press down on the plunger (If your pump has a bulb, just squeeze the bulb).

(3) Once the solder is molten, place the tip of the desoldering pump against the solder that you want to remove.

(4) Release the plunger or bulb. Some desoldering pumps have a release button so that you don't have to hold it the whole time.



(5) Remove free component.

(6) Repeat steps 1-4 to remove any excess solder.

(7) Dispose of the solder inside the pump by repeatedly pressing down and releasing the plunger.

(V) Conclusions (Actions to be taken based on the interpretations)

(VI) Practical Related Questions (Provide space for answers)

(1) What is the main purpose of soldering and desoldering?

(2) What is the main tool used in soldering?

[Space for Answers]

(VII) References/Suggestions for further Reading

(1)www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(VIII) Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	**40%**
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 23 : Test performance of Zener Diode

(I) Practical Significance

Zener diodes are widely used as voltage references and as shunt regulators to regulate the voltage across small circuits. The student will be able to plot the forward and reverse characteristics of the Zener diode and measure the Zener voltage.

(II) Industry/Employer Expected Outcome(s)

Electrical and Electronic industries use different types of DC power supplies with different voltage and current ratings. Zener diode works as a voltage regulator in DC power supply. The Employee should be able to test Zener diode for its ratings.

(III) Course Level Learning Outcome(s)

Use relevant diode in different Electronic circuits.

(IV) Laboratory Learning Outcome(s)

LLO Check the forward and reverse VI characteristics of Zener diode.

(V) Relevant Affective Domain Related Outcome(s)

(1) Handle components and equipment carefully. (2) Follow the safety precautions.

(VI) Relevant Theoretical Background (With diagrams if required)

Zener diode is formed by combining highly doped P and N semiconductor materials. It works on the principle of Zener breakdown and is normally operated in reverse breakdown region. In reverse breakdown region, high current flow through the diode leading to high power dissipation.

The Zener breakdown occurs when the electric field across the junction produced due to the reverse voltage is sufficiently high, this breaks covalent bonds. Thus a large numbers of carriers are generated which causes a more current to flow. This mechanism is called as Zener breakdown. After Zener breakdown the reverse current increases sharply but voltage across Zener diode remains constant. Zener resistance of a Zener diode is a ratio of reverse Zener voltage to the reverse Zener current.

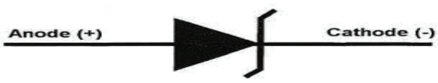


Fig. 23.1 : Symbol of Zener diode

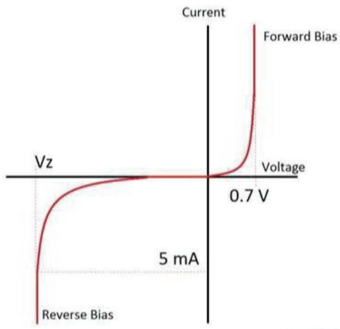


Fig. 23.2 : V-I Characteristics of Zener diode

(VII) Actual Circuit diagram used in laboratory with equipment Specifications

(a) Sample

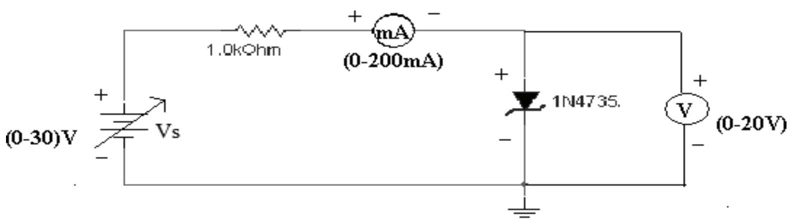


Fig. 22.3 : Zener diode in forward bias

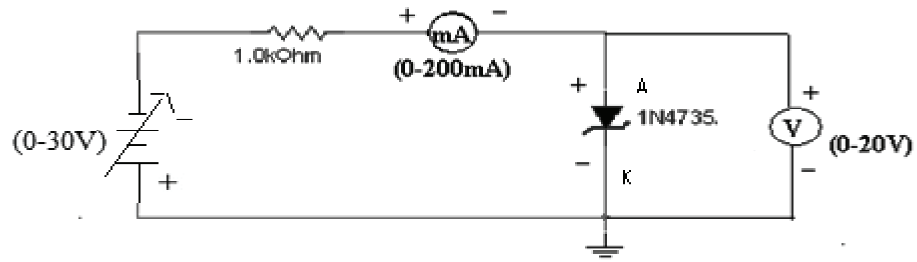


Fig. 22.4 : Zener diode in reverse bias

(VIII) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Instrument/Components	Specification	Quantity
1	Digital Multimeter	Digital Multimeter	2
2	DC Regulated power supply	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current.	1
3	Voltmeter	0-20V	1
4	Ammeter	(0-200ma,0-200 μA)	1
5	Bread board	5.5 CM × 17 CM	1
6	Zener Diode	IN4735 (or any other equivalent diode)	1
7	Resistor	1 KΩ(0.5 watts / 0.25 watta)	1
8	Connecting wires	Single strand Teflon coating(0.6mm diameter)	As per requirement

(IX) Precautions to be followed

(1) Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.

(2) While doing the experiment do not exceed the input voltage of the Zener diode beyond the rated voltage of diode. This may lead to damaging of the diode.

(3) Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

(X) Procedure

(1) Connect the circuit as shown in Fig. 16.2.

(2) Switch ON the power supply.

(3) Record the forward voltage and forward current in the observation table nol.

(4) Increase the input voltage in step of 0.1 V

(5) Record the forward voltage and forward current in the observation table nol.

(6) Repeat steps 4 to 5 till 1 V is reached.

(7) Plot the graph for the forward bias characteristics of Zener diode by taking forward voltage on X-axis and forward current on Y-axis.

(8) Connect the circuit as shown in Fig. 16.3.

(9) Vary input voltage gradually in steps of 1V up to 12V.

(10) Record the corresponding readings of reverse voltage and reverse current in the observation table No. 2.

(11) Plot the graph for the reverse bias characteristics of Zener diode by taking V_R on X-axis and I_R on Y-axis.

(XI) Required Resources/Apparatus/ Equipment with Specifications

S. No	Instruments/Components	Suggested broad specification	Quantity
1			
2			
3			

(XII) Actual Procedure followed

(XIII) Observations and Calculations

Table 1 : Measurement of V_F and I_F

Sr. No	V_F (volt)	I_F (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		

Table 2 : Measurement of V_R and I_R

Sr. No	V_R (volt)	I_R (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		

Calculations

$R_F = \frac{\Delta V_F}{\Delta I_F}$ ohm $\qquad R_Z = \frac{\Delta V_R}{\Delta I_R}$ ohm

(XIV) Results

(1) Zener breakdown voltage = …………………….. V.

(2) Zener resistance = …………………….. Ω

(XV) Interpretation of Results (Giving Meaning to the Results)

(XVI) Conclusions and Recommendation

(XVII) Practical Related Questions

(1) What is the value of Zener voltage for given zener diode?

(2) What is the maximum value of reverse current for given zener diode?

(3) What is the effect on voltage across zener diode and current flowing through it, when reverse voltage across it is more than breakdown voltage?

(4) What portion of zener diode characteristics is most useful for voltage regulation applications?

Space for Answers]

(XVIII) References/ Suggestions for Further Reading; Includes Websites

https://www.youtube.com/watch?v=itzPT3UbC1I

(XIX) Marking Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10%
2	Identification of component	20%
3	Measuring value using suitable instrument	20%
4	Working in team	10%
	Product related (10 Marks)	**40%**
5	Calculate theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

Name of student Team Members

(1) .... (2) ....

(3) .... (4) ....

Marks Obtained			Dated signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Scale -

X-Axis -

Y-Axis -

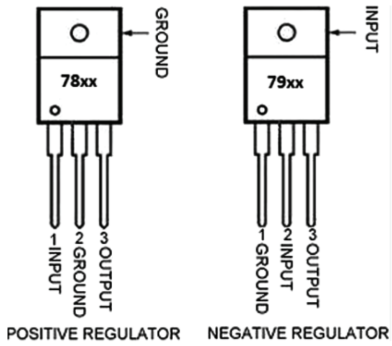
Practical No. 24 : Three Terminal Voltage Regulators

(I) Aim : Identify terminals of three terminal positive and negative voltage regulator

(II) Theory

Three terminal voltage regulators have three terminals which are unregulated input (Vin), regulated output (Vo) and common or a ground terminal. These regulators do not require any feedback connections.

Positive voltage regulators : 78xx is the series of three terminal positive voltage regulators in which xx indicate the output voltage rating of the IC. 7805.This is a three terminal regulator which gives a regulated output of +5V fixed. The maximum unregulated input voltage which can be applied to 7805 is 35V.



7809 : This is also three terminal fixed regulator which gives regulated voltage of +9V.

Negative voltage regulators: 79xx is the series of negative voltage regulators which gives a fixed negative voltage as output according to the value of xx. 7912: This is a negative three terminal voltage regulator which gives a output of -12V.

Line Regulation: It is defined as the change in the output voltage for a given change in the input voltage. It is expressed as a percentage of output voltage or in millivolts.

$$\%RL = \Delta V_o / \Delta V_{in} \times 100$$

Load Regulation: It is the change in output voltage over a given range of load currents that is from full load to no load. It is usually expressed in millivolts or as a percentage of output voltage.

$$\%R\ Load = [(V_{nl} - V_{fl})/V_{nl}] \times 100$$

(III) Required Resources/Apparatus/Equipment with Specification

Sr. No.	Name of Resources	Suggested Broad Specification	Quantity
1			
2			
3			
4			

(IV) Procedure

HOW TO CHECK YOUR 78XX SERIES REGULATOR?

(DMM) Means Digital MultiMeter

Step-1. Select Digital MultiMeter Selector Knob to DIODE MODE, Connect DMM positive test lead to PIN-1 DMM Negative test lead to PIN-2 = Display reading shows OL DMM READING (OL MEANS OVER LOAD)

DMM Negative test lead to PIN-3 = Display reading shows OL

Step-2 : Connect DMM Negative test lead to PIN-1

DMM positive test lead to PIN-2 = 0.527V OR It means 527 mV

DMM positive test lead to PIN-3 = 0.544V

Step-3 : DMM positive test lead to PIN-2

DMM Negative test lead to PIN-1 DISPLAY READING 0.521.v

DMM Negative test lead to PIN-3 DISPLAY READING 0.578.v

Step-4 : DMM Negative test lead to PIN-1
DMM positive test lead to PIN-2 =DISPLAY READING shows OL.
DMM positive test lead to PIN-3 = DISPLAY READING shows OL
Step-5 : DMM Positive test lead to PIN-3
DMM Negative test lead to PIN-1 Display Reading shows 0.538v
DMM Negative test lead to PIN-2 READING shows OL
Step-6 : DMM Negative test lead to PIN-3
DMM positive test lead to PIN-1 =DISPLAY READING shows OL.
DMM positive test lead to PIN-2 = DISPLAY READING shows 0.578V.
Verification: If the DMM above reading shows the condition is GOOD.

How to test a Negative voltage regulator with DMM?

Step-1. Select Digital MultiMeter Selector Knob to DIODE MODE,
Connect **DMM positive test lead** to PIN-1
DMM **Negative test lead** to PIN-2 = Display reading shows OL DMM READING (OL MEANS OVER LOAD)
DMM **Negative test lead** to PIN-3 = Display reading shows OL

Step-2.
Connect **DMM Negative test lead** to PIN-1
DMM **positive test lead to** PIN-2 = 0.507 V OR It means 507Mv
DMM **positive test lead** to PIN-3 = 0.634V

Step-3.
DMM **positive test lead** to PIN-2
DMM **Negative test lead** to PIN-1 DISPLAY READING 0.508.v
DMM **Negative test lead** to PIN-3 DISPLAY READING 0.505.v

Step-4.
DMM Negative test lead to PIN-1
DMM **positive test lead** to PIN-2 =DISPLAY READING shows OL.
DMM **positive test lead** to PIN-3 = DISPLAY READING shows OL

Step-5.
DMM **Positive test lead** to PIN-3
DMM **Negative test lead** to PIN-1 Display Reading shows 0.638v
DMM **Negative test lead** to PIN-2 READING shows OL

Step-6.
DMM Negative test lead to PIN-3
DMM positive test lead to PIN-1 =DISPLAY READING shows OL.
DMM positive test lead to PIN-2 = DISPLAY READING shows 0.508V.
Verification: If the DMM above reading shows the condition is GOOD.

(V) Actual Procedure followed

(VI) Observations

Test lead	IC 78XX	Voltage	IC 79XX	Voltage
DMM positive test lead to PIN-1	Pin __ & Pin __		Pin __ & Pin __	
DMM negative test lead to PIN-1	Pin __ & Pin __		Pin __ & Pin __	
DMM positive test lead to PIN-1	Pin __ & Pin __		Pin __ & Pin __	
DMM negative test lead to PIN-1	Pin __ & Pin __		Pin __ & Pin __	
DMM positive test lead to PIN-1	Pin __ & Pin __		Pin __ & Pin __	
DMM negative test lead to PIN-1	Pin __ & Pin __		Pin __ & Pin __	

(VII) Interpretation of Results (Giving meaning to the results)

(VIII) Conclusions (Actions to be taken based on the interpretations)

(IX) Practical Related Questions (Provide space for answers)

(1) What is the use of 78xx and 79xx voltage regulators in a dual power supply?

(2) What is a 3-terminal regulator?

[Space for Answers]

(X) References/Suggestions for further Reading

(1) www.electrical4u.com (2) www.howstuffworks.com (3) www.electricaltechnology.org

(XI) Assessment Scheme

	Performance Indicators	**Weightage**
	Process related (15 Marks)	**60%**
1	Handling of the components	10%
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8	Practical related questions	15%
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	Total (25 Marks)	**100%**

Name of student Team Members

(1) ………………………………………………… (2) …………………………………………………

(3) ………………………………………………… (4) …………………………………………………

Marks Obtained			**Dated signature of Teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

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