I

Name _____

Roll No. _____ Year 20____ 20____

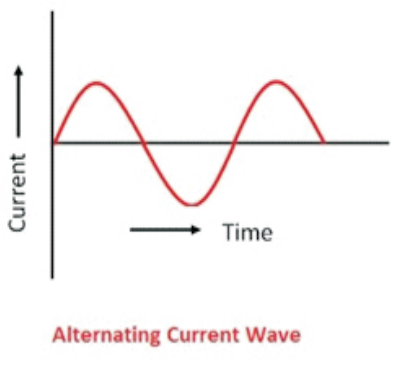
Exam Seat No. _____

ELECTRONICS & COMPUTER GROUP | SEMESTER - II | DIPLOMA IN ENGINEERING AND TECHNOLOGY

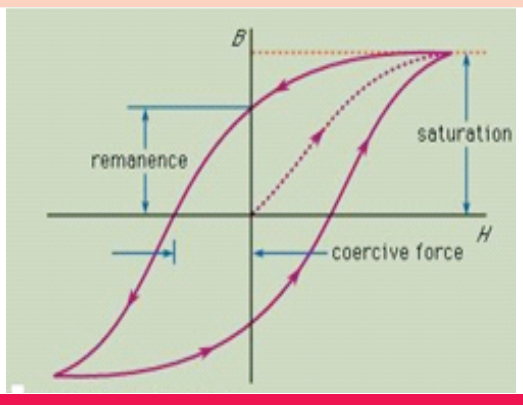
A LABORATORY MANUAL

FOR

ELEMENTS OF ELECTRICAL ENGG. (22215)



Alternating Current Wave



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual for

Elements of Electrical Engineering

(22215)

Semester-II

(EJ/EX/EN/ET/EQ/IS/IC/CO/CM/CW/IF/DE/IE)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO 9001 : 2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on December, 2017)

MAHARASHTRA STATE

BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr. / Ms. …… Roll No. ……., of First Semester of Diploma in…….. …… of Institute,……. ……. (Code: ……...) has completed the term work satisfactorily in Subject **Elements of Electrical Engineering (22215)** 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 'I' 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 practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals 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.

This course deals with the basic fundamentals of electrical engineering and working principles of commonly used AC and DC motors and their characteristics. The basic concepts of electrical engineering in this course will be very useful for understanding electrical 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

Following programme outcomes are expected to be achieved out of the programme outcomes through the practicals of the course on:

PO 1. : **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics related problems.

PO 2. : **Discipline knowledge:** Apply basic electrical knowledge to solve related problems.

PO 3. : **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based basic electrical related problems.

PO 4. : **Engineering tools:** Apply relevant electrical technologies and tools with an understanding of the limitations.

PO 5. : **The engineer and society:** Assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Electrical.

PO 6. : **Environment and sustainability:** Apply basic electricalengineering solutions also for sustainable development practices in social and environmental contexts using programming language.

PO 7. : **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electrical.

PO 8. : **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO 9. : **Communication:** Communicate effectively in oral and written form.

PO 10. : **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Electrical engineering and allied industry.

List of Industry Relevant Skills

The following industry relevant skills of the competency **"Use electrical equipment in industrial applications."** are expected to be developed in you by undertaking the practicals of this laboratory manual.

1. Use principles of magnetic circuits.
2. Use single phase AC supply for electrical and electronics equipment.
3. Use three phase AC supply for industrial equipment and machines.
4. Connect transformers and DC motors for specific requirements.
5. Use FHP motors for diversified applications.
6. Use relevant protective devices/switchgear for different requirements.

Brief Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each experiment
3. Involve students in performance of each experiment.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.

Instructions for Students

1. Listen carefully the lecture given by teacher about subject, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make record all programs.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and gain confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
6. Student shall refer technical magazines.
7. Student should develop habit to submit the practicals on date and time.
8. Student should well prepare while submitting write-up of exercise.
9. Attach /paste separate papers wherever necessary.

Practical- Course Outcome matrix

Course Outcomes (COs)

a. Use principles of magnetic circuits.
b. Use single phase AC supply for electrical and electronics equipment.
c. Use three phase AC supply for industrial equipment and machines.
d. Connect transformers and DC motors for specific requirements.
e. Use FHP motors for diversified applications.
f. Use relevant protective devices/switchgear for different requirements.

S. No.	Title of the Practical	CO a.	CO b.	CO c.	CO d.	CO e.	CO f.
1.	Determine the permeability of magnetic material by plotting it's B- H curve.	√	-	-	-	-	-
2.	Determine frequency, time period, peak value, rms value, peak factor and form factor of a sinusoidal A.C. waveform on C.R.O. Part I	-	√	-	-	-	-
3.	Determine frequency, time period, peak value, rms value, peak factor and form factor of a sinusoidal A.C. waveform on C.R.O. Part II	-	√	-	-	-	-
4.	Find the phase difference between voltage and current on C.R.O. for resistive, inductive and capacitive circuits. Part I	-	√	-	-	-	-
5.	Find the phase difference between voltage and current on C.R.O. for resistive, inductive and capacitive circuits. Part II	-	√	-	-	-	-
6.	Connect balanced star and delta load connections to get the required voltage and currents. Part I	-	-	√	-	-	-
7.	Connect balanced star and delta load connections to get the required voltage and currents. Part II	-	-	√	-	-	-
8.	Determine voltage and current ratio of single phase transformer.	-	-	-	√	-	-
9.	Operate the DC shunt motor using 3-point starter.	-	-	-	√	-	-
10	Operate the DC shunt motor using 4-point starter.	-	-	-	√	-	-
11	Reverse the direction of rotation of single phase induction motor.	-	-	-	-	√	-

12	Reverse the direction of rotation of Universal motor.	-	-	-	-	√	-
13	Identify switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB. Part I	-	-	-	-	-	√
14	Identify switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB. Part II	-	-	-	-	-	√
15	Test circuit using series lamp and multimeter.	-	-	-	-	-	√
16	Use the earth tester.	-	-	-	-	-	√
17	Use the insulation tester.	-	-	-	-	-	√
18	Use different types of digital clamp-on meters	-	-	-	-	-	√

Content Page

List of Practicals and Progressive Assessment Sheet

S. No.	Title of the practical	Page No.	Date of performance	Date of submission	Assessment marks(10)	Dated sign. of teacher	Remarks (if any)
12.	Reverse the direction of rotation of Universal motor.	55					
13.	Identify switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB. Part I	60					
14.	Identify switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB. Part II	65					
15.	Test circuit using series lamp and multimeter.	70					
16.	Use the earth tester.	75					
17.	Use the insulation tester.	80					
18.	Use different types of digital clamp-on meters	86					
Total Marks							

- To be transferred to proforma of CIAAN-2017.

Practical No. 01: Determine the permeability of magnetic material by Plottingits B-H curve.

I Practical Significance

B-H curve is necessary to calculate permeability of magnetic materials. B-H curve is different for different magnetic materials, used in various electrical equipments.

II Relevant Program Outcomes (POs)

PO1- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems.
PO3- **Experiments and practice:** Plan to perform experiments and practices to use the Results to solve broad-based interdisciplinary engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use electrical equipments in industrial applications'***
1.Identify different types of magnetic materials.
2.Interpret circuit diagrams

IV Relevant Course Outcome(s)

Use principles of magnetic circuits.

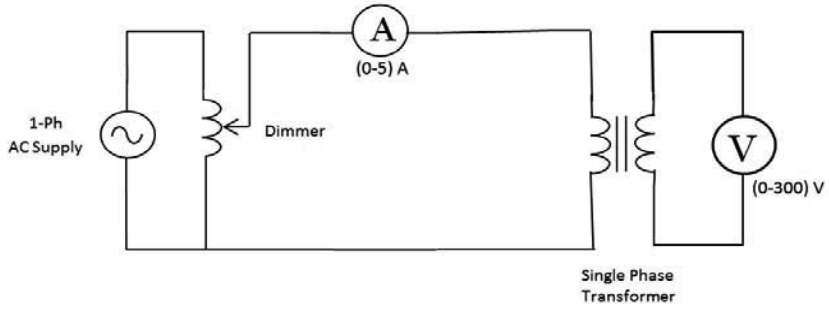
V Practical Outcome

Use magnetic material to:
i. Plot the B-H curve.
ii. Calculate permeability of the material.

VI Minimum Theoretical Background

Magnetization Curve: The non-linear relation between flux density (B) and magnetic field strength (H) for the magnetic material is known as magnetization curve (B-H curve).
Absolute permeability: The relationship is expressed as $B = \mu H$, where μ is called as absolute permeability of magnetic material.
In this experiment measured current is proportional to H and measured voltage is proportional to B.

VII Circuit diagram



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	EMF source	ampere=0-1A Voltage=0-300V	1 No.
2	Voltmeter	0-300voltage	1 No.
3	Ammeter	0-1 A	1 No.
4	Single Phase Transformer	1 kVA, 230/115V	1 No.

IX Precautions to be Followed

1. Avoid loose connections
2. Don't touch wire with wet hand.

X Procedure

1. Select the Single Phase Transformer.
2. Select the relevant voltmeter, ammeter.
3. Connect the circuit as per circuit diagram.
4. Vary the dimmer, measure the current and voltage.
5. Plot B-H curve and calculate permeability by drawing tangent to linear portion of the curve.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Qty	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XII Actual Procedure Followed

……

……

XIII Precautions Followed

……

……

XIV Observations and Calculations

S.No.	Voltage (V) (volt)	Current(I)(ampere)
1		
2		
3		
4		
5		
6		
7		
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9		

XV Results

Value of permeability=

XVI Interpretation of Results (Giving meaning to the results)

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……

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

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……

XVIII 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. Which of the following are magnetic materials
   Copper, Silicon-Steel, Mica, Cobalt, Aluminum, Nickel, Wood.
2. Write the relation between B and H and also between other quantities like flux, MMF, ampere turns, voltage induced E, Current I.
3. Draw B-H curve for nonmagnetic material.
4. Draw hysteresis loop for magnetic material. Mark all parameters.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance Indicators		Weightage	Marks obtained
Process Related (15 Marks)		**60%**	
1	Handling of the instrument	20%	
2	Determination of current and voltage	40%	
Product Related (10 Marks)		**40%**	
3	Plot B-H curve and interpretation of result	20%	
4	Conclusion	10%	
5	Practical related questions	10%	
	Total (25 Marks)	**100 %**	

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No.02: Determine frequency, time period, peak value, rms value of a Sinusoidal A.C. waveform on CRO. Part I.

I Practical Significance

An alternating ac waveform is one that varies in both magnitude and direction in more or less an even manner with respect to time. An AC function can mathematically represent either a power source or a signal source with the shape of an *AC waveform*.

II Relevant Program Outcomes (POs)

PO1- Basic knowledge- Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems

PO3- Experiments and practice- Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipment in industrial applications'.**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcomes

Use single phase AC supply for electrical and electronic equipment.

V Practical Outcome

Determine frequency, time period, peak value, rms value of a sinusoidal A.C. waveform by observing it on C.R.O.

VI Minimum Theoretical Background

AC Waveform Characteristics:

• The Time period, (T)–

Time taken in seconds by an alternating quantity to complete one cycle is called time period. It is denoted by 'T' seconds.

• The Frequency, (f)

The number of cycles completed in one second is called frequency. It is denoted by 'f'(Hz).

$$f=1/T$$

• The Amplitude (A)

It is the magnitude or intensity of the signal waveform measured in volts or amps.

Average value

The average value of alternating quantity is equal to the average of all the instantaneous values over a period of half cycle.

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

RMS value

The R.M.S value is equivalent value of current which produced same amount of heat as that value of dc current through same resistance for the same time.

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

VII Circuit diagram

VIII Resources required

S. No.	Name of Instrument	Specifications	Quantity	Remarks
1	CRO with probe	10Hz-30MHz	01	
2	Function generator	0.1 Hz-11MHz	01	

IX Precautions to be followed (if any)

Connect the function generator output to the CRO's channel using CRO probe properly.

X Procedure

1)Connect the function generator output to the CRO's channel using CRO probe.
2) Adjust the volt per division and time per division of CRO such that the waveform of the current or voltage can be observed properly.
3) Adjust the peak to peak value of voltage.
4) Measure and note down the time period and peak value of sine wave.
5) Switch off the supply.

XI Actual procedure followed

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XII Resources used (with major specifications)

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

XIII Precautions followed

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XIV Observations

1. Time period of ac waveform (T)= ……..division.
2. Peak value of ac waveform = ……division.
3. Time per division =
4. Voltsper division =

Calculations-

1) Time period of ac waveform (T)= …..div x ……time per div=…….sec.
2) Peak value of ac waveform = …..div x…..volt per div=…….v.
3) R.M.S value of ac waveform=Peak value x 0.707=……v
4) Average value of ac waveform=Peak value x 0.637=……v

XV Results

1. Time period=……..sec.
2. Peak value=…….v.
3. R.M.S value=……..v.
4. Average value=……v.

XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations)

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XVIII Sample 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. The value indicated by electrical measuring instrument is…….(average value/rms value)

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No. 03: Determine frequency time period, peak value, rms value, peak factor, form factor, of a Sinusoidal A.C. waveform on CRO part II.

I Practical Significance

An alternating ac waveform is one that varies in both magnitude and direction in more or less an even manner with respect to time. An AC function can mathematically represent either a power source or a signal source with the shape of an *AC waveform*.

Peak factor and Form factor of different wave shapes are different.

II Relevant Program Outcomes (POs)

PO1- Basic knowledge- *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems.*

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcomes

Use single phase AC supply for Electrical and electronic equipments.

V Practical Outcome

Determine peak factor and form factor of a sinusoidal A.C. waveform by observing it on C.R.O.

VI Minimum Theoretical Background

AC Waveform Characteristics

Form Factor: The **form factor** of an alternating current waveform (signal) is the ratio of the RMS (root mean square) value to the average value of waveform

Peak Factor or Crest **factor** is a measure of a waveform, such as alternating current showing the ratio of **peak** values to the rms value

VII Circuit diagram

VIII Resources required

S. No.	Name of Instrument	Specifications	Quantity	Remarks
1	CRO with probe	10Hz-30MHz	01	
2	Function generator	0.1 Hz-11MHz	01	

IX Precautions to be followed (if any)

Connect the function generator output to the CRO's channel using CRO probe Properly.

X Procedure

1)Connect the function generator output to the CRO's channel using CRO probe.
2) Adjust the volt per division and time per division of CRO such that the waveform of the current or voltage can be observed properly.
3) Adjust the peak to peak value of voltage.
4) Measure and note down the time period and peak value of sine wave.
5) Switch off the supply.

XI Resources used (with major specifications)

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

XII Actual Procedure followed

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XIII Precautions followed

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XIV Observations

1. Time period of ac waveform (T)= ……..division.
2. Peak value of ac waveform = ……division.
3. Time per division =
4. Volts per division =

Calculations-

1) Time period of ac waveform (T)= …..div x ……time per div=…….sec.
2) Peak value of ac waveform = …..div x…..volt per div=…….v.
3) R.M.S value of ac waveform=Peak value x 0.707=……v
4) Average value of ac waveform=Peak value x 0.637=……v
5) Peak factor=Peak value/R.M.S value
6) Form factor=R.M.S value/Average value

XV Results

1. Time period=……..sec.
2. Peak value=…….v.
3. R.M.S value=……..v.
4. Average value=……v.
5. Peak factor=……
6. Form factor=……..

XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations)

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.....

XVIII Sample 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 form factor and peak factor for 50 Hz sinusoidal AC supply.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No.04: Find phase difference between voltage and current on CRO for resistive, inductive and capacitive circuits. Part- I

I Practical Significance

Phase difference between voltage and current in a circuit depends on parameters of the circuit. Based on this, circuit has lagging, leading or unity power factor.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems.*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems*.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcome(s)

Use single phase AC supply for electrical and electronics equipment.

V Practical Outcome

Determine the phase difference between voltage and current by observing their waveforms on C.R.O. for inductive circuit.

VI Minimum Theoretical Background

The **phase difference** or phase shift as it is also called of a Sinusoidal Waveform is the angle Φ (Greek letter Phi), in degrees or radians that the waveform has shifted from a certain reference point along the horizontal zero axis. In other words phase shift is the lateral difference between two or more waveforms along a common axis and sinusoidal waveforms of the same frequency can have a phase difference.

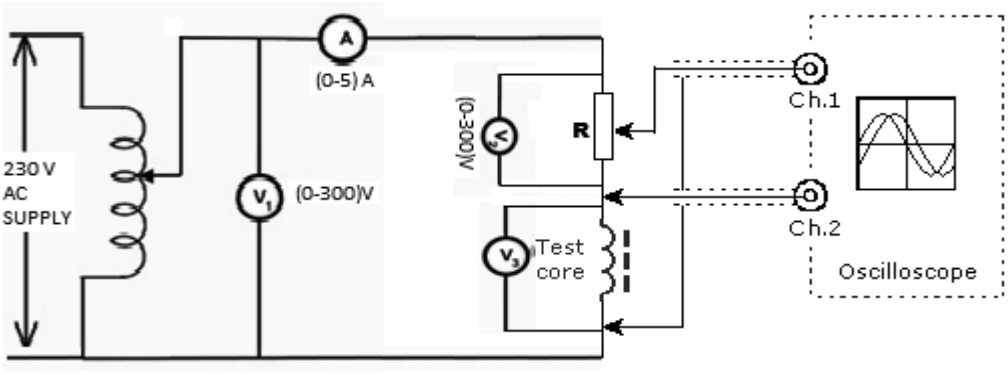
The phase difference, Φ of an alternating waveform can vary between 0 to its maximum time period, T of the waveform during one complete cycle and this can be anywhere along the horizontal axis between, $\Phi = 0$ to 2π (radians) or $\Phi = 0$ to 360^{o}depending upon the angular units used.

Then the equation for the instantaneous value of a sinusoidal voltage or current waveform for pure resistive circuit are $i_r = I_m \sin\omega t$ and $v_r = V_m \sin\omega t$

and for pure inductive circuit are $i_L = I_m \sin\omega t$ and $v_L = V_m \sin(\omega t + 90)$

And for R-L circuit $i = I_m \sin\omega t$ and $v = V_m \sin(\omega t + \phi)$ Where ϕ represents phase angle.

VII Experimental set-up



VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Rheostat	Suitable Rheostat	1	
2	Inductor	Suitable Inductor	1	
3	Voltmeter	Suitable Voltmeter	3	
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 voltage.
4. Plot the waveform for voltage across R and current
5. Plot the waveform for voltage across test core (L) and current.

XI Resources used

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

XII Actual procedure followed

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……

XIII Precautions Followed

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XIV Observations and Calculations

1. phase difference measured on CRO=

S.N.	V1	V2	V3	CURRENT(I)

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations)

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XVIII 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. Give current ,voltage relation in R,L,C element
2. Draw phasor diagram showing relation between V_1,V_2,V_3.
3. Obtain phase difference between supply voltage and current for your set up.
4. Calculate power factor of the circuit.
5. Calculate active and reactive power of the circuit for any one set of readings.
6. Draw power triangle.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No.05: Find phase difference between voltage and current on CRO for resistive, inductive and capacitive circuits. Part- II

I Practical Significance

Phase difference between voltage and current in a circuit depends on parameters of the circuit. Based on this, circuit has lagging, leading or unity power factor. Capacitive circuit has leading power factor.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems.*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems*.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcome(s)

(a) Use single phase AC supply for electrical and electronics equipment.

V Practical Outcome

Determine the phase difference between voltage and current by observing their waveforms on C.R.O. for capacitive load.

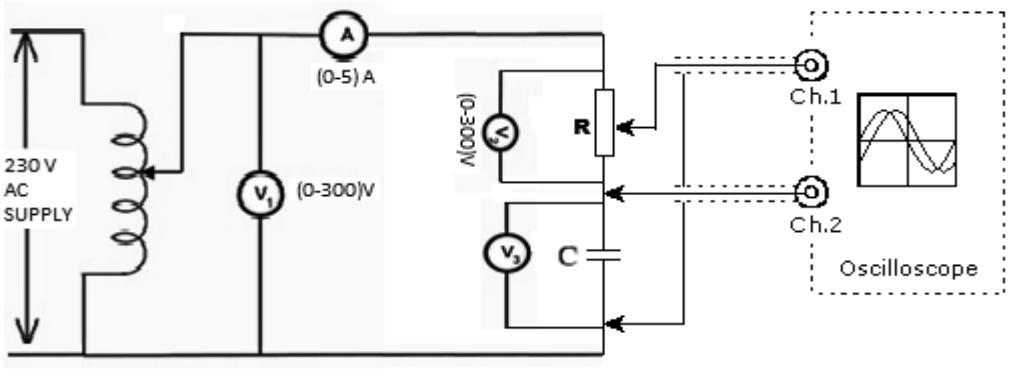
VI Minimum Theoretical Background

The **phase difference** or phase shift as it is also called of a Sinusoidal Waveform is the angle Φ (Greek letter Phi), in degrees or radians that the waveform has shifted from a certain reference point along the horizontal zero axis. In other words phase shift is the lateral difference between two or more waveforms along a common axis and sinusoidal waveforms of the same frequency can have a phase difference.

The phase difference, Φ of an alternating waveform can vary between 0 to its maximum time period, T of the waveform during one complete cycle and this can be anywhere along the horizontal axis between, $\Phi = 0$ to 2π (radians) or $\Phi = 0$ to 360^{o}depending upon the angular units used.

Then the equation for the instantaneous value of a sinusoidal voltage or current waveform expression for a pure capacitive circuit becomes. $i_c=I_m \sin(\omega t)$ and $v_c=V_m \sin(\omega t-90^0)$

VII Experimental set-up



VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Rheostat	Suitable Rheostat	1	
2	Inductor	Suitable Inductor	1	
3	Voltmeter	Suitable Voltmeter	3	
4	Ammeter	Suitable Ammeter	1	
5	CRO	With 2 attenuator / Differential 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.
4. Plot the waveform.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

S.N.	V1	V2	V3	CURRENT(I)

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations)

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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. Give current, voltage relation in R,L,C element
2. Draw phasor diagram showing relation between V_1,V_2,V_3.
3. Obtain phase difference between supply voltage and current for your set up.
4. Calculate power factor of the circuit.
5. Calculate active and reactive power of the circuit for any one set of readings.
6. Draw power triangle.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. ……
3. ……
4. ……

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

Practical No. 06 : Connect balanced star and delta load connections to get the required voltage and current. Part I.

I Practical Significance

In practice large power applications use three phase systems. In a three phase circuit loads can be connected in balanced star and delta mode. It is necessary to formulate voltage and current relations for system parameters for testing, calculations and interpretations.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems.*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems..*

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcome(s)

Use three phase AC supply for industrial equipment and machines.

V Practical Outcome

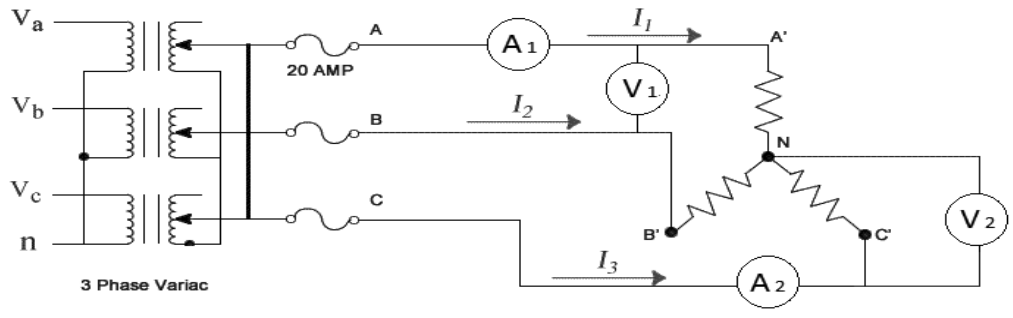
Determine the relation between line and phase values of voltages and currents for balanced star connected load.

VI 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 systems.

VII Experimental set-up

For star connected balanced load:



VIII Resources required

S. No.	Particulars	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	

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. Use only balanced load

X Procedure

1. Connect the 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.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

Star connected load:

S. 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.						

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations ((Actions to be taken based on the interpretations)

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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 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 Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No. 07: Connect balanced star and delta load connections to get the required voltage and current. Part II

I Practical Significance

In practice large power applications use three phase systems. In a three phase circuit loads can be connected in balanced star and delta mode. It is necessary to formulate voltage and current relations for system parameters testing, calculations and interpretations.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems.*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems.*

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcome(s)

Use three phase AC supply for industrial equipment and machines

V Practical Outcome

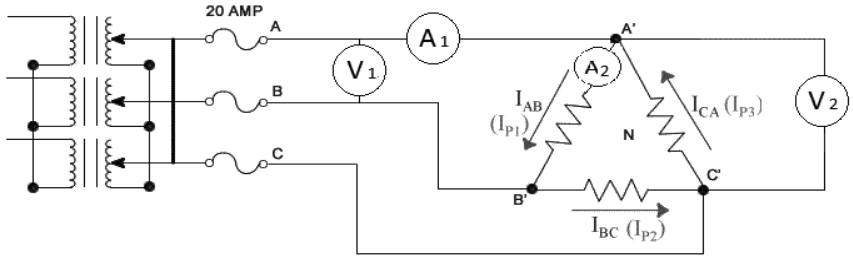
Determine the relation between line and phase values of voltages and currents for balanced Delta connected load.

VI 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 systems.

VII Experimental set-up

For delta connected balanced load:



VIII Resources required

S. No.	Particulars	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	

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. Use only balanced load

X Procedure

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.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

Delta connected load:

S.N.	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						

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations)

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XVIII Practical Related Questions

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

1. State relation between line voltage and line current in delta connection.
2. Write relation for power drawn in three phase delta connected load.
3. State meaning of balanced load.
4. State meaning of unbalanced load.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No. 08: Determine Voltage and Current ratio of Single Phase Transformer.

I 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 a 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.

II Relevant Program Outcomes (POs)

PO1- Basic knowledge- *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter-disciplinary engineering problems*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based inter-disciplinary engineering problems*

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipment in industrial applications'.**

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcomes

Use transformers for specific requirements.

V Practical Outcome

Determine voltage and current ratio of single phase transformer.

VI Minimum Theoretical Background

The voltage ratio of a transformer is equal to the ratio of secondary voltage and Primary voltage

$a=V_P/V_S$

where: V_P – primary voltage

V_S – Secondary voltage

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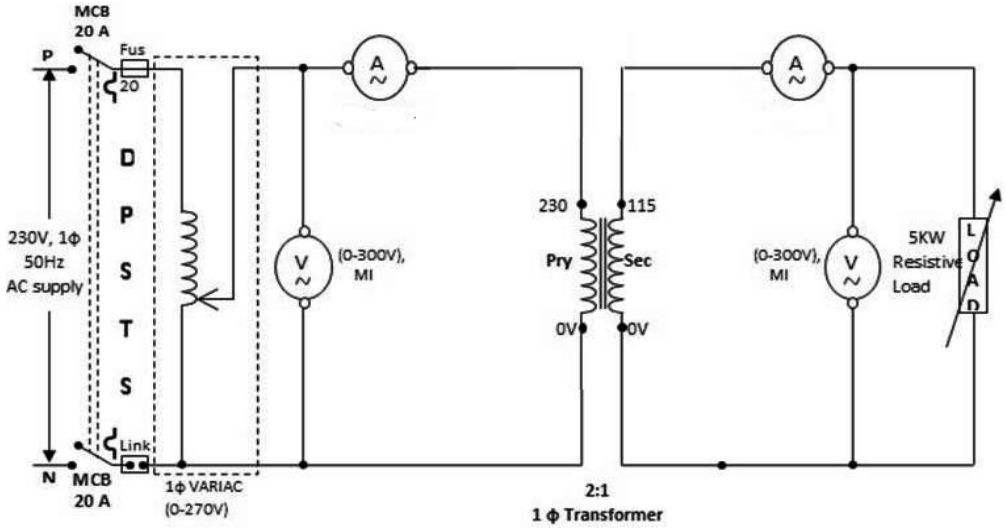
The current ratio of a transformer is equal to the ratio of primary current and Secondary current.

$b=I_p/I_s$

where: I_P – primary current

I_s – secondary current

VII Circuit diagram



VIII Resources required

S. No.	Instrument/Object	Specifications	Quantity	Remark
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 230 V , 15 A, Resistive load	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. Connect equipment as per circuit diagram.
2. Switch on power supply.
3. Note down reading of ammeter and voltmeter.
4. Calculate current ratio and voltage ratio.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations and Calculations

S. No.	Ip	Is	Vp	Vs	CURRENT RATIO=Ip/Is	VOLTAGE RATIO=Vp/Vs
1						
2						
3						
4						

XV Results

Voltage Ratio is found to _____ and Current ratio is found _____ for given Transformer.

XVI. Interpretation of results (Giving meaning to the results)

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XVII. Conclusions and Recommendations(Actions to be taken based on the interpretations)

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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. Give applications of step up transformer.
2. Give applications of step down transformer.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. …….

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

Practical No.09: Operate DC Shunt Motor using Three point Starter.

I Practical Significance

DC Shunt Motor draws very high current during starting which may burn armature winding. Hence to protect DC Shunt Motor from damages due to heavy starting current, Three Point Starter is used to start DC Shunt Motor.

II Relevant Program Outcomes (POs)

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based inter- disciplinary engineering problems.
PO 4. Engineering tools: Apply relevant Electrical technologies and tools with an understanding of the limitations

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use electrical equipment in industrial applications'.**

1. Identify armature winding and field winding terminals of DC Shunt Motor.
2. Identify different parts of Three Point Starter.

IV Relevant Course Outcome(s)

Connect DC Motors for specific requirements.

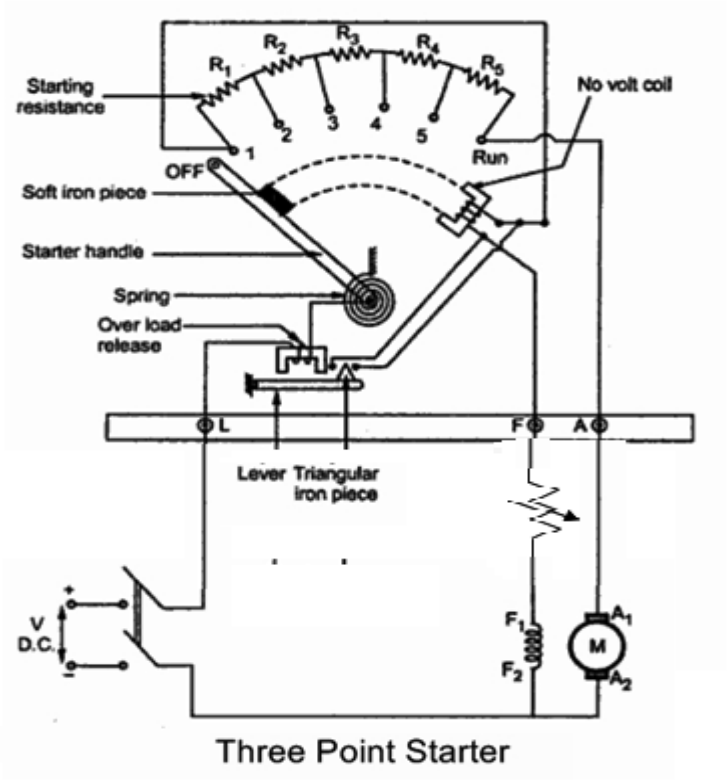
V Practical Outcome

Start DC Shunt Motor with the help of Three Point Starter.

VI Minimum Theoretical Background

3 Point Starter is a device whose main function is starting of DC shunt motor. The three point starter connects the resistance in series with the circuit which reduces the high starting current and hence protects the machines from damage.

VII Circuit diagram



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	DC Shunt Motor	5 HP, 220 V DC	1 No.
2	Three Point Starter	Suitable for 5 HP DC Shunt Motor	1 No.
3	Variable DC Supply	0-230 Volt, 50 amp	1 No.

IX Precautions to be followed

1. Connect Three point Starter with DC Shunt motor properly.
2. Keep rheostat of field winding of DC Shunt Motor minimum position.

X Procedure

1. Connect the apparatus as shown in circuit diagram.
2. Switch on DC Supply.
3. Move handle of starter from start to run position gradually.
4. Observe the starting of DC Shunt Motor.

XI Resources Used

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

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

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XV Results

The DC Shunt Motor is started with the help of three point starter.

XVI Interpretation of Results (Giving meaning to the results)

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XVII Conclusions (Actions to be taken based on the interpretations.)

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XVIII Practical Related Questions

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

1. “Starter is necessary for starting of DC Motor.” Give reason.
2. Write functions of different parts of Three Point Starter.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX. Suggested Assessment Scheme

Performance Indicators		Weightage	Marks obtained
Process Related (15 Marks)		60%	
1	Handling of the instrument	20%	
2	Operation of starter	30%	
3	Working in team	10%	
Product Related (10 Marks)		**4**0%	
4	Interpretation of result	20%	
5	Conclusion	10%	
6	Practical related questions	10%	
	Total (25 Marks)	100 %	

Names 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: Operate DC Shunt Motor using Four point Starter.

I Practical Significance

Four Point starters can also be used for starting of DC Shunt Motor.

II Relevant Program Outcomes (POs)

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based inter- disciplinary engineering problems.
PO 4. Engineering tools: Apply relevant Electrical technologies and tools with an Understanding of the limitations

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use electrical equipment in industrial applications'.**

1. Identify different parts of Four Point Starter.
2. Connect Four Point Starter with DC Shunt Motor.

IV Relevant Course Outcome(s)

Connect DC Motors for specific requirements.

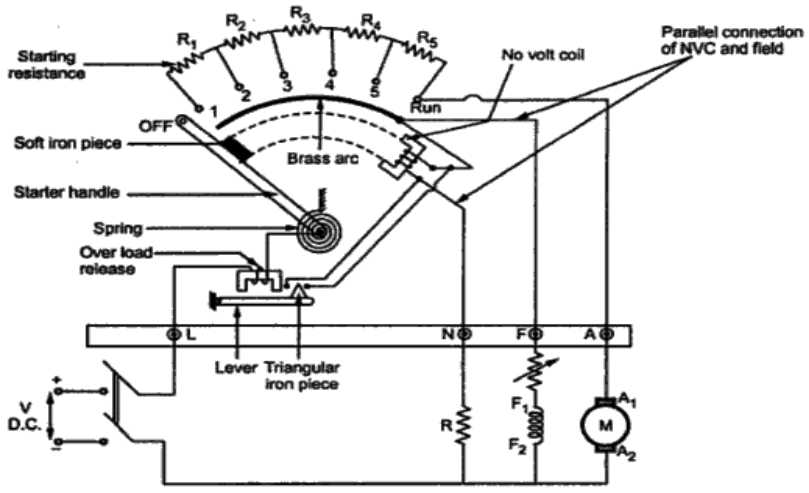
V Practical Outcome

Start DC Shunt Motor with the help of Four Point Starter.

VI Minimum Theoretical Background

The **4 point starter** like in the case of a 3 point starter also acts as a protective device that helps in safeguarding the armature of the shunt or compound excited DC motor against the high starting current produced in the absence of back emf at starting. The 4 point starter has a lot of constructional and functional similarity to a three point starter, but this special device has an additional point and a coil in its construction. This naturally brings about some difference in its functionality, though the basic operational characteristic remains the same. The basic difference in circuit of **4 point starter** as compared to 3 point starter is that the hold ON coil is removed from the shunt field current and is connected directly across the line with current limiting resistance in series.

VII Circuit diagram



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	DC Shunt Motor	5 HP, 220 V DC	1 No.
2	Four Point Starter	Suitable for 5 HP DC Shunt Motor	1 No.
3	Variable DC Supply	0-230 Volt, 50 amp	1 No.

IX Precautions to be followed

1. Connect Three point Starter with DC Shunt motor properly.
2. Keep rheostat of field winding of DC Shunt Motor minimum position.

X Procedure

1. Connect the apparatus as shown in circuit diagram.
2. Switch on DC Supply.
3. Move handle of starter from start to run position gradually.
4. Observe the starting of DC Shunt Motor.

XI Resources Used

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

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

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XV Results

The DC Shunt Motor is started with the help of four point starter.

XVI Interpretation of Results (Giving meaning to the results)

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

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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. Write difference between Three Point starter and Four Point starter.
2. Draw circuit diagram for connecting Four Point Starter with DC Compound Motor.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance Indicators		Weightage	Marks obtained
Process Related (15 Marks)		**6**0%	
1	Handling of the instrument	20%	
2	Operation of starter	30%	
3	Working in team	10%	
Product Related (10 Marks)		**4**0%	
4	Interpretation of result	20%	
5	Conclusion	10%	
6	Practical related questions	10%	
	Total (25 Marks)	100 %	

Names 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: Reverse direction of rotation of single phase induction motor.

I Practical Significance

Single Phase Induction Motoris necessary in some industrial process application.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter-disciplinary engineering problems.*

PO 2- Discipline knowledge –*Apply medical electronics engineering knowledge to solve broad-based inter-disciplinary engineering related problems*.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipment in industrial applications'.**

i) Identify terminals of starting and running winding of Single Phase Induction Motor.

ii) Reverse detection of rotation of Single Phase Induction Motor.

IV Relevant Course Outcome(s)

Use FHP motors for diversified applications.

V Practical Outcome

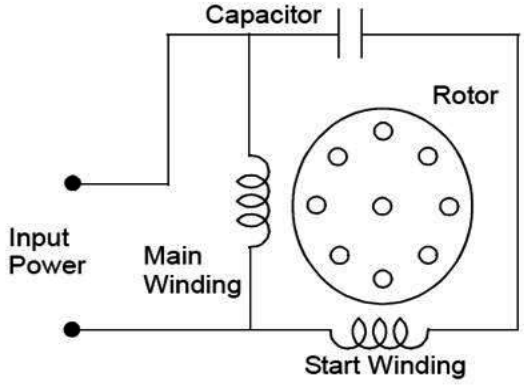
Reverse the direction of rotation of single phase induction motor.

VI Minimum Theoretical Background

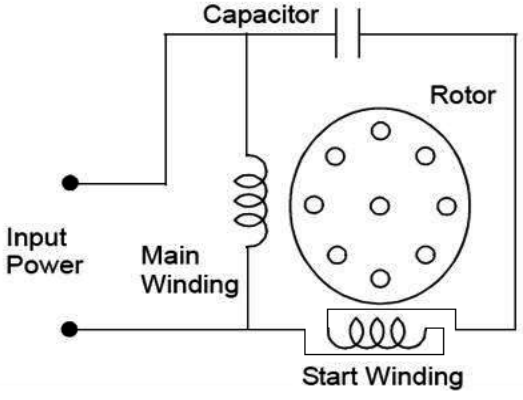
Single phase induction motor direction can be reversed by changing terminals of starting winding or main winding.

VII Experimental set-up

Permanent Split Capacitor Run Motor

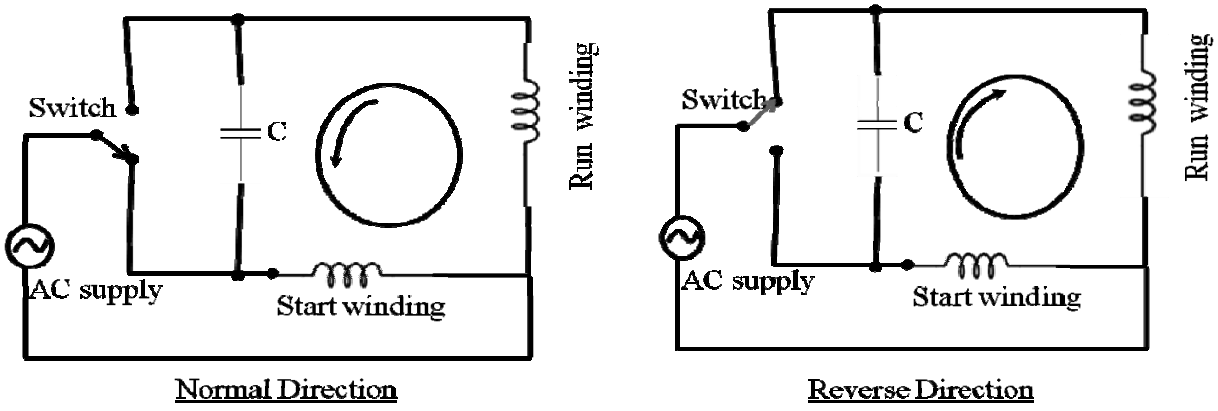


Normal Direction



Reversing Direction of Rotation

Reversing single Phase Induction Motor by using External switch



VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Single Phase Induction Motor	¼ HP , Single Phase , 230 V	1	
2	Single phase supply	Single Phase, 230 V AC	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. Connect circuit as per circuit diagram.
2. Switch on the supply.
3. Start the motor and check the direction of rotation.
4. Change starting winding terminals and check the direction of rotation.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

S.N.	Winding terminal Initial / interchanged	Rotation of motor Clockwise or Anticlockwise
1		
2		

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations)

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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. Give different types of Single Phase Induction Motors.
2. "Single phase Motors are not self-starting". Explain this statement.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**6**0%
1	Handling of the components	20 %
2	Identification of component	20 %
3	Working in team	20 %
Product related (10 Marks)		**4**0%
4	Interpretation of result	10 %
5	Conclusions	10 %
6	Practical related questions	15 %
7	Submitting the journal in time	05%
	Total (25 Marks)	100 %

Names 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: Reverse the direction of rotation of Universal motor.

I Practical Significance

Reversal of rotation of Universal motoris a necessary in many of the electrical applications.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems.*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems*

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**

i. Measure electrical quantities.
ii. Connect circuits as per the requirement.
iii. Follow safe practices.

IV Relevant Course Outcome(s)

Use FHP motors for diversified applications.

V Practical Outcome

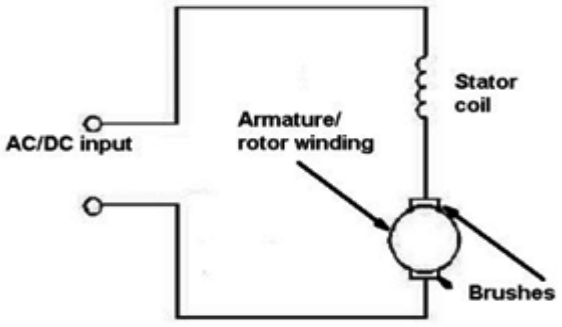
Reverse the direction of rotation of Universal motor.

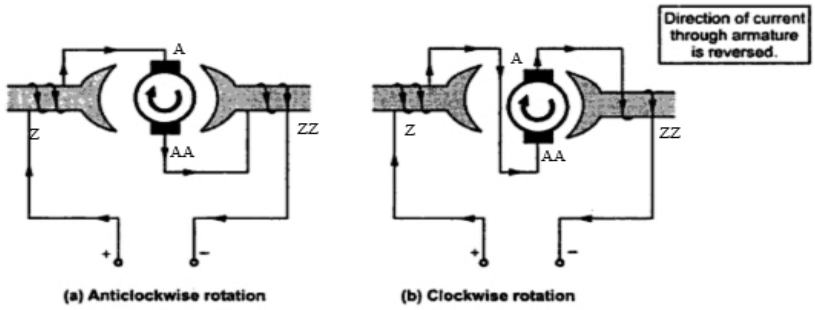
VI Minimum Theoretical Background

Universal motor can be operated on AC and DC supply.

VII Experimental set-up

Simple universal motor schematic





VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Universal motor	Suitable rating	1	
2	Supply ac or dc	Suitable supply	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. Connect universal motor to AC/DC supply.
2. Observe the direction of rotation of motor.
3. Change the armature winding terminal.
4. Observe the direction of rotation of motor.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

S.N.	Winding connection	Rotation
1	Normal	
2	Reversed	

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations.)

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XVIII Practical Related Questions

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

1.Give application of universal motor.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	20 %
2	Identification of component	30 %
3	Working in team	10 %
Product related (10 Marks)		**40%**
4	Interpretation of result	10 %
5	Conclusions	10 %
6	Practical related questions	15 %
7	Submitting the journal in time	05%
	Total (25 Marks)	100 %

Names 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: Identify Switches, Fuses, Switch Fuse Unit, Fuse Switch unit, MCB, MCCB and ELCB.

I Practical Significance

Identification of switchgears plays important role inengineering. Without these switchgears Electrical Installations, Electric Circuit, Electronic Devices, Electric Machines etc. cannot be operated safely.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter disciplinary engineering problems.*

PO 2- Discipline knowledge –*Apply inter disciplinary engineering knowledge to solve broad-based electrical engineering related problems*.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use relevant protective devices/switchgear for different requirements'.**

i) Identify switchgear.

ii) Identify terminals of switchgears.

IV Relevant Course Outcome(s)

Use relevant protective devices/switchgear for different requirements.

V Practical Outcome

Identify switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB.

VI Minimum Theoretical Background

Switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB are the switchgears used for operation and safety of electrical equipment.

VII Experimental set-up /Different switchgears.

VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Different switchgears	Suitable ratings	1 each	

IX Precautions to be followed

Select proper switchgear.

X Procedure

1. Observe the various switchgears.
2. Write the function and application of each switchgear.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

S.N.	Switchgear Name	Function
1		
2		
3		
4		
5		
6		
7		

XV Results

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XVI Interpretation of results (Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations.)

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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 various types of switchgears used in engineering.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	20 %
2	Identification of component	30 %
3	Working in team	10 %
Product related (10 Marks)		**40%**
4	Interpretation of result	10 %
5	Conclusions	10 %
6	Practical related questions	15 %
7	Submitting the journal in time	05%
	Total (25 Marks)	100 %

Names 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: Connect Switches, Fuses, Switch Fuse Unit, Fuse Switchunit, MCB, MCCB and ELCB.

I Practical Significance

Connection of switchgears plays important role engineering. Correct connection is necessary for operating equipment safely.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter disciplinary engineering problems.*

PO 2- Discipline knowledge –*Apply inter disciplinary engineering knowledge to solve broad-based electrical engineering related problems*.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency**'Use electrical equipment in industrial applications'.**

i) Connect switchgear.

IV Relevant Course Outcome(s)

Use relevant protective devices/switchgear for different requirements

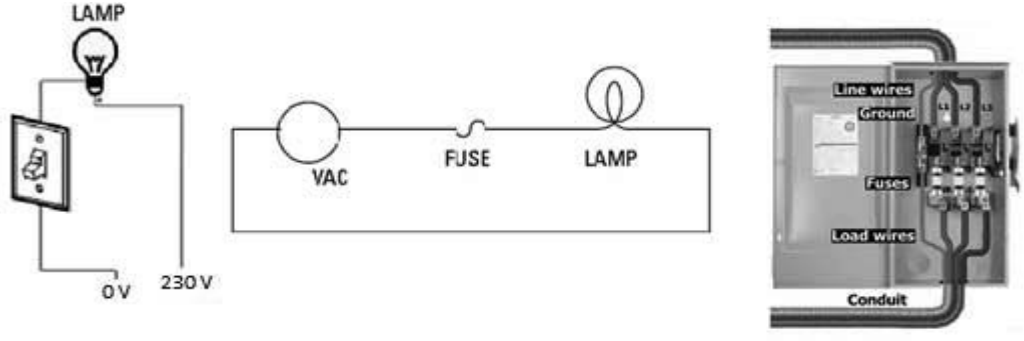
V Practical Outcome

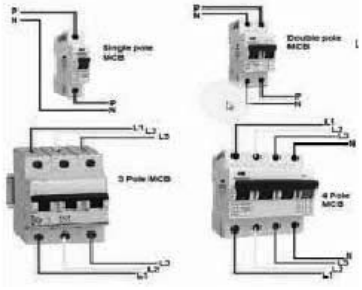
Connect switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB.

VI Minimum Theoretical Background

Switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB are the switchgears used for operation and safety of electrical equipment

VII Experimental set-up /Different switchgears.





VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Different switchgears	Suitable ratings	1 each	

IX Precautions to be followed

Select proper switchgear.

X Procedure

1. Connect various switchgears.
2. Write the function and application of each switchgear.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions Followed

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XIV Observations and Calculations

S.No.	Switchgear Name	Function
1		
2		
3		
4		
5		
6		
7		

XV Results

XVI Interpretation of results (Giving meaning to the results)

XVII Conclusions and Recommendations (Actions to be taken based on the interpretations.)
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XVIII Practical Related Questions

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

1. Draw connection diagram of various types of switchgears used in engineering.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	20 %
2	Identification of component	30 %
3	Working in team	10 %
Product related (10 Marks)		**40%**
4	Interpretation of result	10 %
5	Conclusions	10 %
6	Practical related questions	15 %
7	Submitting the journal in time	05%
	Total (25 Marks)	100 %

Names 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: Test a circuit using Series Lamp and Multimeter.

I Practical Significance

Testing of electric circuit plays an important role in electrical and electronic equipment's. Testing of components such as relays, solenoids, inductors, chokes, coils, loudspeakers, motors, generators, transformers and electricity meters etc., is necessary for fault finding, satisfactory performance of equipment's, safety of operator , life of equipment etc.

II Relevant Program Outcomes (POs)

PO 1- Basic knowledge - *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter-disciplinary engineering problems.*

PO 2- Discipline knowledge –*Apply medical electronics engineering knowledge to solve inter-disciplinary engineering related problems*.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency**'Use electrical equipment in industrial applications'.**

i) Use multimeter and series lamp.

ii) Test simple electric circuits.

iii) Follow safe practices.

IV Relevant Course Outcome(s)

Use relevant protective device/ switchgear for different requirements.

V Practical Outcome

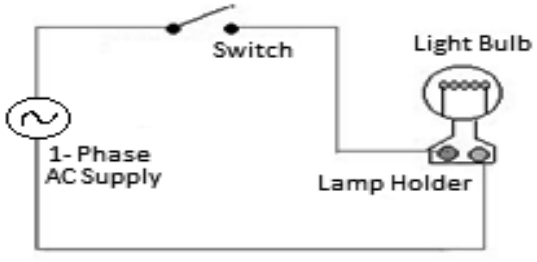
Test circuit using Series Lamp and Multimeter.

VI Minimum Theoretical Background

Amultimeter is an indispensable tool that is used to diagnose and troubleshoot circuits. As its name indicates, it is a meter capable of measuring multiple things related to electricity namely voltage, current and resistance. Multimeter and Test Lamp can be used to find Open circuit and Short Circuit in electric circuit.

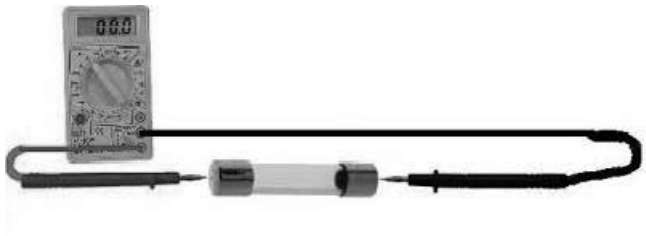
VII Experimental set-up

Use of Test Lamp



Equipment for Test

Test Equipment with the help of Multimeter



VIII Resources required

S. No.	Particulars	Specification	Quantity	Remark
1	Resistance or Equipment	-	1	
2	Switch	5 Amp	1	
3	Multimeter	Suitable multimeter	1	
4	Test lamp	Suitable test lamp	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 Connect circuit as per circuit diagram.
2 Switch on supply and operate switch for testing.
3 Use Multimeter for testing given equipment.
4 Repeat the procedure with other equipment.

XI Resources used

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

XII Actual procedure followed

……
……

XIII Precautions Followed

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……

XIV Observations and Calculations

Using Test Lamp Circuit:

S. No.	Lamp Brightness Dim/ Bright/ No	Remark whether equipment is open circuit/ short circuit/not Faulty
1		
2		

Using Multimeter:

S. No.	Resistance Indicated by Multimeter Very Low/ Medium/ Very High	Remark whether equipment is open circuit/ short circuit/not Faulty
1		
2		

XV Results

The equipment is tested with the help of Test Lamp and Multimeter and its result is mentioned in Observation Table

XVI Interpretation of results (Giving meaning to the results)

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…….
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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations.)

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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. Write necessary conditions for using Test Series Lamp for testing.
2. Draw a diagram for testing choke coil using Series Test lamp
3. Write meaning of 'SERIES' in Series Test Lamp.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX 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 %

Names 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: Use the Earth Tester.

I Practical Significance

In industries substations, power stations and all electrical installations measurement of earth resistance with utmost accuracy and precision is an essential requirement. Earth resistance measurement is possible using Earth Tester.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter- disciplinary engineering problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based inter- disciplinary engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use electrical equipment in industrial applications'.**

1. Measure Earth Resistance and interpret the Earth Resistance value for safety.
2. Interpret circuit diagrams

IV Relevant Course Outcome(s)

Use relevant protective device/ switchgear for different requirements.

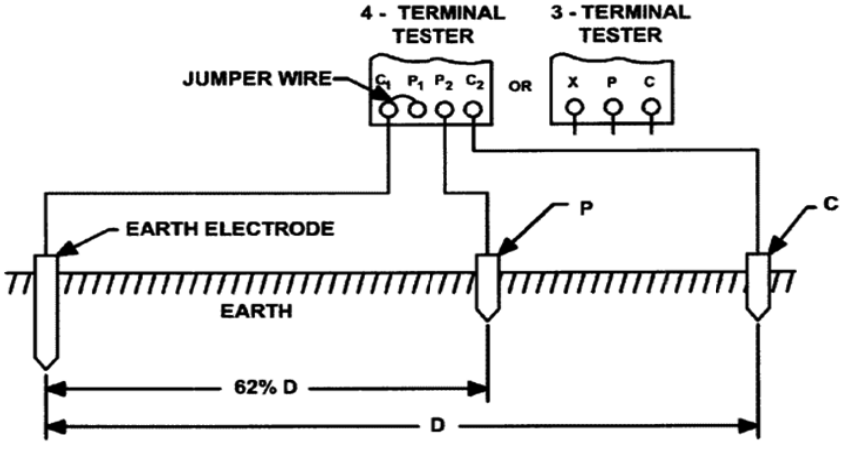
V Practical Outcome

Use Earth Tester to measure earth resistance of earthing of electrical machines and all Electrical Installations.

VI Minimum Theoretical Background

Earthing is necessary for safety of operator and equipment. Pipe earthing, plate earthing, mesh earthing are different types of earthing. Values of Earth Resistance for power stations, major substation, and electrical installation are 0.5 ohm, 1 ohm, 5 ohm respectively.

VII Circuit diagram



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Earth Tester Digital/ Analog	range from 0 - 10 ohm to 10000 ohm (Any one range)	1 No.
2	Hammer and Screw Driver	-	1 No.
3	Spools of Wire	Standard	4 No.
4	M.S.Spikes	Standard	4 No.

IX Precautions to be Followed

1. Avoid loose connections.
2. Bury spikes deeply more than half of total length of spike.

X Procedure

1. Bury spikes at suitable distance as mentioned in manual.
2. Connect the terminals of wire to spikes and earth tester as shown in circuit diagram.
3. Rotate the handle of earth tester with constant and suitable speed.
4. Note down reading and change the distance between spikes.
5. Note down readings for different position of spikes and draw a graph between earth resistance and distance of spikes.

XI Resources Used

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

XII Actual Procedure Followed

…….

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XIII Precautions Followed

…….

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Observations and Calculations

S.N.	Distance in meters	Earth Resistance in Ohm.
1		
2		
3		
4		

XIV Results

The Earth Resistance is found to be _____ ohms.

XV Interpretation of Results (Giving meaning to the results)

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……..……
…….
……

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

…..……..……..……
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XVII Practical Related Questions

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

1. Give the types earth testers available in market.
2. Give applications of earth tester.

[Space for Answer]

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XVIII References / Suggestions for Further Reading

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

XIX Suggested Assessment Scheme

Performance Indicators		Weightage	Marks obtained
Process Related (15 Marks)		**60%**	
1	Handling of the instrument	20%	
2	Determination of distance and resistance	30%	
3	Working in team	10%	
Product Related (10 Marks)		**40%**	
4	Conclusion	20%	
5	Practical related questions	20%	
	Total (25 Marks)	100 %	

Names 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: Use the Insulation Tester

I Practical Significance

The measurement of insulation resistance is a common routine test performed on all types of electrical wires and cables in an electrical Installation and electrical machines before they are put into service. It is necessary to carryout Insulation test on electrical machines and installations for safe operation.

II Relevant Program Outcomes (POs)

PO1- Basic knowledge- *Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based interdisciplinary engineering problems*

PO3- Experiments and practice- *Plan to perform experiments and practices to use the results to solve broad-based interdisciplinary engineering problems*

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use electrical equipments in industrial applications'**:

i. Measure electrical quantities.
ii. Circuit connection.
iii. Follow safe practices.

IV Relevant Course Outcomes

(f)Use relevant protective devices/ switchgear for different requirements.

V Practical Outcome

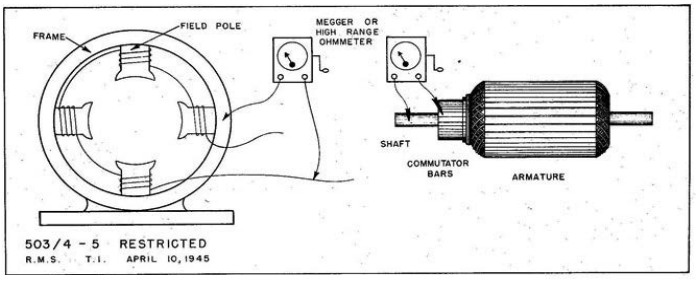
Determine insulation resistance between conductor and earth.
Determine insulation resistance between two conducting parts.
Determine continuity of the conductor.

VI Minimum Theoretical Background

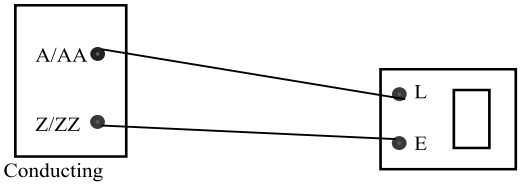
Insulation resistance between all the conductors and earth is measured with the help of a 500 V megger or mega ohmmeter as an insulation tester. It is desirable that the insulation resistance should be less than 1MΩ for the entire installation.

VII Circuit diagram

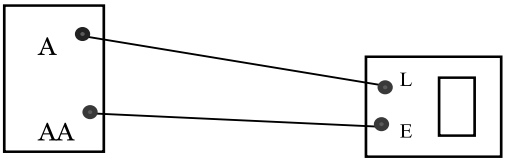
Testing between terminals and Body



Testing between armature and field terminals



Continuity test with insulation tester



VIII Resources required

S. No.	Instrument/Object	Specifications	Quantity	Remark
1	Insulation tester / Megger	Suitable specification	1	
2	Electrical machine	Suitable machine	1	

IX Precautions to be followed

1. All electrical connections should be tight.
2. Test the Megger before use, whether it gives **INFINITY** value when not connected, and ZERO when the two terminals are connected together and the handle is rotated. Check the power supply before connection.
3. Make sure that the earth used when testing for earth and open circuits is a good one otherwise the test will give wrong information.
4. Ensure that all conductors have been reconnected properly.
5. All equipment under test **MUST** be disconnected and isolated.
6. Equipment should be discharged in order to be absolutely safe for the person conducting the test.

X Procedure

1. Connect equipment as per circuit diagram.
2. Rotate the handle of Megger at constant speed.
3. Note down reading for different connections as per above circuit diagrams.

XI Resources used

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

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations and Calculations:

1. Insulation resistance between shunt field winding (Z-ZZ) and armature winding (A-AA) = ... MΩ
2. Insulation resistance between shunt field winding (Z-ZZ) and body = ... M Ω
3. Insulation resistance between armature winding terminals (A-AA) and body = ... M Ω
4. Resistance Between armature winding terminals (A-AA) = ... Ω
5. Continuity test between field winding terminals (Z-ZZ) = ...Ω

XV Results

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XVI Interpretation of results(Giving meaning to the results)

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XVII Conclusions and Recommendations (Actions to be taken based on the interpretations.)

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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. Give applications of insulation tester.
2. Write specifications of insulation tester used in this experiment.
3. List various other instruments used for insulation testing.

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XIX References / Suggestions for Further Reading

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

XX 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 insulation tester	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 %

Names of Student Team Members

1. ……..
2. …….
3. ……
4. ……

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

Practical No.18: Use of Digital Clamp on Meter for different measurements.

I Practical Significance

Clamp on meter is primarily used for measurement of high current without connecting it into power circuit. Also voltage and other parameters can be measured with clamp on meter.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based inter- disciplinary engineering problems.
PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based inter- disciplinary engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use electrical equipment in industrial applications'.**

1. Measure Current, AC/DC Voltage, Resistance.
2. Select proper ranges for different measurements.

IV Relevant Course Outcome(s)

Use relevant protective device/ switchgear for different requirements.

V Practical Outcome

Use Digital Clamp on Meter for measuring Current, Voltage, and Resistance.

VI Minimum Theoretical Background

Clamp on Meter is an electrical device with jaws which open to allow clamping around an electrical current carrying conductor. It is also used as Multimeter.

VII Circuit diagram

1)Measurement of Current 2)Using as multimeter

VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Clamp on Meter	200 amp,200 ohm, 20 kohm, 1000 V DC,750 V AC	1 No.
2	Connecting Probes	-	2 No.
3	Resistance or Rheostats	100 ohm, 370 ohm, 500 ohm	1 each
4	Variable DC Supply	0-230 Volt	1 No.
5	Dimmerstat	Single Phase 15 Amp, 0-230 V	1 No.
6	Loading Rheostat	Single Phase	1 No.

XIX Precautions to be followed

1. Select proper range and rotate selection knob for quantity to be measured.
2. Use insulating Hand Gloves.

X Procedure

1. Connect load to AC Supply and energize the circuit.
2. Insert clamp on meter by opening its jaws.
3. Measure AC current by changing load.
4. Measure AC voltage by using selector switch.
5. Measure DC Voltage by using varying DC Voltage source.

XI Resources Used

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

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

S.No.	Current in clamp on meter
1	
2	

S.No.	AC Voltage indicated by clamp on meter
1	
2	
3	
4	

S.No.	DC Voltage indicated by clamp on meter
1	
2	
3	
4	

S.No.	Resistance indicated by clamp on meter
1	
2	
3	
4	

XV Results

Reading of different quantities are taken and noted in observation table.

XVI Interpretation of Results (Giving meaning to the results)

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

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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. Give list of manufactures of Clamp on Meter.
2. Give applications of Clamp on Meter.

[Space for Answer]

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XIX References / Suggestions for Further Reading

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

XX Suggested Assessment Scheme

Performance Indicators		Weightage	Marks obtained
Process Related (15 Marks)		**60%**	
1	Handling of the instrument	20%	
2	Determination of current & voltage	30%	
3	Working in team	10%	
Product Related (10 Marks)		**40%**	
4	Conclusion	20%	
5	Practical related questions	20%	
	Total (25 Marks)	100 %	

Names of Student Team Members

1. ……..
2. …….
3. ……
4. ……

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

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101W
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048
20	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22049

Fifth Semester:

1	Network Management & Administration	17061
2	Solid Modeling	17063
3	CNC Machines	17064
4	Behavioral Science(Hand Book)	17075
5	Behavioral Science (Assignment Book)	17075
6	Windows Programming using VC++	17076
7	Estimation and Costing	17501
8	Public Health Engineering	17503
9	Concrete Technology	17504
10	Design of Steel Structures	17505
11	Switchgear and Protection	17508
12	Microprocessor & Application	17509
13	A.C. Machines	17511
14	Operating System	17512
15	Java Programming	17515
16	System Programming	17517
17	Communication Technology	17519
18	Hydraulic & Pneumatics	17522
19	Advanced Automobile Engines	17523
20	Basic Electrical & Electronics	17524
21	Measurement and Control	17528
22	Power Engineering	17529
23	Metrology & Quality Control	17530
24	Computer Hardware & Networking	17533
25	Microcontroller	17534
26	Digital Communication	17535
27	Control System & PLC	17536
28	Audio Video Engineering	17537
29	Control System	17538
30	Industrial Electronics and applications	17541
31	Heat Transfer Operations	17560
32	Chemical Process Instrumentation & control	17561

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

HEAD OFFICE

Secretary,
Maharashtra State Board of Technical Education
49, Kherwadi, Bandra (East), Mumbai - 400 051
Maharashtra (INDIA)
Tel: (022)26471255 (5 -lines)
Fax: 022 - 26473980
Email: -secretary@msbte.com
Web -www.msbte.org.in

REGIONAL OFFICES:

MUMBAI

Deputy Secretary (T),
Mumbai Sub-region,
2nd Floor, Govt. Polytechnic Building,
49, Kherwadi, Bandra (East)
Mumbai - 400 051
Phone: 022-26473253 / 54
Fax: 022-26478795
Email: rbtemumbai@msbte.com

PUNE

Deputy Secretary (T),
M.S. Board of Technical Education,
Regional Office,
412-E, Bahirat Patil Chowk,
Shivaji Nagar, Pune
Phone: 020-25656994 / 25660319
Fax: 020-25656994
Email: rbtepn@msbte.com

NAGPUR

Deputy Secretary (T),
M.S. Board of Technical Education
Regional Office,
Mangalwari Bazar, Sadar, Nagpur - 440 001
Phone: 0712-2564836 / 2562223
Fax: 0712-2560350
Email: rbteng@msbte.com

AURANGABAD

Deputy Secretary (T),
M.S. Board of Technical Education,
Regional Office,
Osmanpura, Aurangabad -431 001.
Phone: 0240-2334025 / 2331273
Fax: 0240-2349669
Email: rbteau@msbte.com