I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

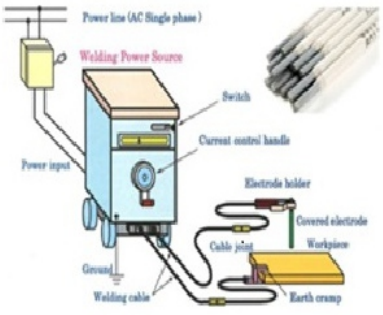
ELECTRICAL GROUP | SEMESTER - VI | DIPLOMA IN ENGINEERING AND TECHNOLOGY

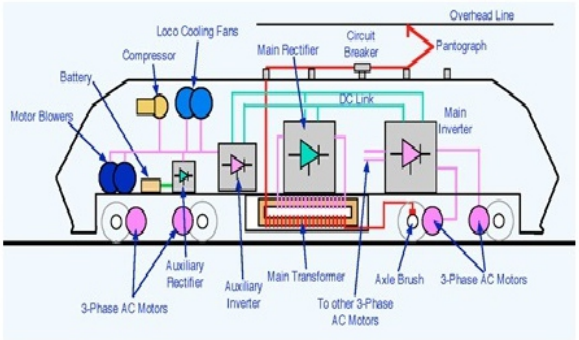
A LABORATORY MANUAL

FOR

UTILIZATION OF ELECTRICAL ENERGY

(XXXXX)





MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

A Practical Manual for

Utilization of Electrical Energy

(22626)

Semester– VI

(EE, EP, EU)

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

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4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai -400051.

(Printed on November 2019)

Maharashtra State
Board of Technical Education
Certificate

This is to certify that Mr./Ms……Roll No…….of Sixth Semester of Diploma in ……..……. of Institute ……... (Code……..) has attained predefined practical outcomes (PROs) satisfactorily in course **Utilization of Electrical Energy (22626)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place ……. Enrollment No……

Date:…..... Exam Seat No. …….....

Course Teacher **Head of the Department** **Principal**

Seal of the Institute

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.

The electrical diploma holder has to work in industry as technical person in middle level management. He has to work as production, maintenance, testing engineer in various industries like power generation, transmission, distribution, traction etc. and has to deal with different electrical measurement. While performing above task he has to measure different electrical and electronic parameters with testing, therefore he/she must require the skills for these measurements and broad idea of different meters and equipments.

Although all care has been taken to check for mistakes in this laboratory manual, yet it is impossible to claim perfection especially as this is the first edition. Any such errors and suggestions for improvement can be brought to our notice and are highly welcome.

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

Following POs and PSO are expected to be achieved through the practicals of the course, Energy Conservation and Audit.

PO 1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
PO 2. **Discipline knowledge:** Apply Electrical engineering knowledge to solve broad-based electrical engineering related problems.
PO 3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
PO 4. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.
PO 5. **The engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of Electrical engineering.
PO 6. **Environment and sustainability:** Apply Electrical engineering solutions also for sustainable development practices in societal and environmental contexts.
PO 7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electrical engineering.
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.

Program Specific Outcomes (PSOs)

PSO 1. Electrical Equipment: Maintain various types of rotating and static electrical equipment.

PSO 2. Electric Power Systems: Maintain different types of electric power systems.

List of Industry Relevant Skills

The following industry relevant skills of the competency **'Maintain different types of electrical utilities and systems'.**

1. Identify different lighting accessories required for various types of lamps, lamp fittings and measure illumination at different places.
2. Identify the components of heating and welding systems.
3. To prepare a technical report on various electrical drives and EMU, various traction systems.
4. Use of static capacitors for power factor improvement.
5. Prepare Energy bill based on energy consumption.

Practical- Course Outcome matrix

Course Outcomes (COs):-

a) Maintain the functioning of different types of lamps and fittings.
b) Maintain different electric heating and welding equipment.
c) Use different electric drives and elevators.
d) Use different electric traction systems.
e) Use equipment for economic operation.

Sr. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.
1.	Identify the different lighting accessories required for various types of lamps.	√	-	-	-	√
2.	Identify the different lighting accessories required for various types of lamp fittings.	√	-	-	-	-
3.	Measure illumination at different places in college using lux meter.	√	-	-	-	–
4.	Identify the different components required for various types heating furnaces	-	√	-	-	-
5.	Observe construction and working of various heating furnaces by watching video programmes.	-	√	-	-	-
6.	Identify the different accessories and safety devices required for various types of welding system.	-	√	-	-	-
7.	Prepare a report of specification of various electrical welding machines available in college workshop	-	√	-	-	-
8.	Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.	-	-	√	-	-
9.	Prepare a comparative chart of two different manufacturing company in India for any two Lift/Elevator with technical data	-	-	√	-	-
10.	Visit a railway loco shed to observe various components and working of electric locomotive and prepare a technical report.	-	-	-	√	-
11.	Prepare a report /chart on various types of traction systems.	-	-	-	√	-

12.	Prepare a report/chart on speed time curves.	-	-	-	√	-
13.	Improve the power factor of available inductive load using static capacitor.	-	-	-	-	√
14.	Prepare a report based on comparative study of various tariff structure of Maharashtra.	-	-	-	-	√
15.	Prepare Energy Bill based on energy consumption of residence/ Institute	-	-	-	-	√
16.	Prepare a technical report after visiting an industry, various power factor improvement devices used. (otherwise from internet)	-	-	-	-	√

Guidelines to Teachers

1. ***Teacher need to ensure that a dated log book*** for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practicals.
3. For difficult practicals if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question bank for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a ***dated log book*** for the whole semester, apart from this laboratory manual which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, IS codes, Safety norms, Electricity act/rules, technical manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practicals.
5. **Select the proper range of meters referring to the machine/s specifications/ratings.**

Content Page

List of Practicals and Progressive Assessment Sheet

10	Visit a railway loco shed to observe various components and working of electric locomotive and prepare a technical report.	59					
11 *	Prepare a report /chart on various types of traction systems.	65					
12	Prepare a report/chart on speed time curves.	72					
13 *	Improve the power factor of available inductive load using static capacitor.	79					
14	Prepare a report based on comparative study of various tariff structure of Maharashtra.	85					
15 *	Prepare Energy Bill based on energy consumption of residence/ Institute	91					
16	Prepare a technical report after visiting an industry, various power factor improvement devices used. (otherwise from internet)	97					
Total							

Note: To be transferred to relevant proforma of CIAAN-2017

Practical No. 1: Identify the different lighting accessories required for various types of lamps.

I Practical Significance

Every diploma electrical engineer must know the use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial sources like lamps and light fixtures, as well as natural illumination by capturing daylight consumption in buildings. Proper lighting can enhance performance, improve the appearance of an area, or have positive psychological effects on occupants.

II Relevant Program Outcomes (POs)

- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics.
- **PSO 2. Electric Power Systems:** Maintain different types of electric power systems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems.**

- Identify and select the suitable lamp accessories.
- Follow safe practices.

IV Relevant Course Outcomes

- Maintain the functioning of different types of lamps and fittings.

V Practical Learning Outcome

- Identify the different lighting accessories required for various types of lamps.

VI Minimum Theoretical Background

1. Lamp holder/ Tube Holder: It is used for holding a bulb or tube. Through holder electrical connection is provided to for lamp. Most of light fittings have a lamp holder
2. Ballast: Ballast regulates the current to the lamp and provides sufficient voltage to start the lamp.
3. Light Diffusers: Light diffuser scatters light to provide softer light. In photography, this is a white surface – usually a board or umbrella, which minimizes harsh lights and unwanted shadows. There are also light shaping diffusers that homogenize and provide uniform light; thus, light is perfectly controlled, distributed, and shaped to form the perfect cone.
4. Light Dimmer: Light dimmer reduces the brightness of light.
5. Lamp Starter: Starter starts the light.

VII Practical Set-Up :
(Students are required to Name the accessories)

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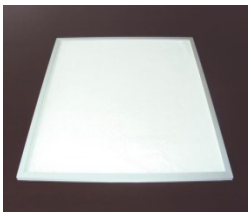

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VIII Resources required

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1.	Candle cup/lamp holder		01
2.	Ballast		01
3.	Diffuser		01
4.	Dimmer		01
5.	Starter		01
6.	Screw type Holder		01

IX Precautions to be followed
1. Handle the lamp with care.
2. Ensure that lamp is correctly positioned on working surface.

X Procedure
1. Collect the different lamp accessories from the laboratory.
2. Identify the accessories required for various lamps.
3. Draw wiring diagram for any one type of lamp.
4. Connect the accessories as per the wiring diagram and check the operation of the lamp.

XI Resources used (with major specifications)

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					
5.					
6.					

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Name of the lamp accessory	Rating	Function

Wiring diagram of lamp (Any one)

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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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) List the two functions of choke.
2) List the two types of starters used in fluorescent tube lights.
3) State the function of starter.
4) List the different types of dimmers.
5) List the different types of diffusers.

[Space for Answers]

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XIX References / Suggestions for Further Reading

1. https://blog.4houselighting.com/lighting-categories/lighting-accessories/www.electricaltechnology.org
2. http://www.lighting-equipment.com/light-fixtures/lighting-fixtures/
3. Art and Science of Utilization of Electrical Energy-H.Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Identifying of lamps and accessories	20 %
2	Handling of the lamps and accessories	20 %
3	Follow safe practices	20 %
Product related (10 Marks)		**40%**
4	Observation	10 %
5	Interpretation of result	05 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

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

Practical No. 2: Identify the different lighting accessories required for various types of lamp fittings.

I Practical Significance

Intensity of light has an impact on emotion of the people. Optimum illumination makes the people to feel warmer. Diploma Electrical Engineers will be able to provide optimum illumination levels by proper selection of lighting schemes.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools**: Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society**: Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics**: Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PSO 2. Electric Power Systems:** Maintain different types of electric power systems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency**' Maintain different types of electrical utilities and systems.**

- Realize the importance and significance of various light fitting/lighting schemes.

IV Relevant Course Outcomes

- Maintain the functioning of different types of lamps and fittings.

V Practical Learning Outcome

- Identify the different lighting accessories required for various types of lamp fittings.
- Select relevant light fitting for different application.

VI Minimum Theoretical Background

Good illumination scheme should have minimum glare and shadows.

Following are the types of lighting schemes/ light fitting:

a) Direct lighting
b) Semi direct lighting
c) Indirect lighting
d) Semi Indirect lighting
e) General Lighting

VII Practical Set up :

Identify the lighting scheme of the given fittings:

1. _____

2. _____

3._____

4._____

5._____

6._____

VIII Resources required:

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Various light fittings	Standard	

IX Precautions to be followed

- Light fittings should be properly identified.
- Handle the accessories with proper care.

X Procedure

1) Collect the information about various light fittings of various lighting schemes.
2) Identify each scheme.
3) Fill the observation table with the respective values.

XI Resources used (with major specifications)

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

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Type of lighting scheme	Percentage of light in Lower Hemisphere	Percentage of light in Upper Hemisphere	Area of Application
1.	Direct			
2.	Semi Direct			
3.	Indirect			
4.	Semi Indirect			
5.	General			

XV Results:

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XVI. Interpretation of results:

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XVII. Conclusion

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XVIII. Practical related Questions

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

1. Write any two applications of direct lighting scheme.
2. Name the lighting scheme of railway platform lighting.
3. Suggest the suitable fitting for operation table in hospital.

(Space for answers)

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XIX. References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
4. Art and Science of Utilization of Electrical Energy- H. Partab

XX. Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Information collected	20 %
2	Identification of Light Fitting	20 %
3	Team work & Coordination	20 %
Product related (10 Marks)		**40%**
4	Quality of observation	10 %
5	Interpretation	05 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the report in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. …….
3. …….

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

Practical No. 3 : Measure illumination at different places in college using lux meter.

I Practical Significance

The illumination level for each location is recommended by IS 3646.The values are related to the visual requirements of the task, to user's satisfaction, to practical experience and to the need for cost effective use of energy. In order to design a good illumination scheme, diploma electrical engineer should be able to measure the illumination at different locations.

II Relevant Program Outcomes (POs)

- **PO3: Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Medical electronics engineering problems.
- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Maintain different types of electrical utilities and systems'.**

- Use lux meter.
- Measure illuminance or illumination at different location in the college.
- Follow safe practices.

IV Relevant Course Outcomes

- Maintain the functioning of different types of lamps and fittings.

V Practical Learning Outcome

- Measure illumination at different places in college using lux meter.

VI Minimum Theoretical Background

Illumination (E): It is the luminous flux falling on surface per unit area. It is expressed in lux. Illumination of one lumen per square metre is called lux.

Good light quality and appropriate illuminance are a necessary requirement for safe work and leisure time. Lux meter measures illumination in terms of lux.

Some of recommended illumination level at different locations is given in the table.

Sr. No.	Location	Recommended Illumination level (Lux)
1	Corridor	100
2	Library, reading hall	500
3	Cafetaria	200
4	Rest rooms	200
5	Staff room	300
6	Standard class room	500
7	Laboratory	500
8	Conference hall	500
9	Drawing Hall	750

VII Practical set up

VIII Resources required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Lux meter	0-50000 lux	1

IX Precautions to be followed

1. Never operate the lux meter in an environment filled with explosive gas or dust.
2. Check the functioning of lux meter before taking actual measurement.
3. Replace the battery periodically.

X Procedure

1. Identify various locations in the Institute where illumination level is to be measured.
2. Place the lux meter on the working surface.
3. Switch on the display of lux meter.
4. Note down the reading.
5. Repeat the above steps for the other locations of your Institute.

XI Resources used (with major specifications)

Sr. 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:

Sr. No.	Location	Measured Lux Level	Recommended Lux level	Remarks
1.				
2.				
3.				
4.				
5.				

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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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 the effect of improper illumination.
2) Give the illumination level in the descending order for the following areas i)Proof reading ii) bedroom iii) hospital ward iv) railway platform
3) Give the units of luminous intensity and luminous flux.
4) State applications of lux meter.
5) Classroom lux level is more compared to the lux level of corridor. Justify.

(Space for answers)

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XIX References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. Art and Science of Utilization of Electrical Energy- H.Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of Lux meter	20 %
2	Selection of different locations	10 %
3	Reading meters accurately	15 %
4	Follow safe practices	15 %
Product related (10 Marks)		**40%**
5	Interpretation of result	10 %
6	Conclusions	10 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….....
2. …….....
3. …….....

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

Practical No. 4 : Identify the different components required for various types heating furnaces.

I Practical Significance

This practical will enable the student to identify the different components of a heating furnace, which in future will help him to work efficiently in furnace related industry.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Identify the type of heating furnace.
- Identify different components of heating furnace.
- Know the function of above components.
- Follow safe practices.

IV Relevant Course Outcomes

- Maintain different electric heating and welding equipment.

V Practical Learning Outcome

- Identify different types of furnace and its components.

VI Minimum Theoretical Background

A furnace is essentially a thermal enclosure and is employed to process raw materials at high temperature both in solid and liquid state. Several industries like iron and steelmaking, non-ferrous metal production ceramic processing, cement manufacturing etc. employ furnaces.

Based on the basic principle of operation there are different types of furnace like resistance furnace, arc furnace, induction furnace.

Principle components of furnace are source of energy, suitable refractory material, heat exchanger, instrumentation and control.

VII Set up:

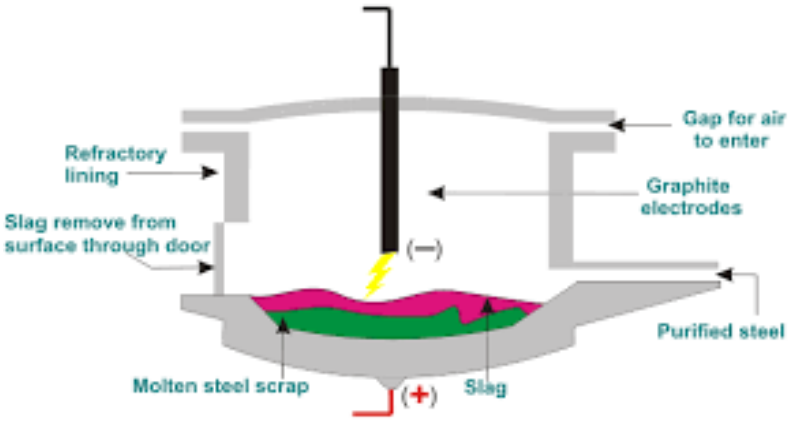

Fig.1 Electric Arc furnace

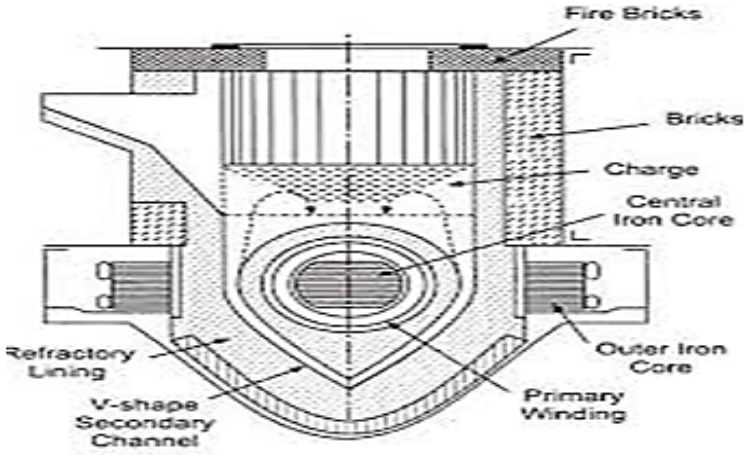

Fig.2 Ajax wyatt furnace

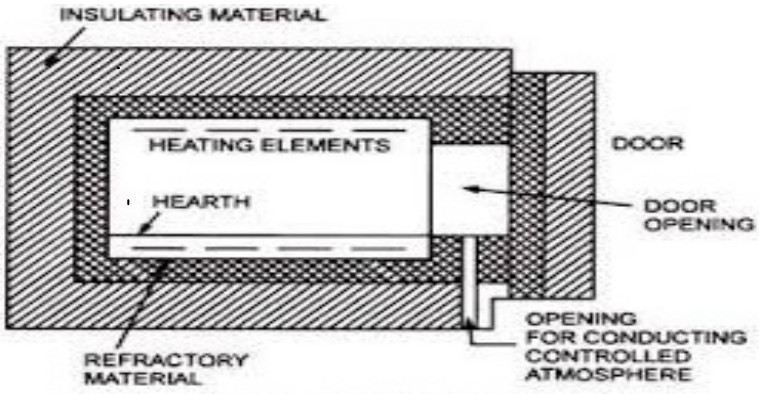

Fig. 3 Resistance Furnace

VIII. Resources required

Sr. No.	Name of the resource	Suggested broad Specification	Quantity
1	Desktop/laptop with internet connection/Standard reference book		2 to 3 websites or books
2	Learn & grow educational series	You tube channel	

IX Precautions to be followed

- Refer the authenticated website only.
- Interpret the images carefully.

X Procedure

1) Search information and images of various electric furnaces showing all the components.(Minimum 3)
2) Prepare a report comprising of different components along with their functions of various electric furnaces.(Minimum 3)

XI Resources used (with major specifications)

Sr. 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:

Sr. No.	Type of the Furnace	Name of the components	Function of the components
1			
2.			
3			

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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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) Name and state the function of refractory material in electric heating furnace
2) State the electrode material used in arc furnaces.
3) Name the component located in the thermostat that shuts the electric furnace down prematurely so that the space will not be overheated.

(Space for answers)

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XIX References / Suggestions for Further Reading

1) www.electrical4u.com
2) www.electricaltechnology.org
3) www.khanacademy.com
4) https://www.networx.com/article/know-your-hvac-system-components-and-how
5) https://solvitnow.com/how-does-a-furnace-work/.
6) Art and Science of utilization of electrical energy- H. Partab
7) Utilization of electrical energy – S.L.Uppal
8) Utilization of electrical energy – J.B.Gupta

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Selection and browsing of websites	20 %
2	Observation and Identification	20 %
3	Sketches and labelling	20 %
Product related (10 Marks)		**40%**
4	Preparation of report	10 %
5	Interpretation of result	05 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….....
2. …….....
3. ……...

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

Practical No. 5 : Observe construction and working of various heating furnaces by watching video programmes.

I Practical Significance

A diploma electrical engineer may sometimes require to work in industry where there are electrical heating furnaces .So he should preferably have the knowledge of construction and working of these furnaces .

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Identify various types of heating furnaces and also various components of different furnaces.
- Follow safe practices.

IV Relevant Course Outcomes

- Maintain different electric heating and welding equipment.

V Practical Learning Outcome

- Observe construction and working of various heating furnaces by watching video programs.

VI Minimum Theoretical Background

Two types of arc heating furnaces: Direct arc heating furnace & indirect arc heating furnace

Two types of induction heating furnaces: Core type induction heating furnace and coreless induction heating furnace.

VII Practical set up:

(Suggested videos, Extra videos may be watched)

1. https://www.youtube.com/watch?v=7oSbZgjXlFo
2. https://www.youtube.com/watch?v=5TLBdBXzMsg
3. https://www.youtube.com/watch?v=wfKLA95fpRY

VIII Resources required

Sr. No.	Name of the resource	Specification	Quantity	Remarks
1	Desktop/laptop with internet connection / standard Reference books.	Any suitable desktop/laptop with convenient monitor		

IX Precautions to be followed

1. All videos should be viewed from authentic sources (Secured sources).

X Procedure

1. Switch on the computer.
2. Confirm access to internet is available.
3. Browse the search engine, say Google/ YouTube.
4. Type above mentioned site address (for videos) in search column and press enter.
5. Watch the video carefully.
6. Draw labeled diagram of any three types of furnace.

XI Resources used (with major specifications)

Sr. No.	Name of Resource	Suggested Broad Specifications	Quantity
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XII Actual procedure followed

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XIII Precautions followed

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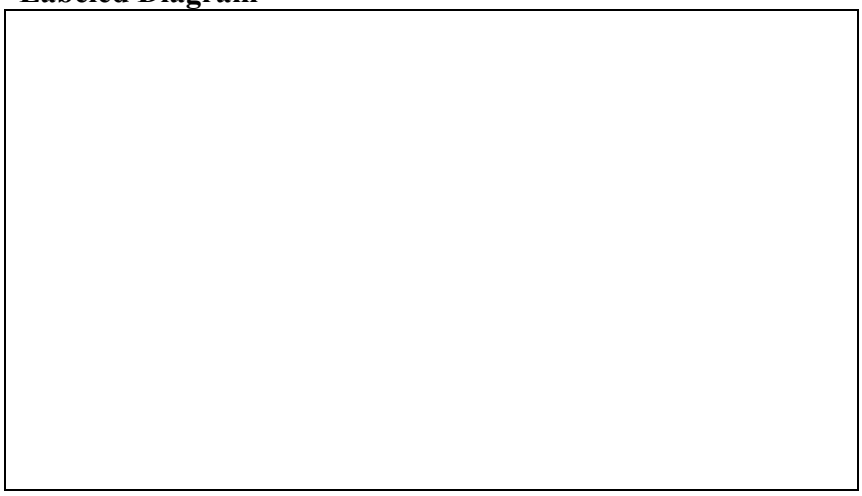
XIV Observations:
Video should be carefully observed for constructional and working details.

Name of the Furnace 1:
Specification:

Labeled Diagram

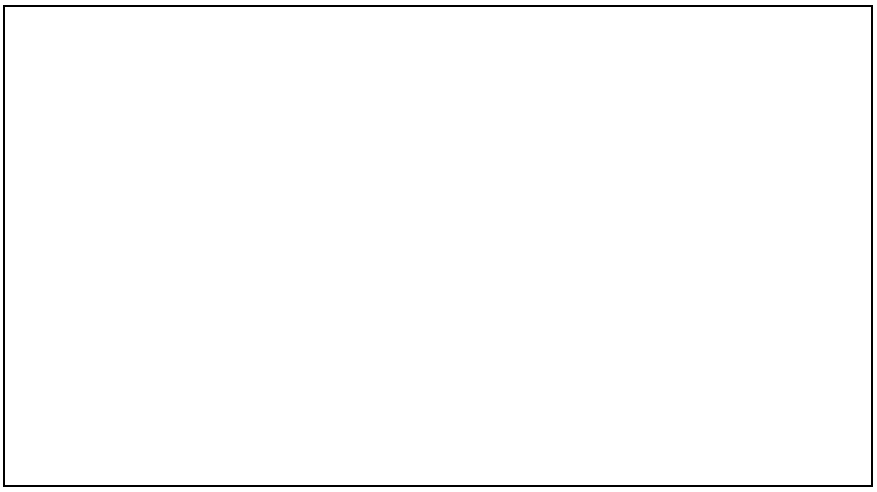


Applications

Name of the Furnace 2:

Specification:

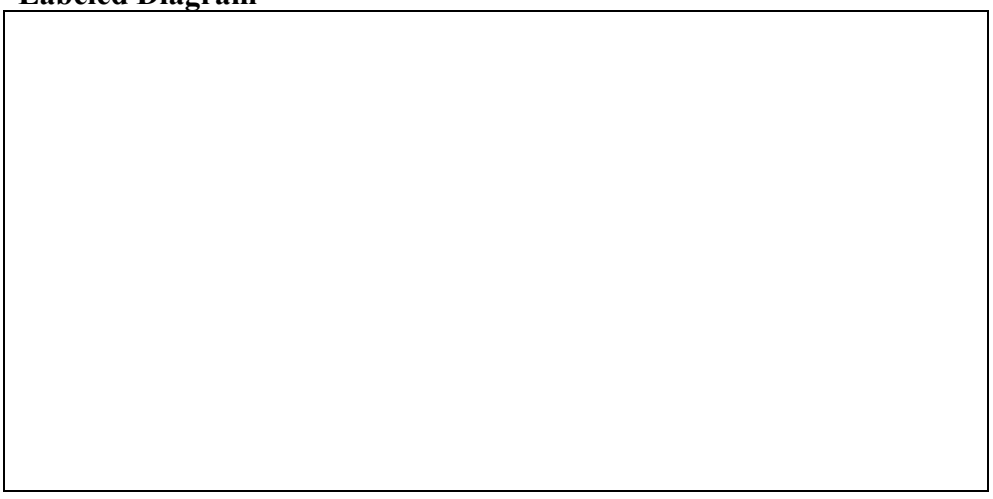
Labeled Diagram



Applications:

Name of the Furnace 3:
Specification:

Labeled Diagram



Applications:

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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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 any four applications of dielectric heating
2. State the purpose of refractory lining in electric furnaces
3. Name any four important heating element material with its maximum permissible operating temperature used for resistance furnace.

(Space for answers)

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XIX References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.electricaltechnology.org
3. www.khanacademy.com
4. https://www.networx.com/article/know-your-hvac-system-components-and-how

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Selection of videos	20 %
2	Observation and Interpretation of videos	20%
3	Labeled diagram	20%
Product related (10 Marks)		**40%**
4	Report writing	15 %
5	Interpretation of result	05 %
6	Conclusions	05 %
7	Practical related questions	10 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1 …….

2 …….

3 …….

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

Practical No. 6 : Identify the different accessories and safety devices required for various types of welding system.

I Practical Significance

Welding accessories enhance a welding operation by increasing safety and efficiency. These accessories are used in conjunction with welding process .For safe and effective work with the welding machine a diploma electrical engineer should possess the knowledge of different accessories for different welding machines.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Identify various types of welding systems, different accessories.
- Follow safe practices.

IV Relevant Course Outcomes

- Maintain different electric heating and welding equipment.

V Practical Learning Outcome

- Identify the different accessories and safety devices required for various types of welding system.

VI Minimum Theoretical Background

Types of welding:

i) Resistance welding:
a) Spot welding
b) Seam welding
c) Projection welding
ii) Electric arc welding

Welding accessories include products used in conjunction with welding processes. Examples include electrode holder, earth clamp torches, nozzles, regulators, safety equipment and protective clothing, and sensors.

VII Set up :
(Label the accessories select any six)

VIII Resources required

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Welding accessories (Electrodes, Electrode Holder, etc.)	Suitable rating available in college workshop	
2	Safety devices for welding (Safety Goggles, Safety Helmet, Apron, etc.)		

IX Precautions to be followed

- Follow safety practices while touching welding accessories in college workshop.

X Procedure

1) Identify the different welding accessories.
2) Write the name of the device in the observation table.
3) Write the function of the accessory in the table.

XI Resources used (with major specifications)

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
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XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Name of the welding accessory /safety devices	Function

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1) Name the metals which can be welded.
2) Give the capacity of light manual welding machine.
3) List the materials which are not used for making non consumable electrodes.
4) List five basic types of welding joints.

(Space for answers)

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XIX References / Suggestions for Further Reading

1. www.khanacademy.com
2. http://www.amadamiyachi.com/products/resistance-welding/rw-accessories
3. https://nptel.ac.in/courses/112107144/welding/lecture11&12.htm
4. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
5. Art & Science of Utilization of electrical energy- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Identification of welding accessories	40 %
2	Follow safe practices	20 %
Product related (10 Marks)		**40%**
3	Proper naming of the accessories	10 %
4	Interpretation of result	05 %
5	Conclusions	05 %
6	Practical related questions	15 %
7	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1.…….....

2.…….....

3.……..

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

Practical No.7 : Prepare a report of specification of various electrical welding machines available in college workshop.

I Practical Significance

Welders are required in architectural and structural metals manufacturing industries, mining and agricultural manufacturing industries, as well as motor vehicle manufacturing, aerospace industries and shipbuilding companies. Diploma electrical engineers who work in these industries are required to have knowledge of various welding machines used.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Identify various types of electrical welding machines.
- Follow safe practices.

IV Relevant Course Outcomes

- Maintain different electric heating and welding equipment.

V Practical Learning Outcome

- Prepare a report of specification of various electrical welding machines available in college workshop.

VI Minimum Theoretical Background

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

VII Set up :

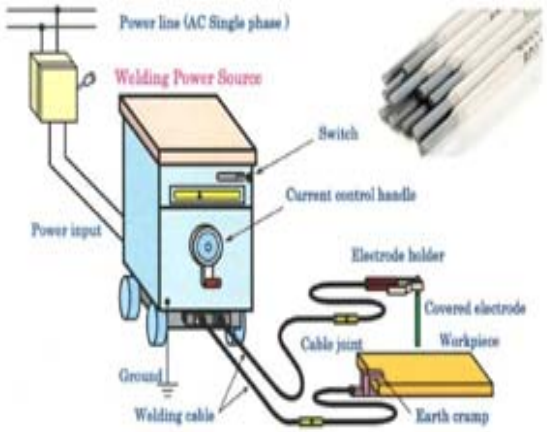

Fig.1 Arc welding machine

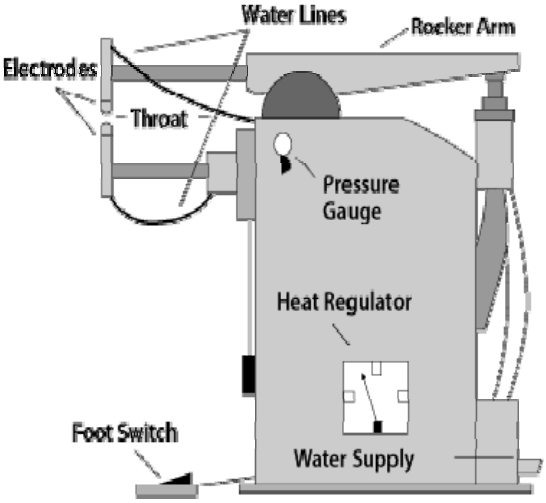

Fig.2 Spot welding machine

Sample Specification:

Sr. No.	Technical Parameter	Name/Rating
1	Type of welding machine	
2	Power voltage	
3	Frequency	
4	Rated Input current	
5	Output current	
6	Rated output voltage	
7	Duty cycle	
8	No load loss	
9	Efficiency	
10	Power Factor	
11	Insulation grade	
12	Housing protection grade	
13	Weight	

VIII Resources required

Sr. No.	Name of the resources	Specification	Quantity
1.	Welding machine	Any welding machine available in the college workshop.	01

IX Precautions to be followed

1. Confirm the power supply to the machine is switched off.
2. Machine is properly earthed.

X Procedure

1) Visit the workshop of your institute.
2) Observe the welding machines.
3) Note the name plate details and write detailed specifications in the space provided.

XI Resources used (with major specifications)

Sr. 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:

Sr. No.	Technical Parameter of Welding Machine	Rating/ Details

XV Results:

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XVI. Interpretation of results

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XVII. Conclusion

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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 the various types of welding machines.
2) The presence of arc blower makes poor quality weld, Justify.
3) Compare A.C welding with D.C welding system.

(Space for answers)

XIX References / Suggestions for Further Reading

1. www.nptel.iitm.ac.in
2. www.khanacademy.com
3. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
4. Art & Science of Utilization of electrical energy- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Recognition of type of welding machine	20 %
2	Noting down the various specifications	20 %
3	Follow safe practices	20 %
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. ……..

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

Practical No. 8 : Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.

I Practical Significance

Electric motors impact almost every aspect of modern living. Industrial visit enable the students to have practical aspect of electric drives and its application in various engineering field.

II Relevant Program Outcomes (POs)

- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PSO 1. Electrical Equipment:** Maintain various types of rotating and static electrical equipment.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency**: 'Maintain different types of electrical utilities and systems'.**

- Students will be able to realize the importance and significance of various electric drives.
- Observe the use of electric drive in industrial application.

IV Relevant Course Outcomes

- Use different electric drives and elevators.

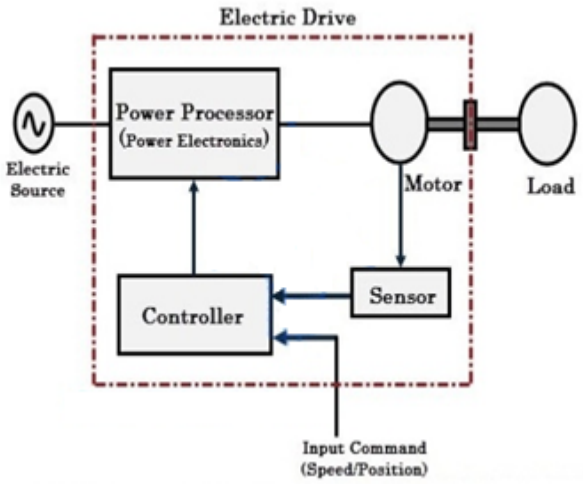
V Practical Learning Outcome

- Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.

VI Minimum Theoretical Background

An electrical drive is defined as a form of machine equipment designed to convert electrical energy into mechanical energy and provides electrical control of the processes. The system employed for motion control is called an electrical drive.

VII Set up:



AC Electrical Drive Block Diagram

Variable speed Drive in Wind Turbine

Hydraulic Drive

VIII Resources required:

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Small manufacturing unit / small scale Industry with electric drive		

IX Precautions to be followed

- Maintain discipline and order in the Industry.
- Should follow safety practices.

X Procedure

1. Visit the manufacturing unit/ small scale industry.
2. Observe electric drive.
3. Prepare a technical report.

- Note: If visit is not possible to arrange, required information is to be searched from relevant websites and demonstration is to be given by watching videos.

XI Resources used (with major specifications)

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

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Drive observed	Whether Group Drive or Individual Drive	Nature of Electric Supply	Nature of Load	Size & Rating of Motor	Type of Enclosure
1.						
2.						

XV Results:

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XVI Interpretation of results.

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XVII Conclusion

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XVIII Practical related Questions (use separate sheet for answer if space is not sufficient)

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

1. Differentiate between group & Individual drive based on the following parameters.
   (a) Cost (b) Appearance (c) Safety (d) Flexibility
2. Name the three different methods of electrical braking applied to drives.
3. State the types of bearings used in electric drives.

(Space for answers)

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XIX. References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
4. Art & Science of Utilization of Electrical Energy- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**(60%)**
1	Information collected	30 %
2	Team work & Coordination	30 %
Product related (10 Marks)		**(40%)**
3	Quality of observation	10 %
4	Interpretation	05 %
5	Conclusions	05 %
6	Practical related questions	15 %
7	Submitting the report in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……

2……..

3……...

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

Practical No. 9 : Prepare a comparative chart of two different manufacturing companies in India for any two Lift/ Elevator with technical data.

I Practical Significance

Elevator and lifts are part and parcel of our life now a day. It has made our life lot more comfortable and easier. Hence Students are required to have knowledge of electric drives used for elevators and lifts.

II Relevant Program Outcomes (POs)

- **PO2: Discipline knowledge:** Apply electrical knowledge to solve broad based electrical engineering related problems.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
  PO7: Ethics: Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8**: Individual and teamwork: Function effectively as a leader and team member in diverse/ multidisciplinary teams.
- **PSO 1: Electrical Equipment:** Maintain various types of rotating and static electrical equipment.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency**: 'Maintain different types of electrical utilities and systems'.**

- Be well versed with the rating/technical data of the elevator and lift for proper selection.
- Identify the electric drive used for elevator and lift.

IV Relevant Course Outcomes

- Use different electric drives and elevators.

V Practical Learning Outcome

- Collect information related to lift/elevator manufacturer
- Prepare comparative chart for different manufacturer based on technical data

VI Minimum Theoretical Background

An elevator can be defined as an electric lift which is used as vertical transportation of goods as well as people among the floors in buildings. As usual, these are activated with the electrical motors that also to drive counterweight system cables for drive transaction such as a hoist, otherwise, pump hydraulic fluid for raising a cylindrical piston such as a jack.

The latest elevator designs use 3-phase induction motors with variable frequency drive electronic controls. Some may also use a similar system with permanent magnet (brushless) DC motors. Some current and prior designs may use commutator-type DC motors with electronic controls.

VII Set up:

VIII Resources required

Sr. No.	Name of the Resource	Specification	Quantity
1.	Catalogues of different manufactures of elevators and lifts / Computer with internet facility		02

IX Precautions to be followed

- The comparative statement of any two elevator/lift manufacturing company should be prepared with earnest care.
- Give some precaution related with use of computer

X Procedure

1. Select catalogues of any two reputed Elevator/Lift manufacturing companies.
2. Catalogues containing technical data should be obtained from market survey / collect data through information search.
3. Prepare a comparative statement containing following technical parameters, any ten.
   - i. Rating and Type of Lift Motor.
   - ii. Dimensions of pent house.
   - iii. Total length of cable.
   - iv. Elevator capacity.
   - v. Dimensions of cage of Elevator.
   - vi. Type of Door.
   - vii. Type of drive.
   - viii. Facility of door locking device.
   - ix. Facility of door reopening device.
   - x. Facility of door open alarm.
   - xi. Facility of emergency landing door unlocking device.
   - xii. Direction and position indictor.

xiii. Load plate indicator and notice board.
xiv. Emergency release equipment and instructions.
xv. Provision of safety gear.
xvi. Provision of over speed governor.
xvii. Provision of overload device.
xviii. Run/stop switch provided where lift equipment is housed.
xix. Availability of fire safety.

XI Resources used (with major specifications)

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

XII Actual procedure followed (Additional sheet to be attached if required)

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XIII Precautions followed

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XIV Observations and Calculations:

Sr. No.	Technical Data	Name of the Company No.1 ----------	Name of the Company No.2 ----------	Approximate cost	Remarks
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XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1) Holding in a call button will make the elevator arrive at its destination faster. Justify whether the statement true or false.
2) Give the name of the mechanism that detects if the elevator is going too fast.
3) State the purpose of counter weight in elevator.
4) Are all elevator machine rooms located on the roofs of the buildings? Justify.

(Space for answers)

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XIX References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.electricaltechnology.org
3. The Maharashtra Lifts, Escalators and moving walks acts, 2017-India Code
4. The Bombay lifts Act 1939-Maharshtra housing and building Laws

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**(60%)**
1	Selection of lift/elevator manufacturing companies	10 %
2	Collection of information from market survey/ from website	30 %
3	Selection of proper technical data	20 %
Product related (10 Marks)		**(40%)**
4	Preparation of comparative statement	15 %
5	Interpretation of result	05 %
6	Conclusions	05 %
7	Practical related questions	10 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….....
2. …….....
3. …….....

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

Practical No. 10 : Visit a railway loco shed to observe various components and working of electric locomotive and prepare a technical report.

I Practical Significance

The first step in electric traction is to know the various components and working of Electric locomotive /EMU. Therefore with this visit, the students will be able to visualize and know the components of locomotive /EMU with their working.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
  PO6: Environment and Sustainability: Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.
- **PO9: Communication:** Communicate effectively in oral and written form.
- **PSO 1. Electrical Equipment:** Maintain various types of rotating and static electrical equipment.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competence: **'Maintain different types of electrical utilities and systems'.**

- Observe Locomotive/EMU and identify various components
- Collect technical information related to the components

IV Relevant Course Outcomes

- Use different electric traction systems.

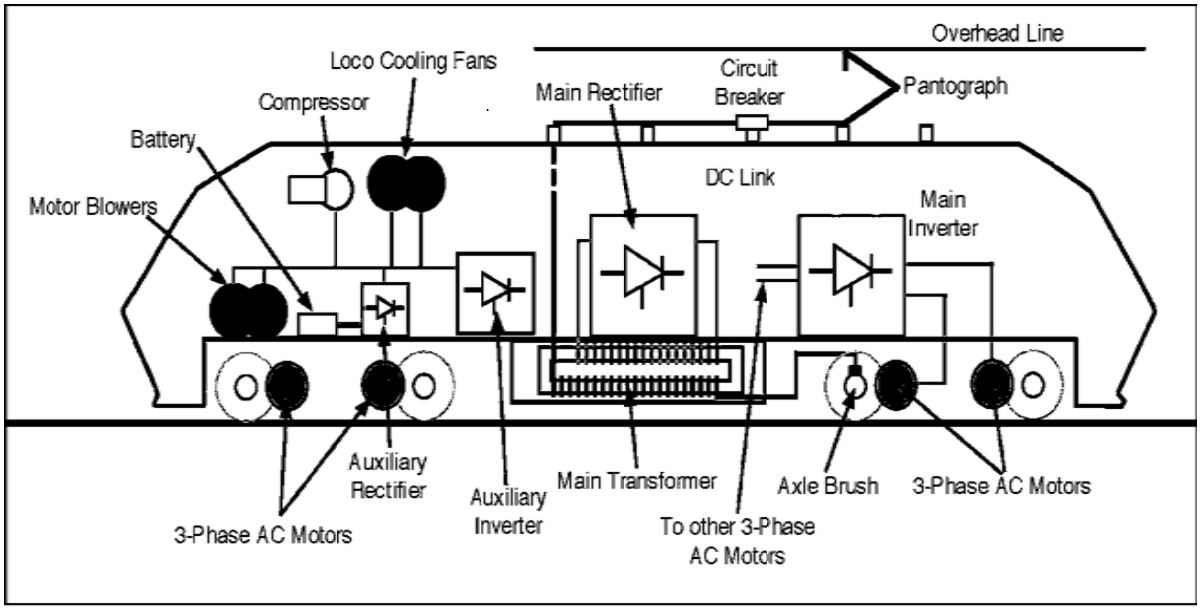
V Practical Learning Outcome

- Visit a railway loco shed to identify various components of EMU.
- Collect specifications of relevant components.

VI Minimum Theoretical Background

Electric locomotive collects current from OHE through sliding contact with it by means of pantograph. ACB is provided on the roof of the locomotive and its main function is to disconnect the locomotive from high voltage supply. By means of on load tap changer, we can vary the output voltage for speed control of traction motors. By means of transformer, high voltage of OHE is reduced to the utilization level. By means of rectifier, AC is rectified to DC. Smoothing choke reduces the magnitude of the alternating component of rectified undulating DC.

VII Set up:



VIII Resources required:

Sr. No.	Name of the resource	Suggested broad Specification	Quantity
1	Access to loco shed/ EMU car shed		
2	Safety accessories required for visit		

IX Precautions to be followed

1. Always wear proper protective clothing and use insulated tools when around EMU.
2. Safety helmet should be provided by the loco shed to each student.
3. Students should compulsorily wear front covered shoes.
4. Use of mobile phone should be restricted.

X Procedure

1. Visit nearby loco shed/ EMU car shed.
2. Observe the locomotive /train and identify various components
3. Note the specification of components and accessories.
4. Collect relevant information and prepare a technical report.

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:

Sr. No.	Name of the Component	Function	Specification
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XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1) Write the classification of locomotives.
2) Give the reason for preference of Air Blast Circuit Breaker in Electric Traction.
3) Suggest the AC and DC motors used in EMU.

(Space for answers)

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XIX References / Suggestions for Further Reading

1. www.electrical4u.com
2. rdso.indianrailways.gov.in
3. Modern Electric Traction- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Identification of components	20 %
2	Attendance collection of information	20 %
3	Follow safety precautions Discipline maintenance Discipline , Safety practices	20 %
Product related (10 Marks)		**40%**
4	Quality of report	10 %
5	Interpretation of report	05 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the report in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1…….....

2…….....

3…….....

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

Practical No. 11 : Prepare a report /chart on various types of traction systems.

I Practical Significance

Railway is a largest means of transportation in India and it is ranked in the world as fourth largest railway network. Study of various types of traction system will enable the student to understand the advantages and drawbacks of various traction system, so that they can select suitable traction system for Indian railways.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.
- **PO9: Communication:** Communicate effectively in oral and written form.
- **PSO 1: Electrical Equipment:** Maintain various types of rotating and static electrical equipment.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Identify the different types of traction systems.

IV Relevant Course Outcomes

- Use different electric traction systems.

V Practical Learning Outcome

- Prepare a report /chart on various types of traction systems.

VI Minimum Theoretical Background

A driving force that causes propulsion of a vehicle is referred to as a traction system. The traction system is of two different types: non electric traction system and electric traction system

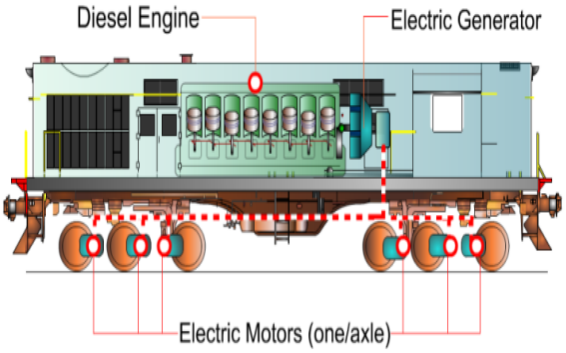
The traction system that doesn't use electricity at any stage of a vehicle movement is referred to as a non-electric traction system. Such a traction system is used in steam locomotives, IC engines, and in the maglev trains (high -speed trains).

The traction system that uses electricity in all stages or some stages of a vehicle movement is referred to as an electric traction system.

The systems which use electrical power for traction system i.e. for railways, trams, trolleys, etc. is called electrical traction.

VII Set up:

Electric Traction System



Diesel Traction System

Steam Traction System

VIII Resources required:

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Railway Manual / Computer with internet facility		

IX Precautions to be followed

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X Procedure

1) Browse websites for authentic information of different traction systems.
2) Visit library to gather information regarding different traction systems.
3) Based on the collected information, prepare either a detailed report or a comparative chart of different traction systems.

XI Resources used (with major specifications)

Sr. 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:

Sr. No.	Name of Traction System	Special features	Advantages	Drawbacks
1	Steam Engine			
2	Diesel Engine (Direct I.C Engine system)			

3	Electric Traction			
4	Diesel Electric Traction			

XV Results

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1. Write the maximum horse power of steam locomotive.
2. Give the approximate efficiency of diesel traction system.
3. List the different reasons for the popularity of electric traction system.
4. Suggest the electric motors used for i) DC traction system ii) Single phase AC traction system iii) 3 phase AC traction system iv) Composite system
5. Compare steam engine system with electric traction on any four parameters.

(Space for answers)

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XIX. References / Suggestions for Further Reading

1. www.electrical4u.com
2. rdso.indianrailways.gov.in
3. www.khanacademy.com
4. www.nptel.iitm.ac.in
5. Modern Electric Traction – H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Information collection	30 %
2	Preparation of report/chart	30 %
Product related (10 Marks)		**40%**
3	Quality of report/chart	10 %
4	Interpretation of the report/chart	05 %
5	Conclusions	05 %
6	Practical related questions	15 %
7	Submitting the report in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1…….....

2…….....

3…….

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

Practical No. 12 : Prepare a report/chart on speed time curves.

I Practical Significance

Preparation of a report/ chart on various speed time curves will enable the student to get the complete information of the motion of the train.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.
- **PO9: Communication:** Communicate effectively in oral and written form.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Draw speed time curve for various types of service.
- Differentiate between various types of train services

IV Relevant Course Outcomes

- Use different electric traction systems.

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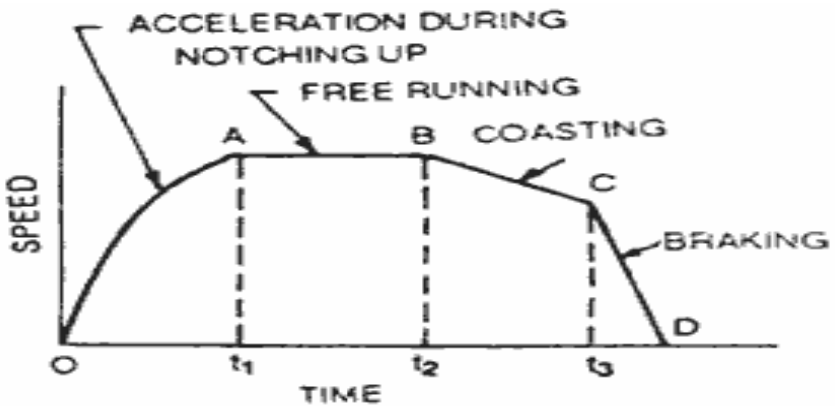
V Practical Learning Outcome

- Prepare a report/chart on speed time curves for various types of services.

VI Minimum Theoretical Background

The curve drawn between speed and time, taking instantaneous speed in kmph on the Y axis and time in seconds on X axis, is known as speed time curve. This curve provides complete information of the motion of the train, i.e. distance travelled by the train during a given time, acceleration, retardation, maximum speed etc.



VII Practical Set up:

i) Draw typical speed time curve for main line services and list five distinct periods of the run.

ii) Draw a labeled simplified speed time curve for main line services, urban and sub urban services

VIII Resources required:

Sr. No.	Name of the resource	Suggested broad Specification	Quantity	Remarks
1	website / reference book / railway catalogue			
2	Drawing materials			

IX Precautions to be followed

- Correct and Authentic information should be collected from reference books and websites to prepare report.
- Guidance from course teacher can be taken to draw the speed time curve.

X Procedure

1) Browse websites for authentic information to prepare the report on speed time curve.
2) Visit library to gather more information about speed time curve.
3) Based on the collected information, draw labeled speed time curve for main line services and list five distinct periods.
4) Draw a labeled simplified speed time curve for main line services, urban and sub urban services.

XI Resources used (with major specifications)

Sr. No.	Name of the resource	Specification	Quantity	Remarks
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2				

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Parameter of comparison	Urban service	Sub urban Service	Main line service	Metro line
1.	Acceleration				
2.	Retardation				
3.	Maximum speed				
4.	Distance between stations				
5.	Special remark				

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

Numerical No.1:
A train has a schedule speed of 30 Kmph over a level track, distance between the stations being 1 Km. Station stopping time is 20 seconds. Assuming breaking retardation of 3 Kmphps and maximum speed 25 % greater than average speed, calculate acceleration required to run the service.

Numerical No.2:
A train runs with an average speed of 40 Kmph. Distance between stations is 2 Km. Value of acceleration and retardation are 1.5 Kmphps and 2.5 Kmphps respectively. Find the maximum speed of the train assuming trapezoidal speed time curve.

Numerical No.3:
An electric train has the following speed time curve: i) Uniform acceleration from rest at 2 Kmphps for 30 seconds .ii) Coasting for 50 seconds. iii) Duration of braking for 20 seconds
iv) Duration of station stops is 15 seconds.
Determine the schedule speed and draw the speed time curve.

Numerical No.4:
An electric train has the following speed time curve :i) uniform acceleration of 1.5 Kmphps for 30 seconds. ii) Constant speed for 40 seconds iii) Coasting for 30 seconds iv) Braking at 2.5 Kmphps to rest. Calculate the total distance covered and draw the speed time curve.

1. State the meaning of crest speed.

2. List the factors on which speed time curve of main line service differs from suburban service.
3. State the different factors affecting schedule speed.

(Space for answers)

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XIX. References / Suggestions for Further Reading

1. www.electrical4u.com
2. rdso.indianrailways.gov.in
3. www.khanacademy.com
4. www.nptel.iitm.ac.in
5. Modern Electric Traction- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Information collected from website/reference book	30 %
2	Quality of chart /drawing	30%
Product related (10 Marks)		**40%**
3	Interpretation of the chart/drawing	10 %
4	Conclusions	05 %
5	Practical related questions/numerical solving	20 %
6	Submitting the report in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….....
2. ……....
3. …….

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

Practical No. 13 : Improve the power factor of available inductive load using static capacitor.

I Practical Significance

Improvement in power factor increases the power handling capacity, improves voltage regulation and reduces the power loss which results in the reduced energy bill. This practical enables the student to make use of power factor correction unit to improve p.f.

II Relevant Program Outcomes (POs)

- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Realize the importance and significance of improved power factor.
- Improve the power factor of given inductive load.

IV Relevant Course Outcomes

- Use equipment for economic operation.

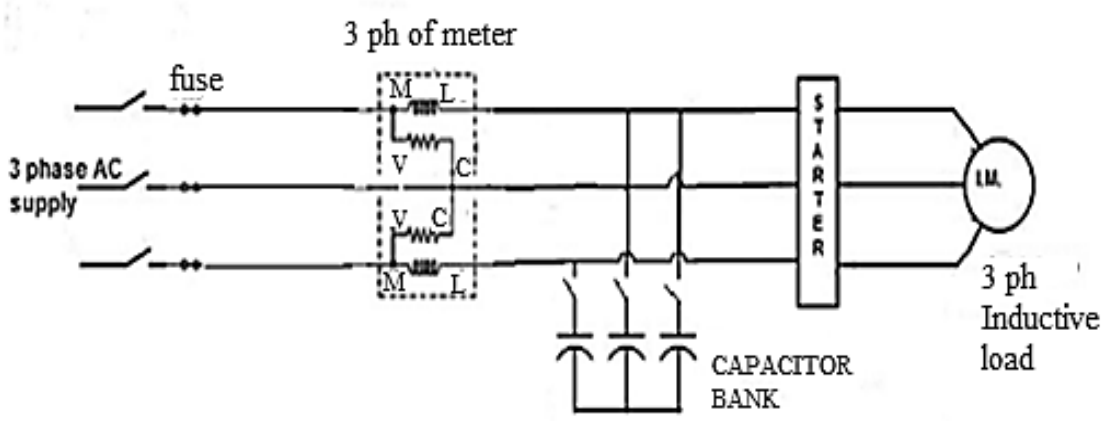
V Practical Learning Outcome

- Improve the power factor of available inductive load using static capacitor.

VI Minimum Theoretical Background

Most of the industries and power system loads are inductive, that takes lagging current which decrease the system power factor. For Power factor improvement purpose, Static capacitors are connected in parallel with those devices which work on low power factor. These static capacitors provides leading current which neutralize (totally or approximately) the lagging inductive component of load current (i.e. leading component neutralize or eliminate the lagging component of load current), thus power factor of the load circuit is improved. These capacitors are installed in vicinity of large inductive load and improve the load circuit power factor to improve the system efficiency.

VII Practical Set up:



Note: Experiment with single phase load also can be performed.

VIII Resources required:

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Three phase Capacitor bank	3 phase 50 Hz, 1 KVAR	01
2	Three phase Induction motor	3hp,415 volts	01
3	Power factor meter	3 phase,5/10A,300/600V	01
4	Digital Clamp on Ammeter	0-20A	01

IX. Precautions to be followed

- Make sure that the main switch is in OFF position while making connections.
- Make sure all capacitors are properly discharged before connection.

X Procedure

1) Make the connections as per the circuit diagram.
2) Keep the switches of capacitor bank in OFF position..
3) Switch ON the supply.
4) Start the Induction motor at No load.
5) Note the current at the supply end (Before capacitor) and Load end (After capacitor) using Clamp on ammeter.
6) Note the reading of power factor meter.
7) Switch ON appropriate capacitor bank in steps.
8) Observe and note the increase in power factor in pf meter.
9) Switch OFF the capacitor bank one by one and Switch OFF the supply.

XI Resources used (with major specifications)

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
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2.					
3.					
4.					
5.					
6.					

II Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Capacitor Bank	I_{supply}	I_{Load}	Power Factor
1.	OFF			
2.	C_1			
3	C_2			
4	C_3			

XV Results:

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XVI Interpretation of results.

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XVII Conclusion

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XVIII Practical related Questions

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

1. State the different methods of power factor improvement.
2. Give the different causes of low power factor.
3. List any three advantages of improved power factor.

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XIX. References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
4. Art & Science of Utilization of Electrical Energy- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Connection of circuit	25 %
2	Handling of meters	10 %
3	Following safety practices	25%
Product related (10 Marks)		**40%**
4	Quality of observation	10 %
5	Interpretation	05 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the report in time	05%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. …….
2. …….
3. …….

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

Practical No. 14 : Prepare a report based on comparative study of various tariff structure of Maharashtra

I Practical Significance

The tariff is method of charging consumer for power consumption. It is utmost important for everybody to know various types of tariff, its benefits and drawback which help us to reduce our energy consumption and electricity bill.

II Relevant Program Outcomes (POs)

- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6**: **Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Identify the different factors affecting tariff.
- Identify particular tariff for given type of consumer.

IV Relevant Course Outcomes

- Use equipment for economic operation.

V Practical Learning Outcome

- Prepare a report based on comparative study of various tariff structure of Maharashtra.

VI Minimum Theoretical Background

Tariff is the rate of payment or schedule of rates on which charges to be recovered from the consumer of electrical energy are computed. Tariff should recover the cost of producing electrical energy in power station and capital invested in transmission and distribution system.

Various Types of Electricity Tariff:

1. Simple Tariff
2. Flat Rate Tariff
3. Block Rate Tariff
4. Two Part Tariff
5. Maximum Demand Tariff
6. Power Factor Tariff
7. Three Part Tariff
8. Time of Day Tariff (T.O.D tariff)

VII Practical Set up:

1. Residential consumers
a) Rural b) Urban
2. Commercial consumers
3. LT Industrial consumers
4. HT industrial consumers
5. Agricultural consumers.

VIII Resources required:

Sr.	Name of the Resource	Suggested Broad Specification	Quantity
1	Visit MSEDCL/ any other utility in Maharashtra, site for various tariff structures.		

IX Precautions to be followed

- The tariff structure taken from MSEDCL site or from any other utility in Maharashtra should be preferably for the current year.

X Procedure

1) Browse utility websites for authentic tariff structure of various consumers.
2) Report should be written based on the information collected.

XI Resources used (with major specifications)

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

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Type of the consumer	Suitable Tariff structure applicable
1	Residential (Rural)	
2	Residential (Urban)	
3	Commercial	
4	Industrial	
5	Agricultural	

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1. List the advantages and drawbacks of Block Rate tariff.
2. State the difference between two part tariff and Maximum demand tariff.
3. Give reason why a big consumer is charged at a lower rate than a small consumer.
4. State the importance of power factor tariff.

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XIX References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. www.nptel.iitm.ac.in
4. Art and Science of Utilisation of Electrical Energy – H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Information collected from website/ reference books	30 %
2	Selection of suitable tariff for various types of consumer	30 %
Product related (10 Marks)		**40%**
3	Quality of report/chart and accuracy of solution	20 %
4	Interpretation of the report/chart	05 %
5	Conclusions	05 %
6	Practical related questions	05 %
7	Submitting the report in time	05%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……

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

Practical No.15 : Prepare Energy Bill based on energy consumption of residence/ Institute

I Practical Significance

Electricity is a powerful form of energy that is essential to the operation of almost every facility in the world. It is also an expensive form of energy that can represent a significant portion of a manufacturing facility's cost of production. Approved rate of return by energy regulation and development authority along with the utility's cost structure, determine prices customers will pay.

II Relevant Program Outcomes (POs)

- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO9: Communication:** Communicate effectively in oral and written form.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- Skill to calculate energy bill based on energy consumption.

IV Relevant Course Outcomes

- Use equipment for economic operation.

V Practical Learning Outcome

- Prepare Energy Bill based on energy consumption of residence/ Institute

VI Minimum Theoretical Background

Key elements of your electricity bill*:*

Electricity metering: Electric utilities meter both the real and reactive power consumption of a facility.

Billing Demand: A charge applied to an energy customer for energy made available explicitly for that customer.

Contract Demand: The kW (or kVA) demand as mutually agreed between Distribution licensee and consumer, used to calculate the Demand Charge in each billing period.

Energy consumption: The other major component of an electric bill is energy. The sane metering equipment that measures power demand also records customer energy consumption. Energy consumption is reported in kilowatt-hours or megawatt-hours.

Load Factor: One useful parameter to calculate each month is the ratio of the average demand to the peak demand.

Power factor: For effective electricity cost reduction, it is important to understand how the customer's electric utility recoups its costs associated with reactive power requirements of its system.

Electricity duty: This is levied at the rate for per unit consumed. (@1.28Rs./unit)
Fuel adjustment charge: Electricity tax (16%)

VII Practical set up:

Students should attach recent residential/commercial electricity bill.

VIII Resources required:

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Electricity bill showing Current meter reading, Last meter reading		

Suggested Tariff:

Units	0-100	101-300	301-500	501-1000	>1001
Energy consumption charges	3.05	6.95	9.9	11.5	12.50
Fuel adjustment charges	0.36	0.61	0.79	0.83	0.88

IX Precautions to be followed

- Take the value of fixed charges properly.
- Take the charges of electricity duty and tax properly.

X Procedure

1. Note the current energy meter reading.
2. Subtract the last reading from the current reading.
3. Get the value of total energy consumed.
4. Multiply the above value by energy rate in your area to get total energy charge.
5. Total electricity bill=Fixed charge + Energy charge + electricity duty + Fuel adjustment tax + electricity tax.

XI Resources used (with major specifications)

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

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Details of consumer:

i. **Name of the consumer:**
ii. **Type of consumer:**
iii. **Billing Period:**

Sr. No.	Current meter reading	Last meter reading	Total units consumed	Total Energy charge
1.				

Fixed charges=

Electricity duty=

Electricity tax=

Fuel adjustment tax=

Energy charges =

Total Electricity bill =

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1. State the difference between duty and tariff.
2. State the type of tariff most suitable for Industrial consumer. Justify your answer.
3. Explain TOD tariff.

(Space for answers)

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XIX. References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. https://www.mahadiscom.in/consumer/wpcontent/uploads/2018/03/Comm_CircularNo.80.pdf
4. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
5. Art & Science of Utilization of electrical energy- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Information collected	30 %
2	Team work & Coordination	30 %
Product related (10 Marks)		**40%**
3	Calculations	10 %
4	Interpretation of bill	05 %
5	Conclusions	05 %
6	Practical related questions	15 %
7	Submission On time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….
2. …….
3. ……..

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

Practical No. 16 : Prepare a technical report after visiting an industry, various power factor improvement devices used. (Otherwise from internet)

I Practical Significance

A power factor of one or "unity power factor" is the goal of any electric utility company since if the power factor is less than one, they have to supply more current to the user for a given amount of power use. In doing so, they incur more line losses.

II Relevant Program Outcomes (POs)

- **PO4: Engineering Tools:** Apply relevant electrical technologies and tools with the understanding of the limitations.
- **PO5: The Engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of electrical engineering.
- **PO6: Environment and Sustainability:** Apply electrical engineering solutions also for sustainable development practices in societal and environmental context.
- **PO7: Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of electrical engineering.
- **PO8: Individual and teamwork:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.
- **PO9: Communication:** Communicate effectively in oral and written form.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency: **'Maintain different types of electrical utilities and systems'.**

- To realize the importance and significance of improved power factor.
- Observe and study various power factor improvement devices used in industry

IV Relevant Course Outcomes

- Use equipment for economic operation.

V Practical Learning Outcome

- To familiarize with various power factor improvement device used for various Industrial application.

VI Minimum Theoretical Background

In electrical engineering, the power factor of an AC electrical power system is defined as the ratio of the real power absorbed by the load to the apparent power flowing in the circuit, and is a dimensionless number in the closed interval of 0 to 1.

Power-factor correction increases the power factor of a load, improving efficiency for the distribution system to which it is attached.

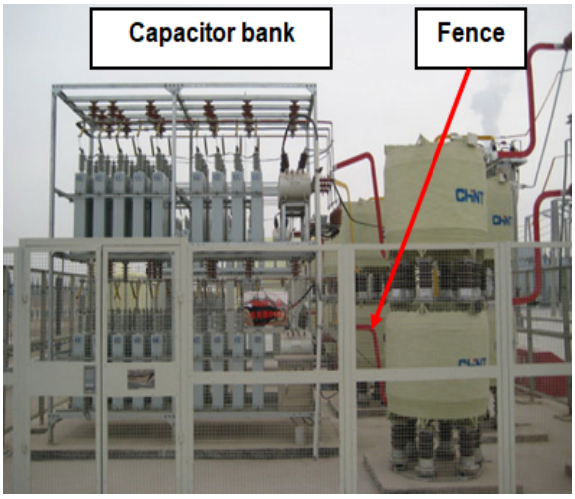
The power factor can be improved by the following methods

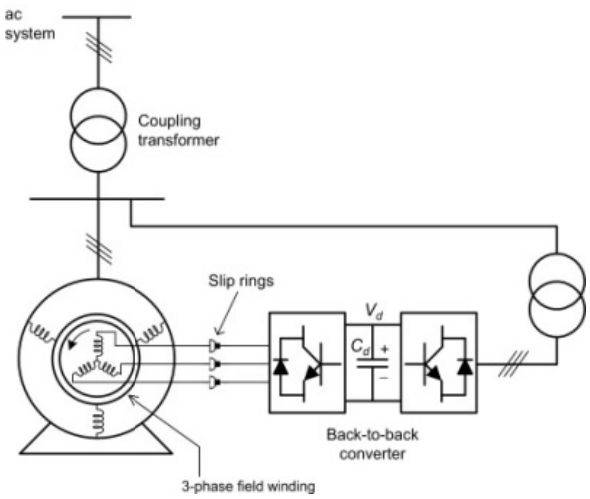
i) By using static capacitor

ii) Synchronous compensator or Synchronous condenser

iii) By using Phase advancers iv) By using phase compensated motors

VII Set up:





VIII Resources required:

Sr. No.	Name of the Resource	Suggested Broad Specification	Quantity
1	Visit to any Industry employing power factor improvement scheme/ Desktop with Internet provision		

IX Precautions to be followed

- In case of Industrial visit, maintain discipline and order during the entire visit.
- Follow safety practices during visit.
- Correct and authentic information should be collected from websites.

X Procedure

1. Visit an Industry having Power factor improvement facility/ browse the website for power factor improvement devices.
2. Based on Information gathered prepare a report on power factor improvement devices.

XI Resources used (with major specifications)

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					

2					

XII Actual procedure followed

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XIII Precautions followed

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XIV Observations:

Sr. No.	Type of the power factor improvement Device	Rating	Areas of Application
1	Static capacitor		
2	Synchronous condenser		
3	Phase advancers		

XV Results:

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XVI Interpretation of results

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XVII Conclusion

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XVIII Practical related Questions

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

1. Capacitor is rated in kVAR. Give reason.
2. A three phase, 5kW Induction motor has a power factor of 0.75 lagging. Calculate the
   size of capacitor in kVAR required to improve the power factor to 0.9.
3. Name the power factor improvement device used for induction motor.
4. State any four advantages of power factor improvement.

(Space for answers)

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XIX References / Suggestions for Further Reading

1. www.electrical4u.com
2. www.khanacademy.com
3. Generation & Utilization of Electrical Energy- S. Sivanagaraju & M. Balasubba
4. Art and Science of Utilization of electrical energy- H. Partab

XX Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Industry visit/ Information collected	30 %
2	Team work & Coordination	30 %
Product related (10 Marks)		**40%**
3	Quality of report/chart	10 %
4	Interpretation of the report/chart	05 %
5	Conclusions	05 %
6	Practical related questions	15 %
7	Submitting the report in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….....
2. …….....
3. …….....

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