SCHEME : K

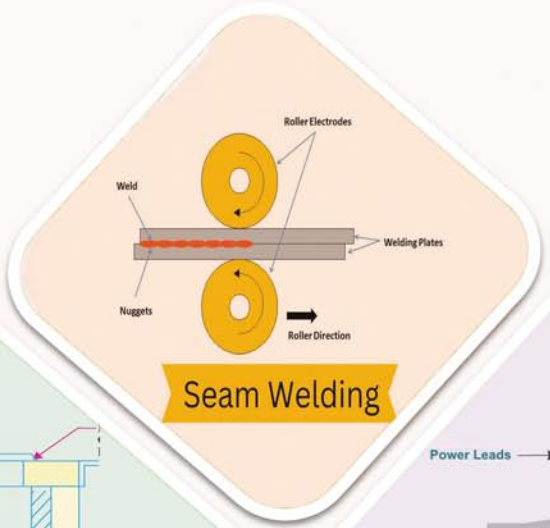
Name : _____

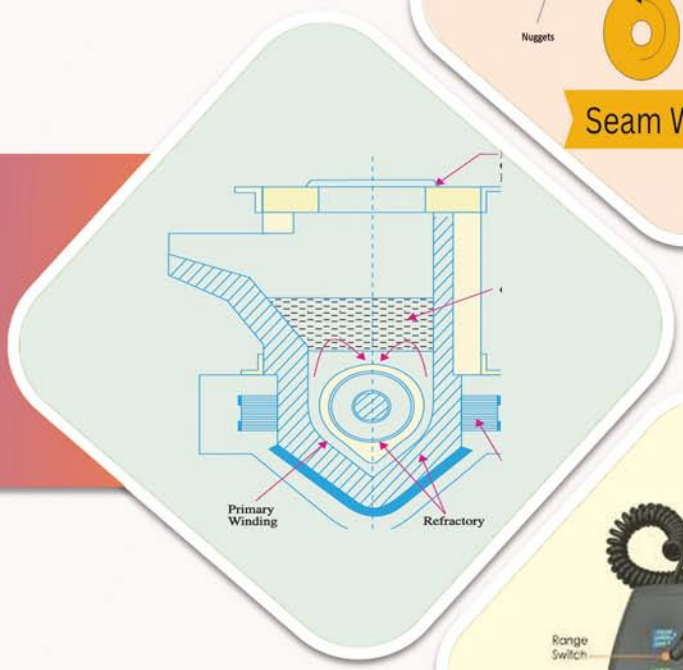
Roll No. : _____ Year : 20___ 20___

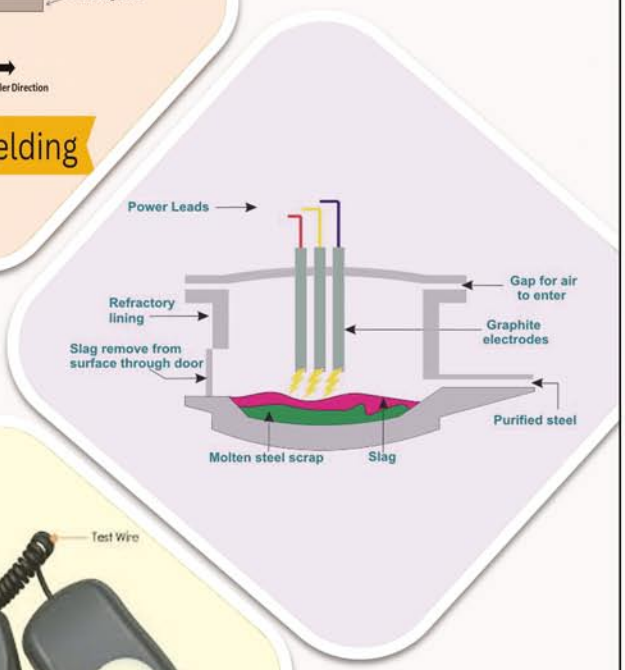
Exam Seat No. : _____

LABORATORY MANUAL FOR

UTILIZATION OF ELECTRICAL ENERGY (314323)







ELECTRICAL ENGINEERING GROUP

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

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

MSBTE believes in the following:

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

A Laboratory Manual For

UTILIZATION OF ELECTRICAL ENERGY

(314323)

Semester – IV

(EE/EP)

Maharashtra State

Board of Technical Education, Mumbai

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

Maharashtra State Board of Technical Education, Mumbai

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

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

MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION
Certificate

This is to certify that Mr. /Ms …….....

Roll No. ……., of Fourth Semester of Diploma in ….……..…… of Institute, ……..……

(Code : ……) has completed the term work satisfactorily in course **Utilization of Electrical Energy (314323)** for the academic year 20…….to 20…….. as prescribed in the curriculum.

Place: …….. **Enrollment No: ……..**

Date: ……. **Exam Seat No: ……**

Subject Teacher **Head of department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much-needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher, instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through "chalk and duster" activity in the classroom situation. Accordingly, the 'K' 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 industry/employer expected outcome, course level learning outcome, laboratory learning outcome, which serve 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/She has to work as production, maintenance, testing engineer in various industries like power generation, transmission, distribution, traction etc. and has to deal with operation and control of various electrical drives, electrical furnaces and traction systems. While performing above task he/she has to utilise the electrical energy efficiently, therefore he/she must require the skills and a broad idea of handling different electrical utilities.

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

Program Outcomes (POs) to be achieved through this course learning

- **PO 1. Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, sciences and engineering fundamentals with electrical engineering specialization to solve the engineering problems.
- **PO 2. Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.
- **PO 3. Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of system components or processes to meet specified needs.
- **PO 4. Engineering tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- **PO 5. Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- **PO 6. Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- **PO 7. Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

List of relevant expected psychomotor domain skills

This Lab manual intends to develop expected psychomotor domain skills of students. The skills mentioned below will be developed through the experiments performed in this Laboratory**.**

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

Practical Course Outcome matrix

Course level learning outcomes (COs)

CO1 - Design simple lighting scheme.

CO2 - Select type of electric furnaces according to applications.

CO3 - Operate the different electric welding system.

CO4 - Select suitable electric drive for a particular application.

CO5 - Maintain different electric traction system.

Sr. No.	Title of the Practical	CO1	CO2	CO3	CO4	CO5
1	*Identification of different lighting accessories required for various types of lamps.	✓	-	-	-	-
2	*Comparison of Lumen output of Fluorescent tube, Metal Halide, CFL and LED.	✓	-	-	-	-
3	*Measurement of illumination at different locations in college using luxmeter and compare with standard illumination level as per SP 72: 2023. (National Lighting code).	✓	-	-	-	-
4	*Design a heating element as per the given parameters.	-	✓	-	-	-
5	*Demonstration of different electrical and safety equipment used for arc welding.	-	✓	-	-	-
6	*Identification of different components required for various heating furnaces.	-	✓	-	-	-
7	*Selection of suitable current range of Welding generator set and Welding transformer for various thickness of metal job.	-	-	✓	-	-
8	*Identification of different defects in arc welding job.	-	-	✓	-	-
9	*Identification of different electrodes used in arc welding.	-	-	✓	-	-
10	*Estimation of size of motor as per the specified load cycle.	-	-	-	✓	-
11	Identification of the different components of an Elevator.	-	-	-	✓	-
12	Identification of different components of Escalator.	-	-	-	✓	-
13	Visit to a traction loco shed and observe various types of system used in traction.	-	-	-	-	✓ -
14	*Demonstrate indirect resistance Oven used in Laboratory.	-	✓	-	-	-

Guidelines to Teachers

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

Instructions for Students

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

Content Page

List of Practical's and Progressive Assessment Sheet

	safety equipment used for arc welding.						
6.	*Identification of different components required for various heating furnaces.	36					
7.	*Selection of suitable current range of Welding generator set and Welding transformer for various thickness of metal job.	44					
8.	*Identification of different defects in arc welding job.	50					
9.	*Identification of different electrodes used in arc welding.	57					
10.	*Estimation of size of motor as per the specified load cycle.	64					
11.	Identification of the different components of an Elevator.	71					
12.	Identification of different components of Escalator.	79					

13.	Visit to a traction loco shed and observe various types of system used in traction.	85					
14.	*Demonstrate indirect resistance Oven used in Laboratory.	90					
Total							

Note: Out of above suggestive LLOs -

'*' Marked Practicals (LLOs) Are mandatory.

Minimum 80% of above list of lab experiment are to be performed.

Judicial mix of LLOs is to be performed to achieve desired outcomes.

Practical No. 1: Identification of 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 day light consumption in buildings. Proper lighting can enhance performance, improve the appearance of an area, or have positive psychological effects on occupants. This practical will enable the students to identify the different lighting accessories used for various types of lamps used at various places.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Design simple lighting scheme.

IV Laboratory Learning Outcome(s)

LLO 1.1 Identify the different lighting accessories required for various types of lamps.

V Relevant Affective Domain related outcome(s)

Follow safety practices.

Maintain tools and equipment.

Maintain tools and measuring instruments.

VI Relevant Theoretical Background (With diagrams if required)

Following are the most required lighting accessories:

1. Lamp holder / Tube holder: it is used for holding a bulb or tube. Through holder electrical connection is provided 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. For Example ballast is used in tube light.
3. Light diffusers : Light diffusers scatters light to provide softer light. In photography, this
4. 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.

5. Light dimmer: Light dimmer reduces the brightness of light by controlling the voltage.
6. Lamp Starter: A starter is a small device used in certain types of lighting, especially fluorescent tubes. It usually consists of a small glass container with argon gas inside and a
7. bimetallic foil. Basically, a fluorescent starter generates a sufficient discharge to "activate" the gas inside the lamp so that it lights up.

VII Practical set-up / Circuit diagram / Work Situation:

Identify the lighting accessories

Figure 1.1 : Lamp Holder

Figure 1.2

Figure 1.3

Figure 1.4

Figure 1.5

Figure 1.6

VIII Required Resources/apparatus/equipment with specification

Sr.No.	Name of Resource	Suggested Broad Specification	Quantity
1	Candle cup/Lamp Holder		
2	Ballast (electrical)		
3	Diffuser plate		
4	Dimmer/fan regulator		
5	Starter		
6	Screw type holder		
7	Ballast (electronic)		

IX Precautions to be followed

1. Handle the lamp with care.
2. Ensure the 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 the 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 Observation table

Sr. No.	Name of lamp accessories	Rating	Function
1			
2			
3			
4			
5			
6			

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. List the two functions of the choke.
2. List the two types of starters used in fluorescent tube.
3. State the function of starter.
4. List the different types of the dimmer.
5. List the different types of diffuser.
6. Write the function of ballast.
7. Enlist the different types of dimmer.

(Space for answers)

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XVI References/Suggestions for further reading

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

XVII Suggested Assessment Scheme

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

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

Practical No. 2: Comparison of Lumen output of Fluorescent tube, Metal Halide, CFL and LED.

I Practical Significance

Electrical Engineering diploma graduate are expected to know different types of lamps based on construction, working principle, power consumption and cost. Lumens measure the total visible light output produced by a light source, and they are crucial for understanding how effectively a lamp can illuminate a space. This practical will help you in acquiring necessary skills to identify the components of different types of lamps and their LUX level.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Design simple lighting scheme.

IV Laboratory Learning Outcome(s)

LLO 2.1 To compare the Lumen output of various lamps.

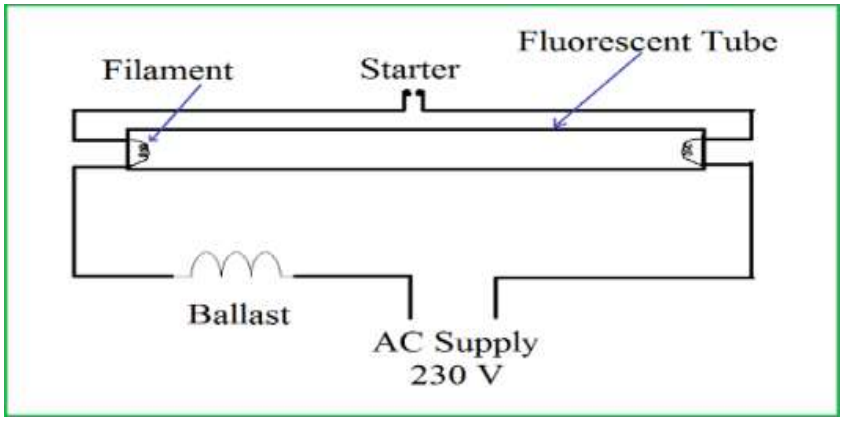
V Relevant Affective Domain related outcome(s)

Follow safety practices.

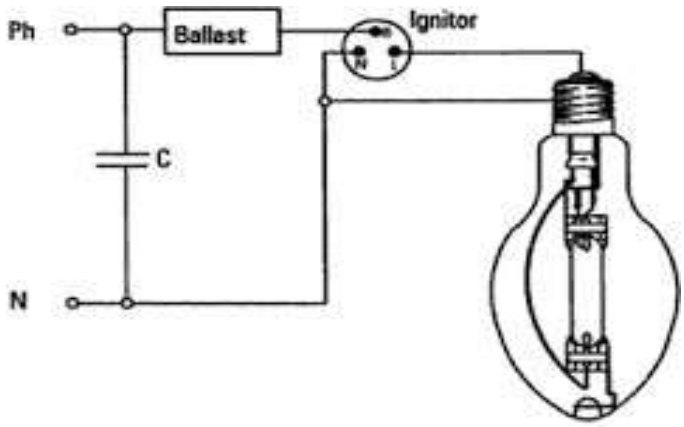
Maintain tools and equipment.

VI Relevant Theoretical Background (With diagrams if required)

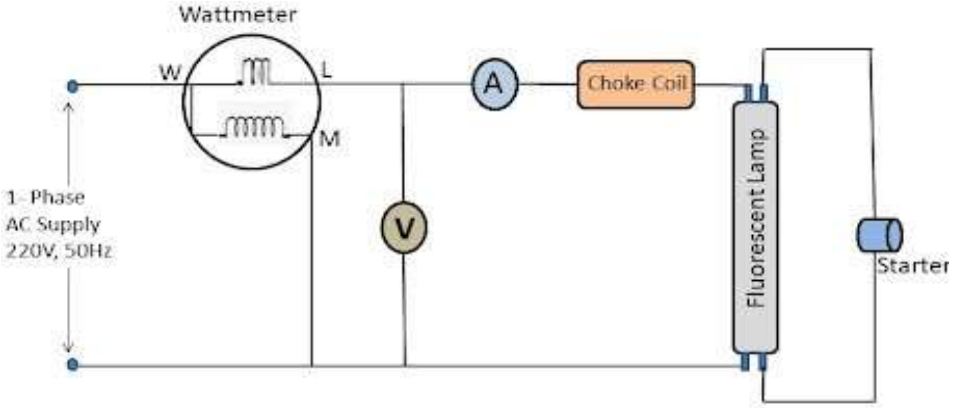
A fluorescent lamp has changed over electrical energy into useful light energy to a great deal more proficiently than incandescent lamps. The normal luminous viability of fluorescent lighting frameworks is 50 to100 lumens per watt, which is a few times the adequacy of incandescent lamps with equivalent light yield.



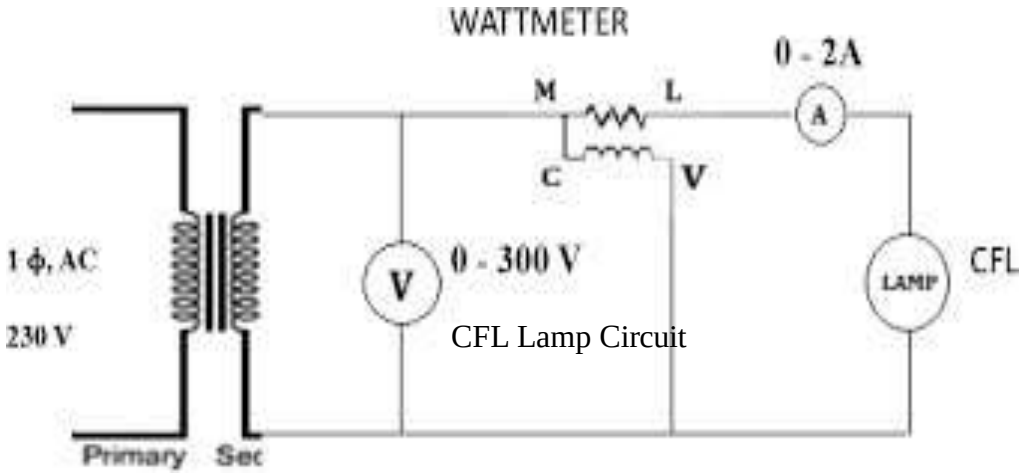
VII Practical set-up / Circuit diagram / Work Situation



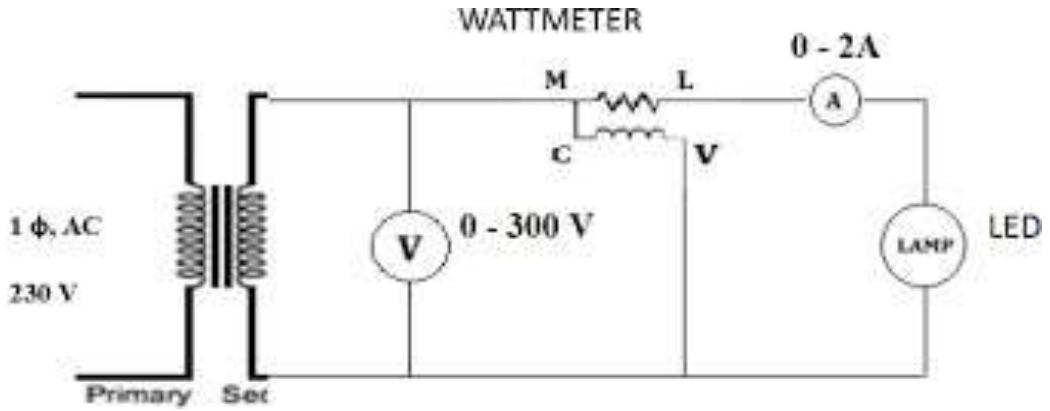
Metal halide lamp circuit



Fluorescent Lamp Circuit



CFL Lamp Circuit



LED Lamp Circuit

VIII Required Resources/apparatus/equipment with specification

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Fluorescent tube	Standard rating available in the laboratory with choke, starter	1
2	Metal Halide	Standard rating available in the laboratory with ballast	1
3	CFL	Standard rating available in the laboratory, with holder	1
4	LED	Standard rating available in the laboratory, with holder	1
5	Ammeter	0-2/5A, AC	1
6	Voltmeter	0-300 V, AC	1
7	Wattmeter	600 W, Electrodynamometer	1
8	Lux-meter	Digital type	1
9	Auto Transformer	1 KVA, 0-270V,6A	1

IX Precautions to be followed

1. Select the proper range of meters.
2. Ensure the position of auto- transformer at zero position before switching on the supply.

3. Position of Lux-meter must be at the same distance (approximately 1.5 m) from light source for the measurement of illumination.

X Procedure

1. Make the connection as per the circuit diagram for fluorescent tube.
2. Check and adjust the zero settings of all the meters.
3. Keep the auto transformer at zero position.
4. Switch on the supply.
5. Adjust the voltage to the rated voltage of the lamps.
6. Note down the meter readings and measure illumination with lux-meter.
7. Now gradually reduce the voltage up-to zero and switch off the supply.
8. Repeat the step 1-7 for CFL , LED and metal Halide Lamp respectively.
9. Note down the observations.
10. Compare the Lumens/Watt of the lamps.

XI Observation table

Type of Lamp	**Lamp rating (watt)**	**Current I (Amp)**	**Voltage V (volts)**	**Power consumed (Watts)**	**Illumination on the working plane (Lumen /Sq. m)**

(Students will fill the table collecting the information after discussion with teacher)

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion

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XV Practical related questions (Note:- Teacher should provide various questions related to practical- sample given)

1. Distinguish between CFL and LED.
2. Discuss the factors considered while adapting lamp replacement technique for energy conservation.
3. Write the function of ballast.
4. Suggest the lamps for stadium lighting, give reason.
5. Write 10 application of LED.
6. Write demerits of CFL.

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XVI References/Suggestions for further reading

1. www.bee-india.nic.in
2. www.mnes.nic.in
3. www.worldenergy.org
4. Catalogues of different manufactures of CFL , LED and FTL.
5. www.energyrating.gov.in

XVII Suggested Assessment Scheme

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

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

Practical No. 3: Measurement of illumination at different locations in college using luxmeter and compare with standard illumination level as per SP 72: 2023. (National Lighting Code).

I Practical Significance

In the industry Electrical Engineering diploma graduate are expected to know the illumination level required for each location. The illumination is recommended by SP 72: 2023. 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 have the knowledge of the illumination at different locations.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Design simple lighting scheme.

IV Laboratory Learning Outcome(s)

LLO 3.1 To measure illumination at different locations in college using Lux meter and compare with standard illumination level as per SP 72 :2023 (National Lighting Code).

V Relevant Affective Domain related outcome(s)

Follow safety practices.

Maintain tools and equipment

VI Relevant 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 meter 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	Classrooms	300
2	Lecture rooms (including) Demonstration areas	300
3	Reading rooms	150 to 300
4	Laboratories	300

VII Practical set-up / Circuit diagram / Work Situation

Lux meter

VIII Required Resources/apparatus/equipment with specification

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Lux meter	0-50,000 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 (check the range of the meter).
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 the institute.

XI Observations

Student should observe the Lux level of various places in the institute recommended by the teacher (use blank sheet for more places in the institute)

Sr. No.	Name of the place	Lux level Measured (Lux)
1		
2		
3		
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XII Result(s)

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XIII Interpretation of results

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XIV Conclusion

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. State the effect of improper illumination.
2. Give the illumination level in the descending order for the following areas: (i) Proof reading (ii) bed-room (iii) hospital ward (iv) railway platform.
3. Give the units of luminous intensity and luminous flux.
4. State the applications of Lux-meter.
5. Classroom Lux Level is more as compared to the lux level of corridor, justify.

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XVI References/Suggestions for further reading

1. https://www.electrical4u.com/electrical-engineering-articles/illumination-engineering/
2. https://youtu.be/-0_GSBgnS-A?si=lZZBwuJAh1lDMIVF
3. https://internationallight.com/sites/default/files/pdf/handbook/ILT-Light-Measurement-Handbook.pdf
4. https://sensing.konicaminolta.us/us/applications/light-measurement/

XVII Suggested Assessment Scheme

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

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

Practical No. 4: Design a heating element as per the given parameters.

I Practical Significance

In today's world of sustainable development, it is essential for the Diploma Electrical Engineer to know the parameters of electrical heating elements. Heating elements find application in a wide range of domestic, commercial, and industrial settings, Home Appliances Common household appliances. 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 Industry/Employer Expected Outcome(s)

various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Select the type of electric furnace according to the applications.

IV Laboratory Learning Outcome(s)

LLO 4.1 Design a heating element as per the given parameters.

V Relevant Affective Domain related outcome(s)

Follow safetypractices.

Maintain tools and equipment.

Follow ethical Practices.

VI Relevant Theoretical Background

The device which receives electrical energy as input and converts it into the heat energy is known as a **heating element**. The wire employed for the heating element may be circular or rectangular. By determining the electrical input and its voltage, the size (or diameter) and length of the wire required as the heating element to produce the given temperature can be calculated.

Design of Heating Element:

Consider the heating element is in the circular shape. Therefore, the length and diameter of the heating element can be calculated as follows

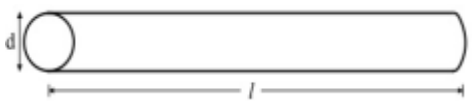

Figure 4.1 Circular heating element parameter

$$\frac{l}{d^2} = \frac{\pi V^2}{4\rho P} \quad \ldots\ldots (1)$$

$$\frac{d}{l^2} = \frac{4\rho H}{V^2} \quad \ldots\ldots..(2)$$

Hence, for the given voltage and power, the length and diameter of the heating element can be determined by using the eqns. (1) and (2) When heating element is circular.

VII Practical set-up / Circuit diagram / Work Situation:

If flat rectangular cross section conductor of width 'w' and thickness 't' is used. Under the guidance of the teacher students will develop the parameters l,w and t.

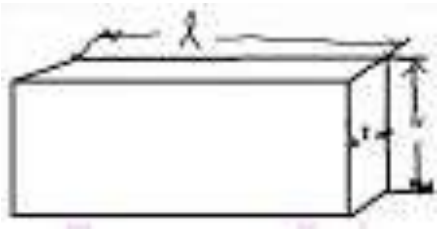

Figure 4.2 Rectangular heating element parameter

Fig 4.3 Heating element circular in shape

VIII Resources used (suggesations):

Sr. No.	Name of Resource (heating element)	Suggested Broad Specification	Quantity	Remarks
1	Ni- Cr Alloy wire	Range available in lab 80% Ni, 20% Cr 60% Ni, 16% Cr 35% Ni, 20% Cr	1	Teacher will design a problem and for this alloy
2	Fe-Cr-Al alloys (AKA Kanthal wire	Range available in lab	1	Teacher will design a problem and for this alloy

IX Precautions to be followed

1. Ensure proper material is chosen for heating element parameters for calculation.
2. Accordingly, resistivity will be decided in the calculation.

X Procedure

1. Teacher will give the numerical to calculate the parameters of heating material for circular shape.
2. Practice it for rectangular shape also.
3. Space for numerical (use A4 size paper if space is not sufficient)

XI Observation

Sr. No.	**Power (Watt)**	**Length of heating element l (m)**	**Diameter of heating element d (mm)**	**Resistivity of the selected material**	**T_1 (^{0}C absolute)**	**T_2 (^{0}C absolute)**	**ρ (Ω-m)**	**H (W/m^2)**
1								
2								
3								
4								

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: Teacher should provide various questions related to practical- sample given)

1. Name the material which is used for making heating element write their commercial name also.
2. Give reason that Nichrome is chosen over tungsten for heating element.
3. Write the properties of a good heating element.
4. Write the application of electric heating.
5. A resistance oven employing nichrome wire is to be heated from 220V , single phase supply and is rated at 16 KW. If temperature of element is to be limited to 1170 ^{0}C and average temperature of charge is 500 ^{0}C, find the diameter and length of wire. (K= 0.57, e=0.9 and ρ of nichrome = 1.09 X 10 $^{-6}$ Ω-m)

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XVI References/Suggestions for further reading

1. https://www.tutorialspoint.com/design-of-heating-element
2. https://en.wikipedia.org/wiki/Electric_heating
3. https://www.heating-element-alloy.com/article/heating-element-design-factors.html
4. Utilisation of Electrical Power By Er. R. K. Rajput
5. https://en.wikipedia.org/wiki/Heating_element

XVII Suggested Assessment Scheme

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

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

Practical No. 5: Demonstration of different electrical and safety equipments used for arc welding.

I Practical Significance

Electrical Engineering diploma graduate are expected to know the arc welding electrical and safety equipment. 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 Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Operate the different electric welding system.

IV Laboratory Learning Outcome(s)

LLO 5.1 Identify the different electrical and safety equipment used for Arc welding.

V Relevant Affective Domain related outcome(s)

Follow safetypractices.

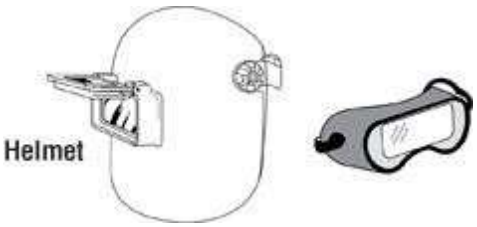
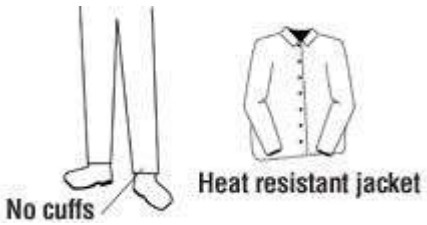
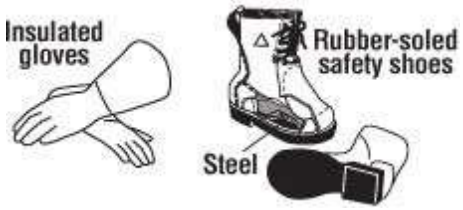
Maintain tools and equipment.

Follow ethical Practices.

VI Relevant Theoretical Background

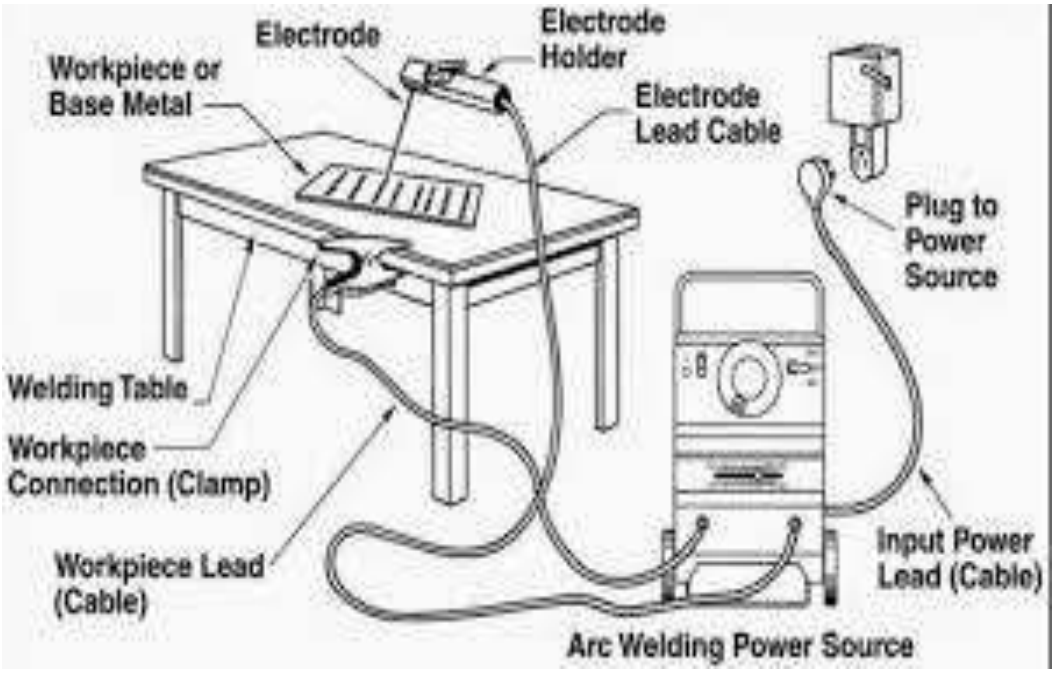
Arc welding is a versatile and widely used welding process that joins metals by creating an electrical arc between an electrode and the workpiece. This process requires specific tools and equipment to ensure safety, precision, and efficiency. Whether you're a professional welder or a DIY enthusiast, having the right tools at your disposal is essential for successful arc welding projects.

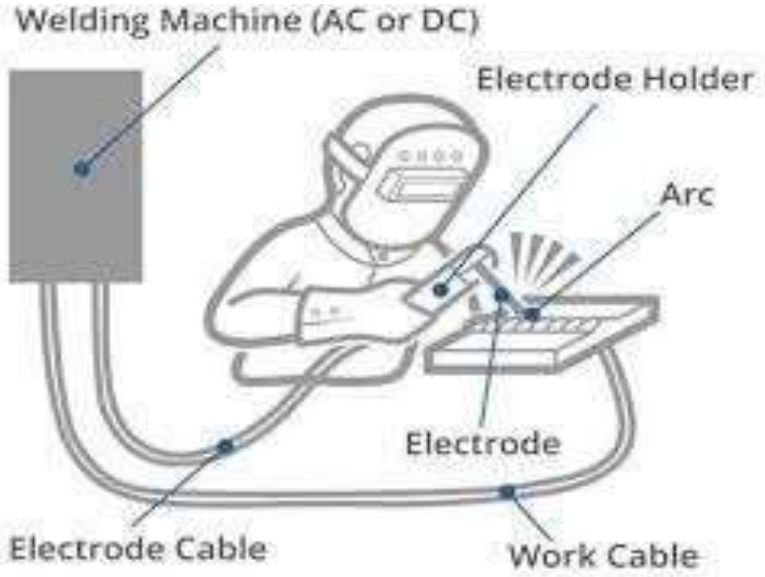
Different Electrical arc welding accessories.

Body Part	Equipment	Illustration	Reason
Eyes and face	Welding helmet, hand shield, or goggles		Protects from: radiation flying particles, debris g, sparks e light irritation and chemical burns Wear fire resistant head coverings under the helmet where appropriate.
Lungs (breathing)	Respirators		Protects against: fumes and oxides
Exposed skin (other than feet, hands, and head)	Fire/Flame resistant clothing and aprons		Protects against: urns on Notes: pants should not have cuffs, shirts should have flaps over pockets or be taped closed
Ears - hearing	Ear muffs, ear plugs		Protects against: ise Use fire resistant ear muffs where sparks or splatter may enter the ear, rather than plugs.
Feet and hands	Boots, gloves		Protects against: electric shock heat burns fires

VII Practical set-up / Circuit diagram / Work Situation

(Students will observe different arc welding electrical and safety equipments and will stick the picture of actual equipments available in the laboratory, few of then are shown for students)





VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource/equipment	Suggested Broad Specification	Function	Remarks
1				
2				
3				
4				
5				
6				

IX Precautions to be followed

1. Follow safety practices.
2. Maintain tools and equipment.
3. Follow ethical Practices.
4. Follow safety practices while touching welding accessories in college workshop.

X Procedure

1. Observe the various arc welding electrical equipments.
2. Observe the various safety equipments for arc welding.
3. Note down the function of the equipments in the observation table.

XI Observation and function of equipments

Sr. No.	Arc welding equipments	Function	Remarks
1			
2			
3			
4			

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. Enlist the metals which are arc welded?
2. What material is used in arc welding?
3. Is arc welding DC or AC?
4. List five basic types of welding joints.
5. List the materials which are not used for making non consumable electrodes.
6. Give the capacity of light manual welding machine.

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XVI References/Suggestions for further reading

1. Text book of welding technology by O. P. Khanna , Dhanpatray Publication
2. https://www.electricaldeck.com/2021/04/extension-of-range-of-ammeter.html
3. https://www.har-tech.com/en/electric-arc-welding/
4. https://www.tutorialspoint.com/what-are-the-equipment-used-in-electric-arc-welding

XVII Suggested Assessment Scheme

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

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

Practical No. 6: Identification of different components required for various heating furnaces

I Practical Significance:

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

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Select type of electric furnaces according to applications.

IV Laboratory Learning Outcome(s)

LLO 6.1Identify the different components required for various heating furnaces.

V Relevant Affective Domain related outcome(s)

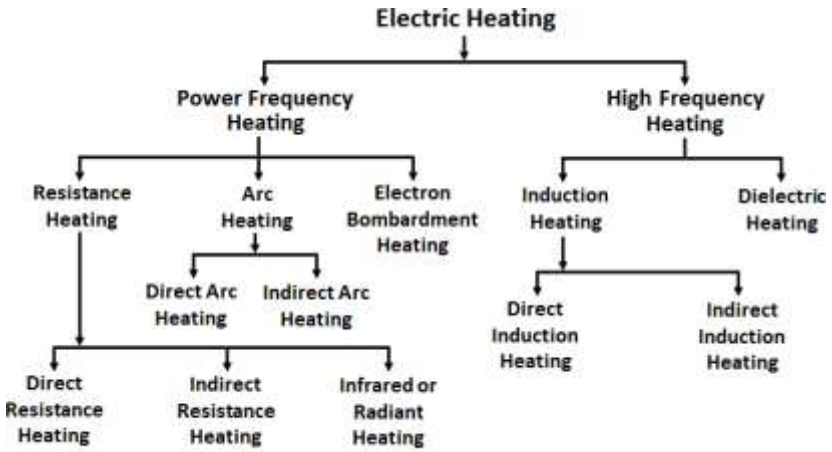
Follow safetypractices.

Maintain tools and equipment.

Follow ethical Practices.

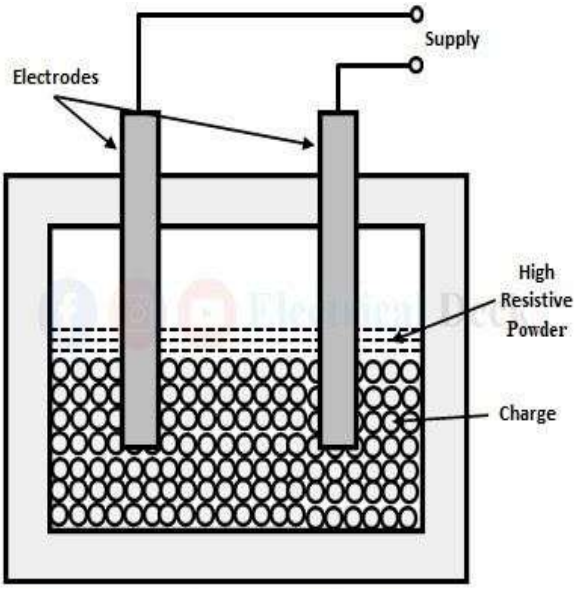
VI Relevant Theoretical Background

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.

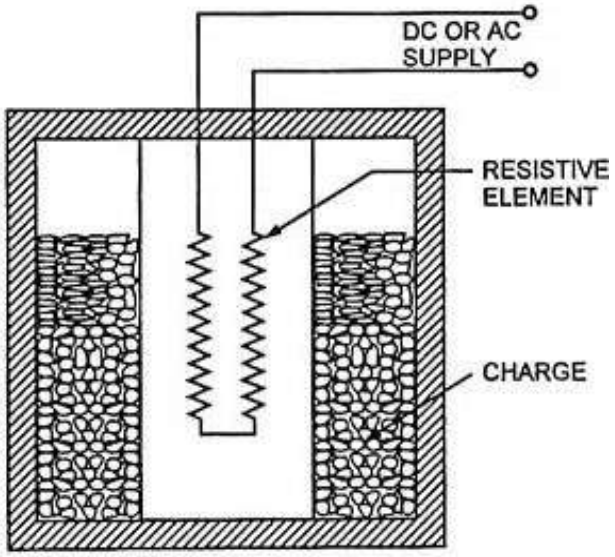


Methods Of Electric Heating

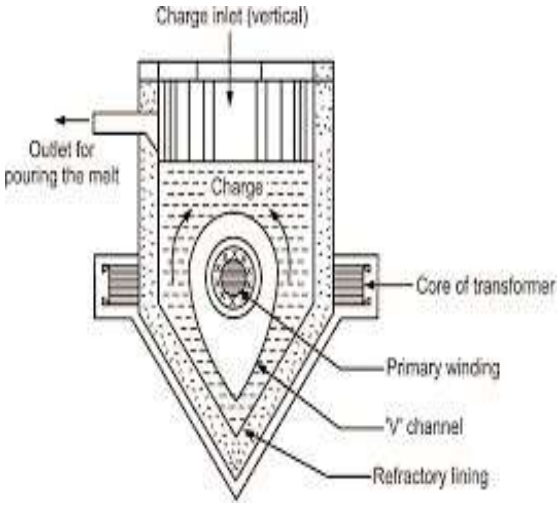
VII Practical set-up / Circuit diagram / Work Situation



Direct Resistance Heating



Indirect Resistance Heating



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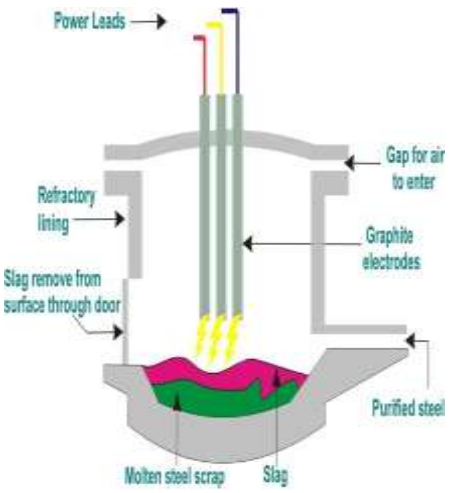
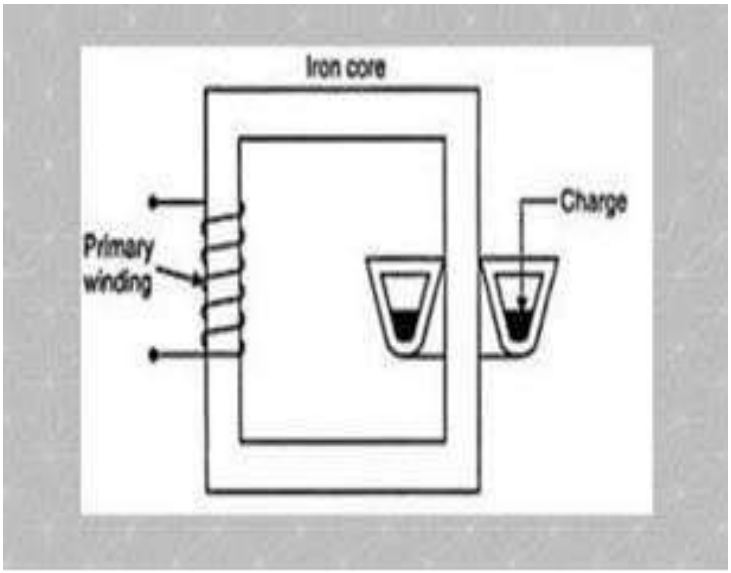


Electric Arc Furnace



Direct core type induction furnaces

VIII Required Resources/apparatus/equipment with specification

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Desktop/laptop with internet connection/Standard reference book		1
2.	Learn & grow educational series	You tube channel	1

IX Precautions to be followed

1. Refer the authenticated website only.
2. Interpret the images carefully.

X Procedure

1. Search information and images of various electric furnaces showing all the components.(Minimum 4)
2. Prepare a report comprising of different component's function of various electric furnaces.

XI Observation table (Minimum 4)

Sr. No	Type of furnace	Name of component	Function of component
1.			
2.			
3.			

4.			

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. Name and state the function of refractory material used 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.
4. Write the advantages of electric heating.

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XVI References/Suggestions for further reading

1. https://youtu.be/uTyN4jcS9u4?si=Aaocc4g-jEs0g6ar
2. https://youtu.be/tXvEbjVYhSA?si=pdxoWTfCym5Jrhsi
3. https://en.wikipedia.org/wiki/Electric_arc_furnace
4. https://www.electrical4u.com/electric-furnace/

XVII Suggested Assessment Scheme

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

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

Practical No. 7: Selection of suitable current range of welding generator set and welding transformer for various thickness of metal job.

I Practical Significance

Welding is a fundamental process in metal fabrication, where the correct current range plays a crucial role in ensuring high-quality welds. Electrical Engineering diploma graduate are expected to have the knowledge of suitable current range of welding generator set and Welding transformer for various thickness of metal job.Therefore this practical will help you to work efficiently in welding industry.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Operate the different electric welding system.

IV Laboratory Learning Outcome(s)

LLO 7.1 Write specification of Welding generator set and welding transformer.

V Relevant Affective Domain related outcome(s)

Follow safetypractices.

Maintain tools and equipment.

Follow ethical Practices.

VI RelevantTheoretical Background

Welding current is the flow of electricity through the welding circuit, which generates heat to melt the base metal and filler material, forming a strong joint. The current directly influences the depth of penetration, bead shape, and overall strength of the weld. An inadequate current may result in weak joints or poor penetration, while excessive current can lead to burn-through, spatter, or other defects.

There are two key methods of providing welding current:

Welding Generator Set: These are portable units powered by an engine, generating the required electrical power for welding. They are used where there is no direct access to electrical power.

Welding Transformer: These convert the high voltage, low current from a power supply into low voltage, high current suitable for welding. Transformers are commonly used in fixed workstations.

VII Practical set-up / Circuit diagram / Work Situation

(Students will do the welding for given material and given thickness under the guidance of the teacher)

Fig: 7.1 welding machine operation

VIII Required Resources/apparatus/equipment

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Transformer welders	220-415V input, 17-45 V output voltage ,55-590A, 7.5 -29.25 KVA or any suitable range	1
2.	MIG welding machine	Any suitable range	1
3.	TIG welding machine	Any suitable range	1
4.	Spot welding machine	Any suitable range	1
5	Stick welding machine	Any suitable range	1

IX Precautions to be followed

1. Be sure the welder is properly installed and grounded.
2. Never weld without adequate ventilation.
3. Take proper precautions to prevent fires.
4. Protect your entire body with fire retardant clothing, shoes, and gloves.
5. Wear eye protection at all times.
6. Weld only in a fire safe area.

X Procedure

1. Metal thicknesses from 1/16 to 1/2in. (1.6 to 12.7mm) can be welded with no edge preparation.

2. With edge preparation, welds can be made with a single pass on material from 1/4 to 1 in. (6.4 to 25.4 mm).

XI Observation table

Sr.No.	Current rating of welding machine (Amp)	Thickness of weld (mm)
1.		
2.		
3.		
4.		

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. What is the primary function of a welding transformer in a welding circuit?
2. How does a welding generator set differ from a welding transformer in terms of power supply?
3. What factors should be considered when selecting the current range for a welding transformer?
4. Why is it important to match the electrode size with the current setting in welding machines?
5. What is the role of the duty cycle in a welding machine, and how does it affect welding performance?

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XVI References/Suggestions for further reading

1. https://en.wikipedia.org/wiki/Arc_welding
2. https://www.sciencedirect.com/topics/engineering/electric-arc-welding
3. https://youtu.be/_mRdOrBhf2k?si=Anv6t7cVDvvpMq0C
4. https://www.sciencedirect.com/topics/engineering/electric-arc-welding

XVII Suggested Assessment Scheme

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

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

Practical No. 8: identification of different defects in arc welding job.

I Practical Significance

Electrical Engineering diploma graduate are expected to handle the defective welding. Visual inspection can pick up undercuts, overlaps, cracks, and surface-breaking porosity. It cannot reveal poor fusion or sub-surface porosity.

I I Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications

III Course Level Learning Outcome(s)

Operate the different electric welding system.

IV Laboratory Learning Outcome(s)

LLO 8.1 Identify the different defects in arc welding job .

V Relevant Affective Domain related outcome(s)

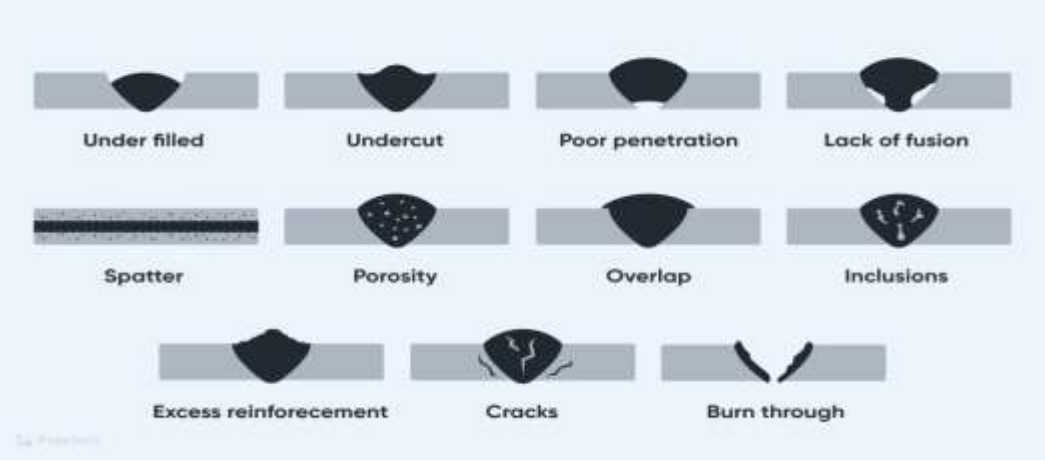
Follow safetypractices.

Maintain tools and equipment.I

Follow ethical Practices.

VI Relevant Theoretical Background

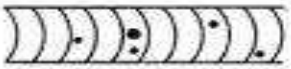
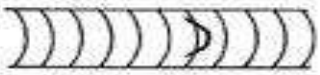
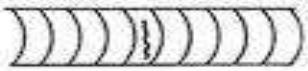
Welding defects can be defined as weld surface irregularities, discontinuities, imperfections, or inconsistencies that occur in welded parts. Defects in weld joints could result in the rejection of parts and assemblies, costly repairs, significant reduction of performance under working conditions and, in extreme cases, catastrophic failures with loss of property and life.



Different types of defects at the time of arc welding

VII Practical set-up / Circuit diagram / Work Situation

(Students will study the following chart and will visit the college workshop to see the various welding joints and defects/ videos can be observed)

Description	Cross-section of weld	Radiogram
Worm hole		
Linear Slag Inclusion - |		
Gas Pore		
Porosity (Linear)		
Lack of side-wall fusion - (lack of root fusion)		
Lack of inter-run fusion		
Longitudinal Crack		
Traverse Crack		
Radiating Cracks		

Observations for various types of faults in arc welding

VIII Required Resources/apparatus/equipment

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Desktop/laptop with internet connection/Standard reference book		3 or 4 websites or books
2.	Learn and grow educational series	You tube channel	

IX Precautions to be followed

Observe the video carefully.

X Procedure

1. Observe and understand the various defects in the welding.
2. Note-down the reasons of the defects in arc welding. (in videos)
3. Understand causes of defects in arc welding.
4. Find the remedies.
5. Complete the table given below.

XI Observations (From Videos/ Charts)

Sr. No.	Types of the defects	Causes	Remedies
1			
2			
3			
4			
5			
6			
7			

8			
9			
10			

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. What are the defects of arc welding?
2. How to detect the weld defects?
3. Why do weld fail occur?
4. Write the prevention from welding defects.
5. List the different types of defects in welding.

XVI References/Suggestions for further reading

1. https://en.wikipedia.org/wiki/Arc_welding
2. https://testbook.com/mechanical-engineering/welding-defects-types-and-causes
3. https://www.rapiddirect.com/blog/types-of-welding-defects/
4. https://sentin.ai/en/10-common-weld-defect-imperfections-discontinuities/
5. https://elearn.nptel.ac.in/shop/iit-workshops/completed/weld-defects-and-their-remedies/?v=c86ee0d9d7ed

XVII Suggested Assessment Scheme

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

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

Practical No. 9: identification of different electrodes used in arc welding.

I Practical Significance

This practical is expected to develop the skills like, the identification system for arc welding electrodes in Electrical Engineering diploma graduate. They a r e expected to handle to use of proper electrodes in arc welding industry. The identification system for arc welding electrodes is important because it provides information about the electrode's properties and how to use it in welding industry.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications.

III Course Level Learning Outcome(s)

Operate the different electric welding system.

IV Laboratory Learning Outcome(s)

LLO 9.1 Identify the different electrodes in arc welding.

V Relevant Affective Domain related outcome(s)

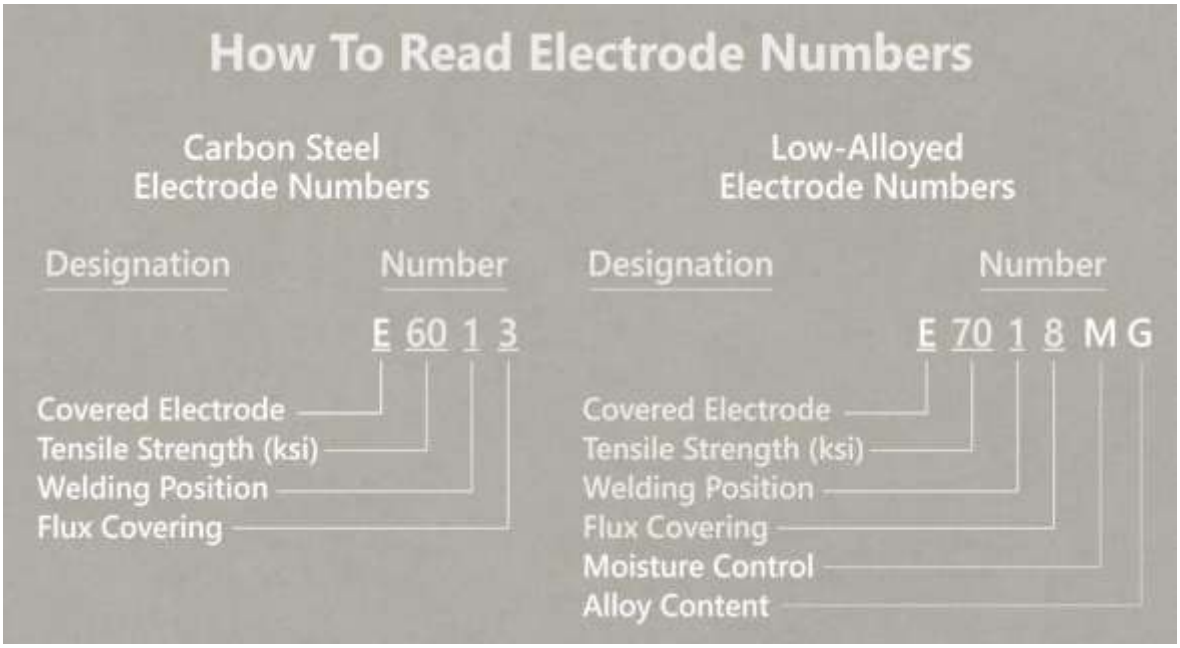
1. Follow safetypractices.
2. Maintain tools and equipment.
3. Follow ethical Practices.

VI Relevant Theoretical Background

When you pick up a shielded metal arc welding (SMAW) holder, you face a wide choice of electrodes. But not all SMAW consumables, also known as stick, work for every material or job.In arc welding, the choice of electrode is critical for achieving good weld quality. Electrodes serve as a filler material and can also generate a shielding gas to protect the molten weld pool from atmospheric contamination. Different electrodes have unique characteristics that make them suitable for various materials and welding positions.

VII Practical set-up / Circuit diagram / Work Situation

Welding Rods



VIII Required Resources/apparatus/equipment

(students will study at least 5 welding rods available in the workshop/ practical lab)

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity	Remarks
1	Welding rod-1	Standard	1	
2	Welding rod-2	Standard	1	
3	Welding rod-3	Standard	1	
4	Welding rod-4	Standard	1	

IX Precautions to be followed

1. Select proper range of rod
2. Understand the coding well of welding rod.

X Problem Statement (to be provided by Teacher, sample given here)

1. Teacher must avail the various welding rods to note-down the code and meaning of the codes.
2. Students will take picture of the rods and will write the code and meaning of the code of Rod.

XI Procedure (Student should write the procedure) (use blank sheet)

1. Students will take picture of the rods and will write the code and meaning of the code of Rod.

XII Observation (Prepare table on blank sheet for several welding rods)

Sr. No.	Welding rods code	Code meaning	Remarks
1			

2			
3			
4			
5			

XIII Result(s)

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XIV Interpretation of results

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XV Conclusion and recommendation

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XVI Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. What are different types of electrodes used in arc welding?

2. How do you identify welding electrodes?
3. What are different types of metals used in electrodes?
4. What are 5 commonly used welding rods?
5. What are different types of electrodes?

XVII References/Suggestions for further reading

1. https://youtu.be/Nic2GXvwzC0?si=rSj5CZ21oSrwjqcS
2. https://youtu.be/cQqsWpgtgMI?si=Mcv_9-QO5MB5UuEa
3. https://youtu.be/JdwgwY8L3lU?si=jfwJHbDzZqHVlpOV
4. https://images.app.goo.gl/Kp5aZZRexu9d8Nuc7

XVIII Suggested Assessment Scheme

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

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

Practical No. 10: Estimation of size of motor as per the specified load cycle.

I Practical Significance

Electrical diploma graduate is expected to have an estimation of size of motors as per the specified load cycle. Electrical motors have a great impact on almost every aspect of modern living. This practical will develop the skills of estimating the size of motor as per specified load cycle for its application in various engineering field.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications

III Course Level Learning Outcome(s)

Estimation of size of motors as per the specified load cycle.

IV Laboratory Learning Outcome(s)

LLO 10.1 To estimate the size of motor as per the specified load cycle.

V Relevant Affective Domain related outcome(s)

Follow safetypractices.

Maintain tools and equipment.

Follow ethical Practices.

VI Relevant Theoretical Background

Power in the size and rating of the motor mainly depends on the following factors:

Nature of load

Starting conditions of the load

Matching of speed torque characteristics.

Nature of load :

The load may be having different nature as :

1. Hoist, cranes : torque is constant irrespective of speed .
2. Fluid friction: Torque is proportional to speed.
3. Blowers , Fans : Torque is α (speed)^2
4. Load torque α 1/ speed

Starting conditions of load :

1. Some application like traction require heavy torque at start with low speed.
2. Applications like : drilling machine , lathe machine need medium torque at normal speed. The motor rating is to be selected accordingly.

3. Matching of speed torque characteristics.. the load dynamics should be properly known. The motor characteristics should match with load characteristics.

VII Practical set-up / Circuit diagram / Work Situation

Case no 1: A certain motor has to perform following duty cycle:

100 KW for 10 minutes

No load for 5 minutes

52 KW for 8 minutes

No load for 4 minutes

The above duty cycle is repeated indefinitely. Assume that losses are proportional to square of the load. Determine the size of continuously rated motor.

[HINT: Ans: 67.12 KW (Approx 70 KW motor can be used); students will solve the above case under the guidance of teacher using rms Method]

(Space for Calculation)

Case 2: A electric motor has load variations as given below:

Torque 250 Nm for 20 minutes

Torque 150 Nm for 10 minutes

Torque 300 Nm for 10 minutes

Torque 200Nm for 20 minutes.

If the speed of motor is 720rpm find the power rating of motor.

(Hint : Power = Torque X Speed ; under the guidance of teacher using RMS method students will find out the rating of motor)

(Sapace for calculation)

VIII Result(s)

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IX Interpretation of results

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X Conclusion and recommendation

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XI Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. Write an example of continuous and intermittent load.
2. Describe root mean torque method for equivalent torque?
3. Define duty cycle of the motor.
4. Write the relation of torque and output of the motor .
5. Describe long time intermittent loading of the motor.
6. Draw the curve of various loads and temperature rise.

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XII References/Suggestions for further reading

1. https://beeindia.gov.in/sites/default/files/3Ch2.pdf
2. https://www.electricaldeck.com/2022/04/what-is-continuous-and-intermittent-duty-of-motor.html
3. Utilization of Electric Power & Electric Traction. By J. B. Gupta
4. https://www.drivesandautomation.co.uk/useful-information/electric-motor-duty-cycles/
5. https://www.alltorquetransmissions.com/electric-motor-duty-ratings/

XIII Suggested Assessment Scheme

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

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

Practical No. 11: Identification of the different components of an Elevator.

I Practical Significance

Electrical diploma graduate is expected to handle the maintenance of the elevator and its parts. Elevators usually run on electricity. Most modern elevators are propelled by electric motors, with the aid of counter weight, through a system of cable and sheaves. After study of this practical of identification of the different components of an elevator, a diploma engineer will able to work in elevator industry. Therefore, this practical will help to acquire necessary skill.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications

III Course Level Learning Outcome(s)

Select suitable electric drive for a particular application

IV Laboratory Learning Outcome(s)

LLO 11.1 To identify the different components of elevator.

V Relevant Affective Domain related outcome(s)

1. Follow safetypractices.
2. Maintain tools and equipment.
3. Follow ethical Practices.

VI Relevant Theoretical Background

a device like a box that moves up and down, carrying people or goods from one floor of a building to another or taking people up and down underground in a mine**.** In electrical engineering, an elevator is a vertical transportation device that uses electric motors to move people or freight between floors:

How they work

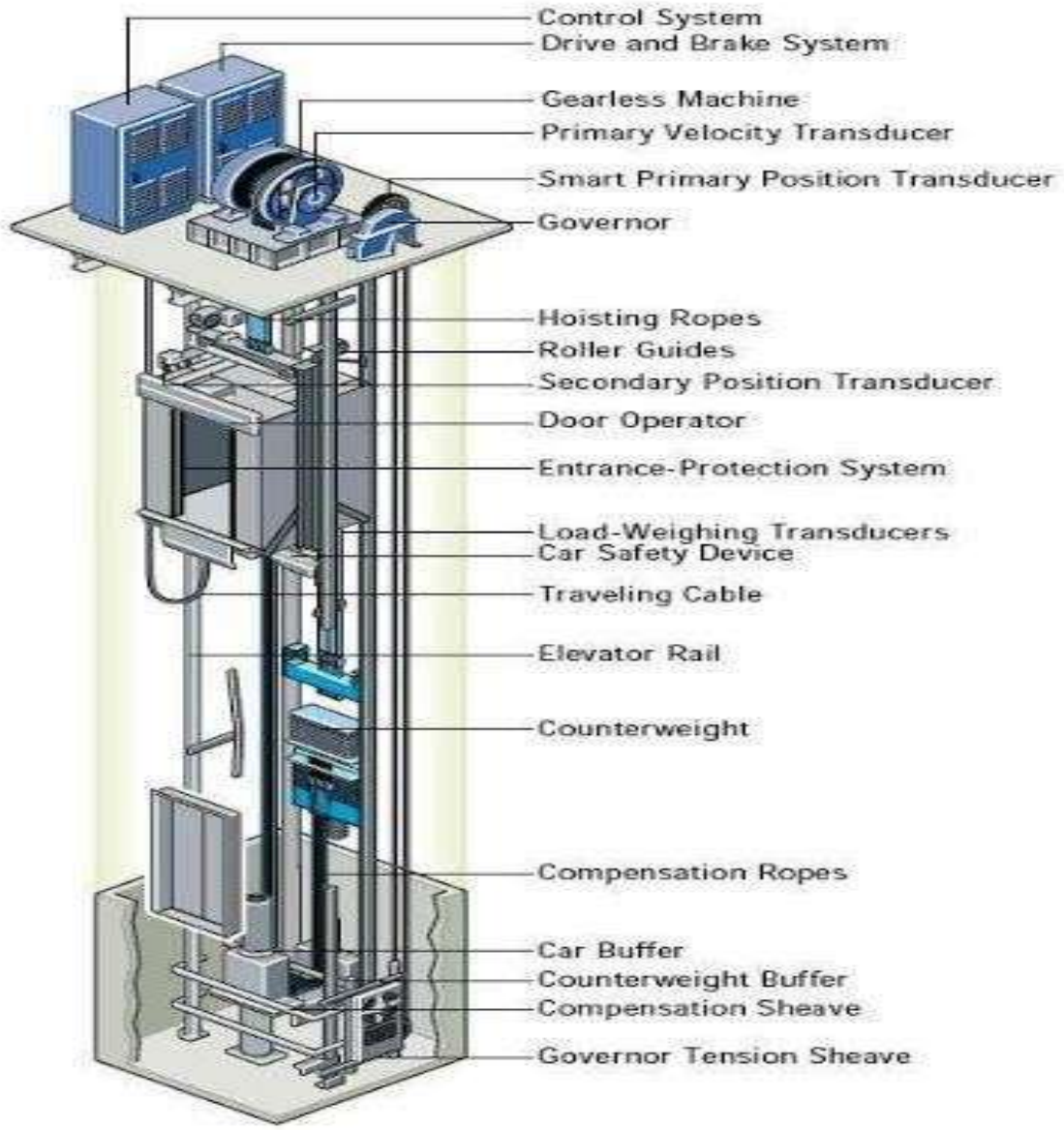
Most elevators use electric motors to drive cables and counterweight systems, or pump hydraulic fluid to raise a piston.

Where they are used

Elevators are commonly found in multi-story buildings, ships, and other structures. They are often a legal requirement in new buildings, especially where wheelchair ramps would be impractical.so the function of elevators is transporting at a fixed place.

VII Practical set-up / Circuit diagram / Work Situation

(Students will collect the information about the parts of elevator /visit local elevator installation company and will collect the information to identify the parts of an Elevator system and their function)



Set –up of Elevator

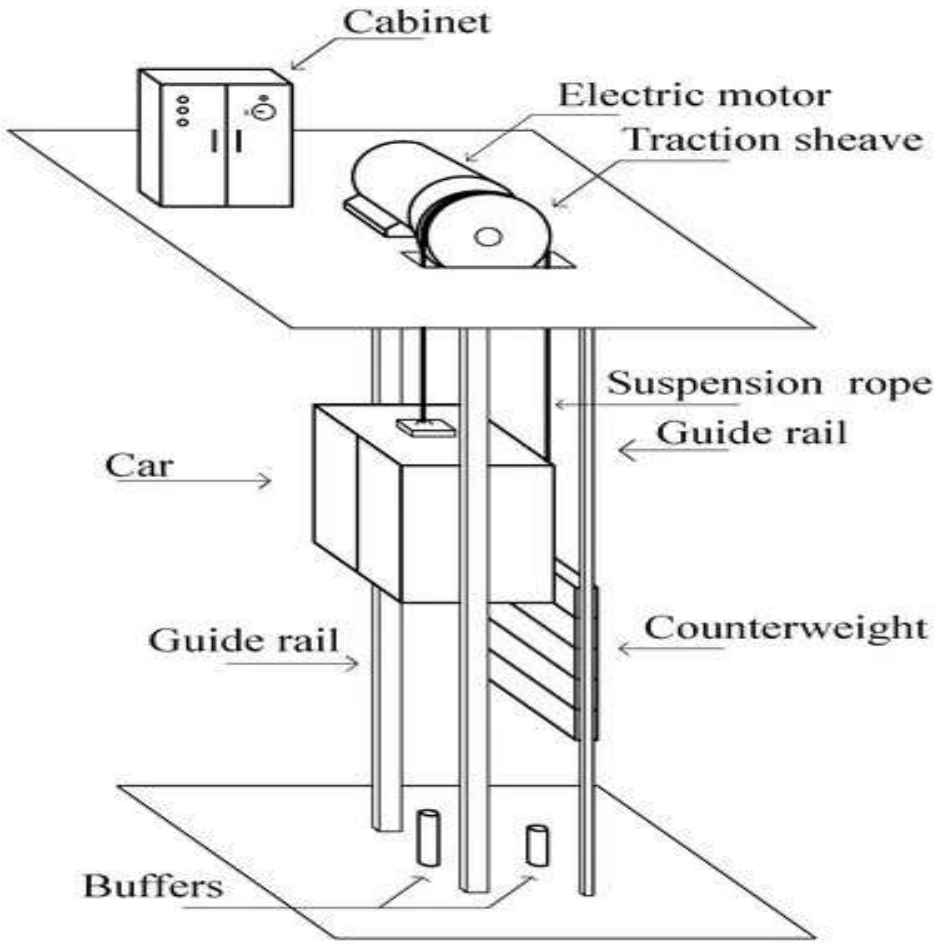


Figure 11.2 schematic diagram of Elevator with various parts

VIII Required Resources/apparatus/equipment

(Student can take the help of video/catalogues/local manufacturer of elevator to know the component)

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Catalogue of Different Manufacturer of Elevators and Lift / Computer with internet facility	Standard specification	1

IX Precautions to be followed

1. The Elevator and its components must be known carefully from video/catalogue.

X Procedure

After studying the catalogue and watching video following data must be known of elevator and their specifications must be written in the observations.

1. Rating and Type of Lift Motor
2. Dimensions of pent house
3. Toothed/flat cable
4. Elevator capacity
5. Dimensions of cage of Elevator
6. Type of Door
7. Type of drive
8. Facility of door locking device
9. Facility of door reopening device
10. Facility of door open alarm
11. Facility of emergency landing
12. Direction and position indicator
13. Load plate indicator and notice board.
14. Emergency release equipment and instructions.
15. Provision of safety gear.
16. Provision of over speed governor.
17. Provision of overload device.
18. Run/stop switch provided where lift equipment is housed.
19. Availability of fire safety.

XI Observation (use blank sheet provided if space not sufficient)

Sr.No	Component of an Elevator	Specifications	Functions	Remark
1				
2				
3				
4				
5				
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7				
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10				
11				
12				
13				

XII Result(s)

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XIII Interpretation of results

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. What is the primary function of the elevator car in the system?
2. How does the counterweight in an elevator system help improve energy efficiency?
3. What role does the traction motor play in the operation of an elevator?
4. How do guide rails contribute to the safe movement of the elevator car?

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XVI References/Suggestions for further reading

1. www.naec.org
2. www.elevatorworld.com
3. www.iuec.org
4. www.asme.org
5. www.edx.org/course/elevator-related-courses

XVII Suggested Assessment Scheme

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

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

Practical No. 12: Identification of different components of Escalator.

I Practical Significance:

Electrical diploma graduate is expected to handle the maintenance of escalators. Escalators are an essential part of modern transportation systems, commonly found in airports, shopping malls, subway stations, and office buildings.Understanding the various components that make up an escalator helps in appreciating the engineering behind this convenience, Therefore this practical will help students to acquire necessary skills.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial applications

III Course Level Learning Outcome(s)

Select suitable electric drive for a particular application.

IV Laboratory Learning Outcome(s)

LLO 12.1 To identify the different components of Escalator.

V Relevant Affective Domain related outcome(s)

1. Follow safetypractices.
2. Maintain tools and equipment.
3. Follow ethical Practices.

VI Relevant Theoretical Background

An escalator is a moving staircase which carries people between floors of a building or structure. It consists of a motor-driven chain of individually linked steps on a track which cycle on a pair of tracks which keep the step tread horizontal. Escalators are often used around the world in places where lifts would be impractical, or they can be used in conjunction with them. Escalators have the capacity to move large numbers of people. They have no waiting interval (except during very heavy traffic). They can be used to guide people toward main exits or special exhibits and may be weatherproofed for outdoor use. A non-functional escalator can function as a normal staircase, whereas many other methods of transport become useless when they break down or lose power.

VII Practical set-up / Circuit diagram / Work Situation

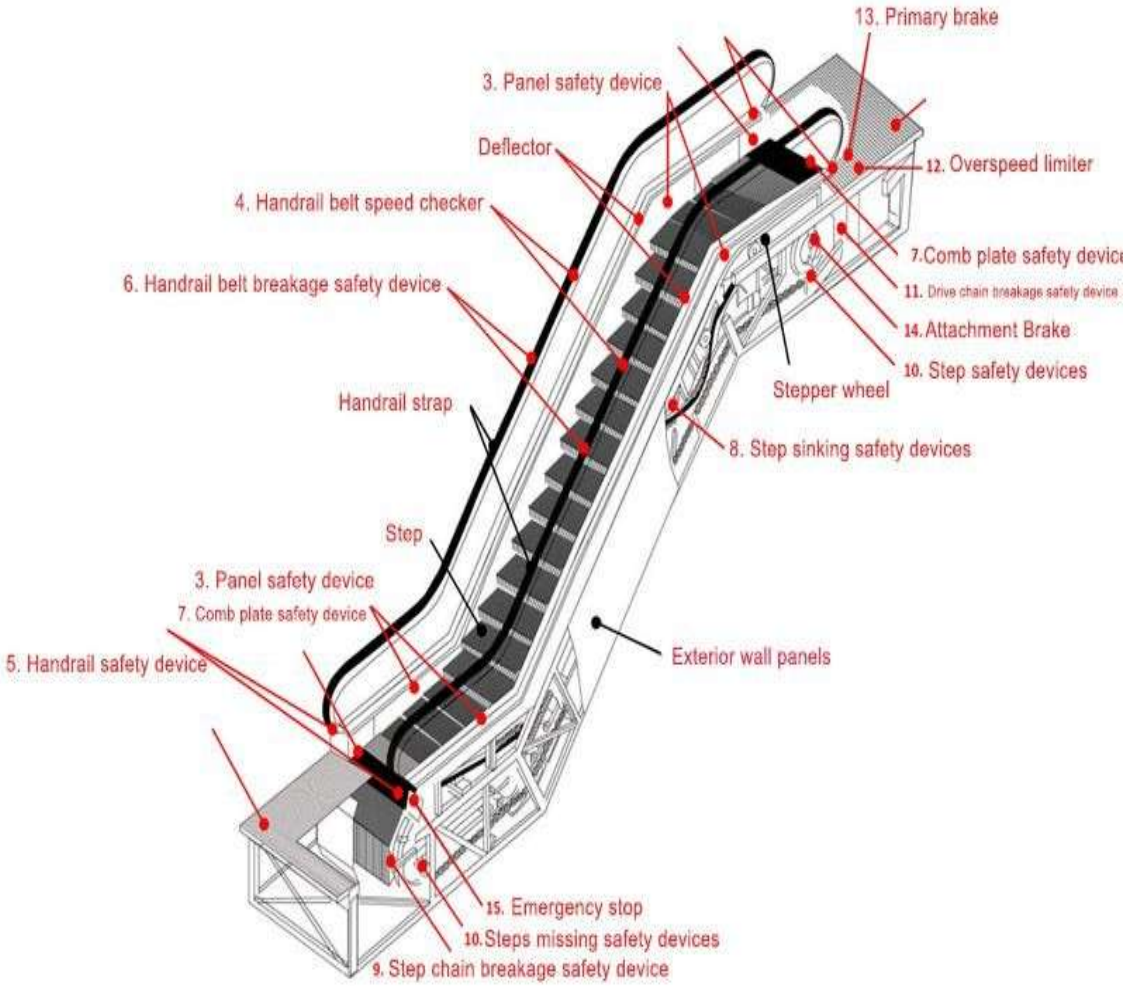

Figure12.1 Escalator components

VIII Required Resources/apparatus/equipment

(Students will collect the information about the parts of escalator from video /visit local escalator installation company and will collect the information to identify the parts of an Escalator system and their function)

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Catalogue of Different Manufacturer of Escalator/ Computer with internet facility	Standard specification	1

IX Precautions to be followed

1. Watch video carefully and learn the function of the parts of escalator
2. Or visit the local escalator manufacturing company to identify the parts of escalator.

X Procedure

1. Write a report on escalator's components and their function in your own words after discussion with your teacher.

XI Observation

Sr.No	Component of an Escalator	Specifications	Functions	Reark
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

XII Result(s)

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XIII Interpretation of result

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XIV Conclusion and recommendation

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XV Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. What are the primary structural components of an escalator, and what role does the truss play in its overall design?
2. How do the step chains function in moving the escalator steps, and what materials are typically used in their construction?
3. What is the role of the drive system in escalator operation, and what types of motors are commonly used?
4. How are handrails synchronized with the escalator steps, and what mechanisms ensure their smooth operation?

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XVI References/Suggestions for further reading

1. www.dazenelevator.com/the-ultimate-guide-to-escalator
2. www.cbaconsultants.com/how-does-an-escalator-work
3. www.wikipedia.org/wiki/Escalator
4. www.la-grazia.com/escalator-parts-definitions

XVII Suggested Assessment Scheme

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

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

Practical No. 13: Visit a traction loco shed and observe various types of system used in traction.

I Practical Significance

The railway vehicle that provides the necessary traction power to move the train is referred as the traction or locomotive. This traction power can be diesel, steam or electric power. Now a days electric traction is used utmost. 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 Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial application.

III Course Level Learning Outcome(s)

Maintain different electric traction system.

IV Laboratory Learning Outcome(s)

LLO 13.1 To observe the different types of signal used in traction system.

LLO 13.2 To observe the raising and lowering of Faiveley type pantograph.

LLO 13.3 To observe the different parts of E.M.U.

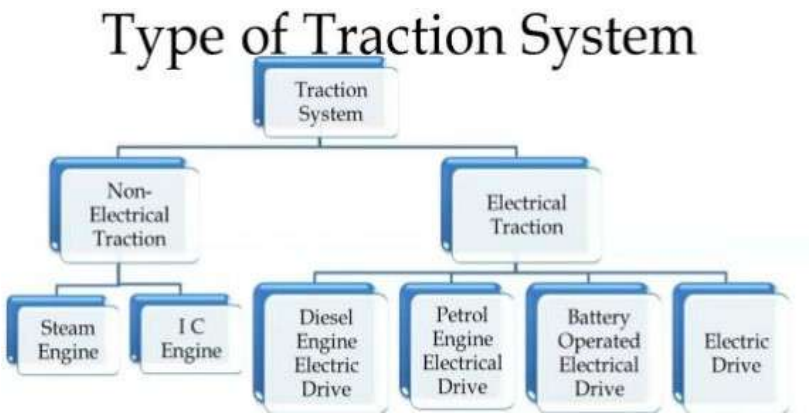
V Relevant Affective Domain related outcome(s)

Follow safetypractices.

Maintain tools and equipment.

Follow ethical Practices.

VI Relevant Theoretical Background



Electric traction involves the use of electricity at some stage or all the stages of locomotive movement. This system includes straight electrical drive, diesel electric drive and battery operated electric drive vehicles. In this, electrical motors are used for producing the vehicle movement and are powered by drawing electricity from utilities or diesel generators or batteries.

VII Practical set-up / Circuit diagram / Work Situation

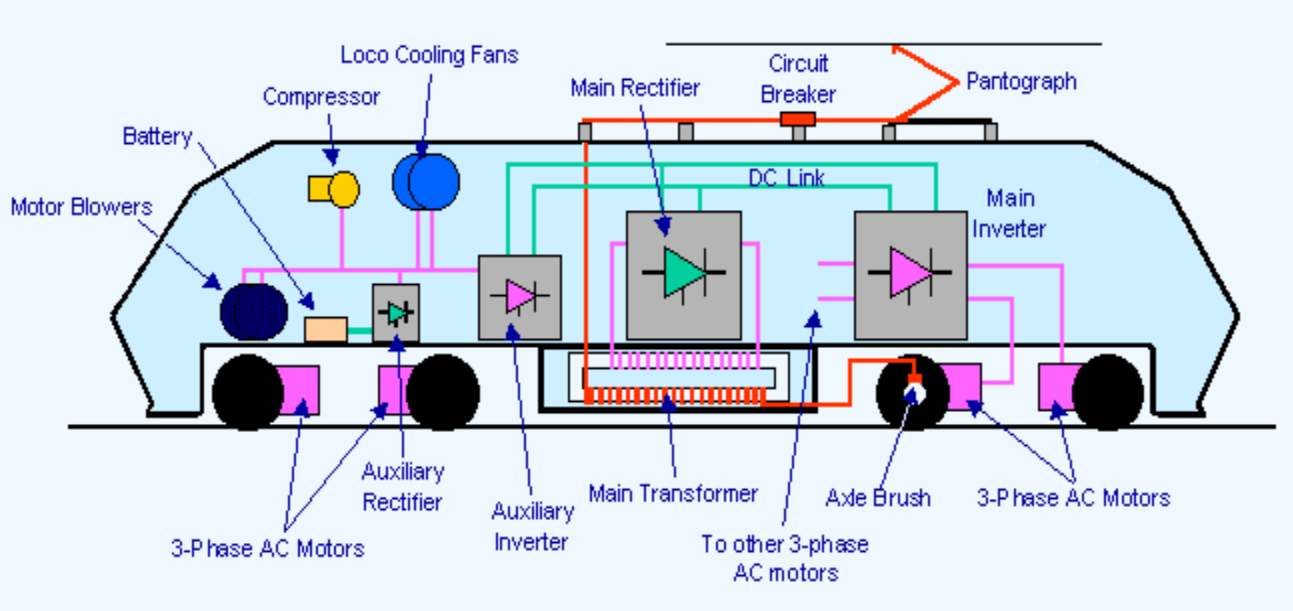


Figure 13.1 block diagram of electric locomotive

VIII Required Resources/apparatus/equipment

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity	Remark
1.				
2.				
3.				
4.				
5.				
6.				

IX Result(s)

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X Interpretation of results

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XI Conclusion and recommendation

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XII Practical related questions (Note:Teacher should provide various questions related to practical- sample given)

1. What are the key components of an electric traction system, and how do they contribute to the operation of trains?
2. How does the regenerative braking system work in an electric traction system, and what are its advantages?
3. What is the role of traction motors in an EMU, and how do they differ from motors used in other train systems?

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XIII References/Suggestions for further reading

1. www.railwaygazette.com
2. www.irfca.org
3. www.wikipedia.org/wiki/Cardiff_Canton_TMD
4. www.wikipedia.org/wiki/Exeter_TMD
5. www.nap.edu/catalog/13482/design-and-operation-of-locomotive-sheds

XIV Suggested Assessment Scheme

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

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

Practical No. 14: Demonstrate indirect resistance oven used in Laboratory.

I Practical Significance

Electrical Engineering diploma graduate are expected to operate the indirect resistance heating oven. The significance of demonstrating an indirect resistance oven lies in its educational and practical benefits, particularly for understanding industrial heating processes. Therefore this practical will help you to acquire necessary skills.

II Industry/Employer Expected Outcome(s)

Operate various electrical utilities used for industrial and commercial application.

III Course Level Learning Outcome(s)

Select the type of electric furnaces according to the applications.

IV Laboratory Learning Outcome(s)

LLO 14.1 Write the specification of oven.

LLO 14.2 Measure elimination of moisture from substance

V Relevant Affective Domain related outcome(s)

Follow safety practices.

Maintain tools and equipment.

Follow ethical Practices.

VI Relevant Theoretical Background

Indirect ovens play a crucial role in laboratory environments, providing controlled heating for a range of applications such as drying, sterilization, and material testing. This practical outlines the demonstration of an indirect oven, highlighting its key specifications, working mechanism, and uses in a laboratory setting.Indirect ovens operate by generating heat that is transferred to the chamber's interior through convection rather than direct exposure. This method allows for uniform heating, ensuring that delicate samples are not exposed to direct heat, which could affect their integrity.

VII Practical set-up / Circuit diagram / Work Situation

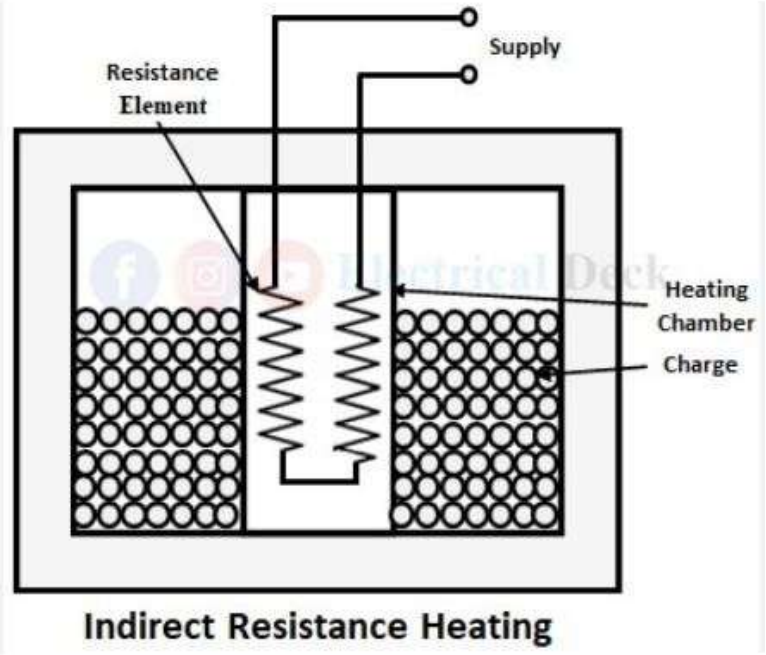

Fig.No.14.1 Front view of Electronic Energy Meter

VIII Required Resources/apparatus/equipment

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	LAB-IND-3000,	3.5 KW	1
2.	Silika Gel (wet)	Violet than pink colour	50gm
3	Heat resistant Tray (for heating)	As available in the lab	1
4	Gloves and safety gear	Good insulation quality pair	5
5	Temperature control system (if applicable)	----	------
6	Air-tight container	Capacity 100 gm storage	1
7	Heat resistant tool	Longer for sufficient Stirring	1

IX Precautions to be followed

1. Proper Ventilation: Ensure the oven is installed in a well-ventilated area to prevent heat buildup and reduce the risk of fire hazards due to overheating.

2. Avoid Direct Contact with Heating Elements: While the heating element does not touch the material directly, it's important to avoid any accidental contact with the oven's heated surfaces to prevent burns or damage.
3. Temperature Control: Monitor the temperature settings carefully. Overheating can damage the oven and materials, while insufficient heat may lead to incomplete processing. Use thermostats or control systems accurately.
4. Regular Maintenance: Periodically check for wear and tear, especially on insulation and electrical components, as damaged parts could lead to energy inefficiency or even cause hazards like electrical shorts.

X Problem statement (to be provided by Teacher, sample given here)

1. Take the sample of moist silica gel (violet to pink).
2. After drying silica gel, observe the condition and color of silica gel .

XI Procedure

Steps for Moisture Removal from Silica Gel:

1. Preheat the Oven.
2. Prepare the Silica Gel.
3. Place Tray in the Oven.
4. Set the Drying Duration.
5. Monitor the Temperature.
6. Check for Full Dryness.
7. Turn Off the Oven.
8. Remove the Tray.
9. Storage.

XII Observation table (silica gel is suggested here, others will be suggested by teacher)

Sr. No.	Material sample (to eliminate the moisture)	Temperature maintained	Duration for drawing the sample	Remedial action observed
1	Silika Gel			
2				
3				

XIII Result

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XIV Interpretation of Result

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XV Conclusion and recommendation

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XVI Practical related questions (Note: - Teacher should provide various questions related to practical- sample given)

1. What is the working principle of indirect resistance heating, and how does it differ from direct heating methods?
2. How does indirect resistance heating ensure uniform temperature distribution within an oven chamber?
3. Why is indirect heating preferred over direct heating for certain laboratory applications, especially in moisture removal?
4. What role does insulation play in the efficiency of an indirect resistance oven during the moisture removal process?

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XVII References/Suggestions for further reading

1. www.thermofisher.com
2. www.laboven.net
3. www.carbolite-gero.com
4. www.thermalprocessing.com

XVIII Suggested Assessment Scheme

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

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