**5.5 UTILIZATION OF ELECTRICAL ENERGY**

**RATIONALE**

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This subject assumes importance in view of the fact that an electrical technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas

## LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

* Design lighting scheme for domestic, industrial and commercial installation
* Design and select a suitable heating arrangement for a particular job
* Handle and maintain electric welding equipment
* Handle and maintain electrolytic plant
* Find faults in electric circuits of refrigerators
* Suggest electric drives as per need
* Maintain electric traction lines and track

## DETAILED CONTENTS

1. Electric Heating (12 Periods)
   1. Advantages of electrical heating
   2. Heating methods:
      1. Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit
      2. Induction heating; principle of core type and coreless induction furnace, their construction and applications
      3. Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace
      4. Dielectric heating, applications in various industrial fields
      5. Infra-red heating and its applications (construction and working of two appliances)
      6. Microwave heating and its applications (construction and working of two appliances)

1.2.7 Solar Heating

* 1. Calculation of resistance heating elements (simple problems)

1. Electric Welding: (06 Periods)
   1. Advantages of electric welding
   2. Welding methods

2.2.1. Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment

2.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper

1. Electrolytic Processes: (12 Periods)
   1. Need of electro-deposition
   2. Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing
   3. Equipment and accessories for electroplating
   4. Factors affecting electro-deposition
   5. Principle of galvanizing and its applications
   6. Principles of anodizing and its applications
   7. Electroplating of non-conducting materials
   8. Manufacture of chemicals by electrolytic process
2. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers:

(08 Periods)

* 1. Principle of air conditioning
  2. Description of Electrical circuit used in

1. Refrigerator,
2. Air-conditioner, and
3. Water cooler
4. Electric Drives: (12 Periods)
   1. Advantages of electric drives
   2. Characteristics of different mechanical loads
   3. Types of motors used as electric drive
   4. General idea about the methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.
   5. Examples of selection of motors for different types of domestic loads
   6. Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.
   7. Selection of motors for Domestic Appliances
5. Electric Traction: (14 Periods)
   1. Advantages of electric traction
   2. Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves
   3. Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph
   4. Factors affecting scheduled speed

6.5. Electrical block diagram of an electric locomotive with description of various equipment and accessories used.

* 1. Types of motors used for electric traction
  2. Power supply arrangements
  3. Starting and braking of electric locomotives
  4. Introduction to EMU and metro railways
  5. Train Lighting Scheme

## Note: Students should be taken for visits to nearest electrified railway track and railway station to study the electric traction system.

**INSTRUCTIONAL STRATEGY**

It is desired to give ample practical examples in the class while teaching this subject. Teacher must supplement his/her classroom teaching with aids such as models, charts, and video films from time to time. This subject requires demonstrations and exposure to actual workplace/industry/field. For this purpose, the subject teacher should do advance planning for visits/studies related to each topic in consultation with HOD and Principal of the polytechnic/institution.

## MEANS OF ASSESSMENT

* Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
* Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce
* Software installation, operation, development

## RECOMMENDED BOOKS

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai & Sons, Delhi
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana
3. Utilization of Electrical Energy by Sahdev, Uneek Publication, Jalandhar
4. A Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi
6. Utilization of Electrical Energy by D.R. Arora, North Publication, Jalandhar
7. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa, Wiley Eastern Ltd., New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

## Websites for Reference:

[http://swayam.gov.in](http://swayam.gov.in/)

## SUGGESTED DISTRIBUTION OF MARKS

|  |  |  |
| --- | --- | --- |
| **Topic No.** | **Time Allotted**  **(Periods)** | **Marks Allocation**  **(%)** |
| 1 | 12 | 19 |
| 2 | 06 | 09 |
| 3 | 12 | 19 |
| 4 | 08 | 12 |
| 5 | 12 | 19 |
| 6 | 14 | 22 |
| **Total** | **64** | **100** |