

**Teaching Scheme**

Theory : 03 Hrs./Week

**Credits**

03

**Examination Scheme [Marks]**

In Sem : 30 Marks

End Sem : 70 Marks

**Prerequisite:**

- Basics of Electrical Engineering, Effects of electric current
- Chemical reactions in electrolyte
- Control circuit design basics, awareness about artificial lighting, refrigeration, air conditioning
- Characteristics and application of different electric motors, awareness about traction

**Course Objective:**

The course aims to:-

- Ensure that the knowledge acquired can be applied in various fields such as electric heating, illumination, chemical processes, and electric traction.
- Make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
- Develop ability amongst the students to design -heating element for resistance furnaces and design- illumination schemes. To develop ability amongst the students to analyze the performance of arc furnaces, electric traction, different sources of light, illumination schemes
- Provide know how about Refrigeration, Air Conditioning
- Provide know about electrochemical processes and applications of these in practical world, modern welding techniques.
- Develop self and lifelong learning skills, introduce professionalism for successful career.

**Course Outcome:**

Upon successful completion of this course, the students will revise :-

- Get knowledge of principle of electric heating, welding and its applications.
- Design simple resistance furnaces and residential illumination schemes.
- Calculate tractive effort, power, acceleration and velocity of traction.
- Get knowledge of electric braking methods, control of traction motors, train lighting and signaling system.
- Understand collection of technical information and delivery of this technical information through presentations.

**Unit 01: Electric Heating****(06 Hrs.)**

Modes of heat transfer, mathematical expressions

**Electric heating:** Introduction to electric heating, Advantages of electrical heating**Heating methods:** - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating element materials, temperature control of resistance furnaces, and design of heating element (Numerical).

Applications of resistance heating

**Induction heating :** Principle, core type and coreless induction furnaces, Ajax Wyatt furnace, Numerical on melting furnaces Applications of induction heating

**Electric arc heating** – Direct and indirect arc heating, types of arc furnaces, equivalent circuit of arc furnace, condition for maximum output, power factor at maximum output (Numerical), Heat control in arc furnace, Applications of arc heating

**Dielectric heating** –Principle, choice of voltage and frequency for dielectric heating (Numerical), Applications of dielectric heating

Electric Welding -**Welding methods** –Electric arc welding and resistance welding, Equivalent circuit of arc furnace (Numerical) Modern welding techniques like ultrasonic welding and laser welding

**Unit 02:      Electrochemical Process      (04 Hrs.)**

Need of electro-deposition. Applications of Faraday's laws in electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications

**Electrical Circuits Used in Refrigeration, Air Conditioning**

Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in Refrigerator, Air Conditioner

**Unit 03:      Illumination      (04 Hrs.)**

Definitions of luminous flux, solid angle, luminous intensity, illumination, luminous efficacy, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination.

**Design of illumination schemes**-Factors to be considered for design of illumination scheme, Calculation of illumination at different points, considerations involved in simple design problems for indoor installation, illumination schemes, standard illumination level. Natural day light illumination (brief information)

**Different sources of light:** Incandescent lamp, fluorescent lamp, comparison between them. Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs Comparison of all above luminaries.

**Unit 04:      Electric Traction      (06 Hrs.)**

History of Indian railways.

**Traction systems** - Steam engine drive, electric drive, diesel electric drive, types of diesel locomotives, Advantages of electric traction, Brief treatment to - Indian railway engine coding terminology, WDM,WDP,WDG series and their capacity . Introduction to metro system, mono rail system.

**Systems of track electrification:** D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. system

**Different accessories for track electrification** -overhead wires, conductor rail system, current collector-pentograph, catenary

**Electric locomotive-** Block diagram with description of various equipment and accessories.

**Supply system constituents**-Layout and description of -Traction substation, feeding post(25kV), feeding and sectioning arrangement, sectioning and paralleling post, neutral section.

**Details of major equipment in traction substation**-transformer, circuit breaker, interrupter

**Unit 05: Traction Mechanics****(08 Hrs.)**

**Types of services-** Urban, Sub-urban, Main line Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed (Numerical), Tractive effort. Specific energy consumption. Factors affecting specific energy consumption (Numerical), Mechanics of train movement, coefficient of adhesion (Numerical).

**Unit 06: Traction Motors, Control of Traction Motors, Train Lighting****(08 Hrs.)**

Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor, 3 phase induction motor and linear induction motor for traction. Control of traction motors -Series-parallel control, Shunt and bridge transition (Numerical), Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system.

**Railway signalling:** - History, necessity, block system route relay interlock and necessity. Metro signalling, Electromechanical system for route relay interlock. Introduction to train tracking system, types. Anti-collision system-brief treatment only.

**Industrial Visit: Visit to any one location from the following-**

- Railway station (Control room)
- Loco shed
- Traction substation

**Text Books:**

- [T1] E. O. Taylor 'Utilization of Electrical Energy' – Revised in S.I. Units by V.V.L. Rao, Orient Longman
- [T2] J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K. Kataria and sons, Delhi
- [T3] C. L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', Eastern Wiley Ltd.
- [T4] A. Chakraborti, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, 'A text book on Power System Engineering', Dhanpat Rai and Co.(P) Ltd – Delhi
- [T5] Clifford F. Bonnett 'Practical Railway Engineering', (Imperial college press)

**Reference Books:**

- [R1] 'Art and science of Utilization of Electrical Energy' by H. Partab, Dhanpat Rai and Co.(P) Ltd –Delhi
- [R2] 'Modern Electric Traction' by H. Partab, Dhanpat Rai and Co. (P) Ltd – Delhi
- [R3] 'Lamps and lighting' by M. A. Cayless, J.R. Coaton and A. M. Marsden
- [R4] 'BIS, IEC standards for Lamps, Lighting Fixtures and Lighting' By Manak Bhavan, New Delhi
- [R5] 'Illumination Engineering from Edison's Lamp to the Laser' Joseph B. Murdoch
- [R6] 'Two centuries of Railway signalling' by Geoffrey, Kichenside and Alan Willims (Oxford Publishing Co-op)
- [R7] 'Generation and Utilization of Electrical Energy' S. Sivanagaraju, M. Balsubba Reddy, D. Srilatha (Pearson)
- [R8] 'Electrical Powers' S. L. Uppal, Khanna Publication

**NOTE****Assignments can be given on following topics**

- Types of Electric Welding- Electric arc welding and resistance welding (accessories involved and working of the system, characteristics of arc welding)
- Modern welding techniques like ultrasonic welding and laser welding
- Study of different types of lamps-Incandescent lamp, fluorescent lamp, their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs
- Comparison of all above luminaries.
- WDM, WDP, WDG series and their capacity. Introduction to metro system, mono rail system.

| Unit | Text Books    | Reference Books     |
|------|---------------|---------------------|
| 1    | T1,T3,T4      | R1,R7, R8           |
| 2    | T1,T3, T4     | R1, R7              |
| 3    | T1,T3, T4     | R1, R3,R4,R5,R7, R8 |
| 4    | T1,T2,T5, T4  | R1, R2,R7, R8       |
| 5    | T1,T2,T5, T4  | R1, R2,R5, R8       |
| 6    | T1, T2,T5, T4 | R1, R2,R6, R8       |