**UTILIZATION OF ELECTRICAL ENERGY** **Course Code : 314323**

**Programme Name/s** : **Electrical Engineering/ Electrical Power System**
**Programme Code** : **EE/ EP**
**Semester** : **Fourth**
**Course Title** : **UTILIZATION OF ELECTRICAL ENERGY**
**Course Code** : **314323**

## I. RATIONALE

Electrical energy is the most widely used form of energy by every sector. The generated power before being utilized by the consumer has to pass through various stages. One of the important aspect of electrical power system is efficient utilization of electrical energy. The electrical engineering diploma pass outs are therefore required to posses knowledge and skills of operation and use of electrical drives, electrical furnaces, and traction systems. Essential theoretical and practical knowledge will be achieved by learning this course. Contents of course are designed essentially keeping in mind the job profile of electrical engineer handling electrical utilities.

## II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Operate various electrical utilities used for industrial and commercial applications.

## III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- 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.

## IV. TEACHING-LEARNING & ASSESSMENT SCHEME

| Course Code | Course Title | Abbr | Course Category/s | Learning Scheme | | | | | Credits | Assessment Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Actual Contact Hrs./Week | | | SLH | NLH | | Paper Duration | Theory | | | | Based on LL & TL | | | | Based on SL | | Total Marks |
| | | | | | | | | | | | | | | | Practical | | | | | | |
| | | | | CL | TL | LL | | | | | FA-TH | SA-TH | Total | | FA-PR | | SA-PR | | SLA | | |
| | | | | | | | | | | | Max | Max | Max | Min | Max | Min | Max | Min | Max | Min | |
| 314323 | UTILIZATION OF ELECTRICAL ENERGY | UEE | DSC | 4 | - | 2 | 2 | 8 | 4 | 3 | 30 | 70 | 100 | 40 | 25 | 10 | 25@ | 10 | 25 | 10 | 175 |

**Total IKS Hrs for Sem. :** 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

## V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|---|---|---|---|
| 1 | TLO 1.1 Define the given term(s) as related to illumination.<br>TLO 1.2 Explain the construction and working of the given type of lamp(s) and lamp fittings.<br>TLO 1.3 State the laws of illumination<br>TLO 1.4 Select the relevant lamp for the specified application with justification.<br>TLO 1.5 Design simple lighting scheme for the given data.<br>TLO 1.6 Explain factors affecting on quality of lighting system | **Unit - I ILLUMINATION**<br>1.1 Definitions of various illumination terminology- Luminous flux, Lumens, Candela, solid angle, luminous intensity, lux, candlepower, MHCP, MSCP, MHSCP, illumination, lamp efficacy, glare, shadow. Brightness<br>1.2 Various types of Lamps :Fluorescent Tube, CFL, Metal Halide and LED.<br>1.3 Laws of illumination: Inverse squares and Lambert's Cosine law.<br>1.4 Various lighting schemes: Direct, Indirect , Semidirect and Semi indirect :features and application.<br>1.5 Design of Lighting Scheme: Factors considered designing such as- Space height ratio, Utilization factor, depreciation factor, reflection factor, Waste light factors, coefficient of utilization (Numerical on design of indoor lighting scheme)<br>1.6 Domestic and industrial lamp fittings.<br>1.7 Factors affecting on quality of lighting system | Lecture Using Chalk-Board<br>Presentations<br>Video Demonstrations<br>Flipped Classroom |

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|---|---|---|---|
| 2 | TLO 2.1 Explain construction, working principle and classification of the specified electrical heating system.<br>TLO 2.2 Recommend the relevant heating system for the given application with proper justification.<br>TLO 2.3 Design the heating element of the given type of furnace from the specified data.<br>TLO 2.4 Solve simple numerical on estimation of size of induction furnace<br>TLO 2.5 Estimate voltage and power requirement in dielectric heating | **Unit - II ELECTRIC HEATING**<br>2.1 Concept of electrical heating, Advantages and classification of electric heating, modes of heat transfer.<br>2.2 Resistance Heating: Construction and Operation of Direct Resistance Heating - Salt Bath Furnace, Indirect Resistance Heating: Resistance Ovens, Requirements of Heating Element Material, Causes Heating Elements, Methods of Temperature Control, Applications of Resistance Heating, Design of Heating Element. (Simple Numerical problems on heating elements)of Failure of<br>2.3 Arc Heating - Construction and Operation of Direct Arc Furnace, Indirect Arc Furnace. Applications of Arc Heating.<br>2.4 Induction Heating - Construction and Operation of Core Type Induction Furnaces: Ajax Wyatt Furnace, Coreless Induction Furnace, Applications of Induction Heating, High frequency eddy current heating. Radiant and infrared heating, Estimation of Heat data (Simple Numerical to estimate rating of furnace).<br>2.5 Dielectric Heating: Principle of Dielectric Heating, Advantages of Dielectric Heating<br>2.6 Limitations of Dielectric Heating, Applications of Dielectric Heating ( Simple Numericals) | Lecture Using Chalk-Board<br>Video Demonstrations<br>Site/Industry Visit<br>Case Study |
| 3 | TLO 3.1 Select the relevant welding system for the specified application with justification.<br>TLO 3.2 Describe the working principle and construction of special type of transformer used in welding.<br>TLO 3.3 Describe the working principle of Electric Welding and its types<br>TLO 3.4 State the applications of modern welding techniques | **Unit - III ELECTRIC WELDING**<br>3.1 Electric Welding: Principles of electric resistance welding.<br>3.2 Methods of Electric Welding – Electric arc welding, resistance welding.<br>3.3 Resistance Welding – Principles, Advantages, types of resistance welding.<br>3.4 Electric Arc Welding- Formation and Characteristics of electric arc, effects of arc length.<br>3.5 Principle of electric arc welding: Types, advantages, disadvantages and applications of all types.<br>3.6 Comparison with resistance welding and Electric Arc Welding<br>3.7 2.7 Modern welding techniques like Ultrasonic, Laser, under water welding, IGBT controlled welding. | Lecture Using Chalk-Board<br>Video Demonstrations<br>Presentations<br>Site/Industry Visit |

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|---|---|---|---|
| 4 | TLO 4.1 Differentiate the salient features between the given types of electric drives.<br>TLO 4.2 Recommend the relevant motor for the given application with justification.<br>TLO 4.3 Select the relevant enclosure for the given atmospheric condition with justification.<br>TLO 4.4 Select the power transmission drive of the electric motor for the given application with justification.<br>TLO 4.5 Estimate the relevant size and rating of electric motor for the specified load cycles.<br>TLO 4.6 Select relevant elevator machine and electric motor for the specified application with justification.<br>TLO 4.7 Describe the procedure to maintain the given electric drive and elevator. | **Unit - IV ELECTRIC DRIVES AND ELEVATORS**<br>4.1 Electric drives : Concept, factors governing selection of electric drives(motor).<br>4.2 Types of electrical drives : Individual and Group drive, Applications.<br>4.3 Mechanical features of drives: Types and applications various types of enclosures.<br>4.4 Transmission of Mechanical Power: Direct and Indirect drive ( Belt, Rope, Chain, Gear), Vertical drives and its applications.<br>4.5 Bearing: Types and applications.<br>4.6 Size and Rating of motor : (Simple numerical on this topic)<br>4.7 Load Cycles : Concept with graphical representation.<br>4.8 Load Equalization : Concept , and methods and condition of load equalization.<br>4.9 Elevators: Function, Application, types, safety and precautions, case study of latest Elevator.<br>4.10 Factors on which shape and size of car depends. | Lecture Using Chalk-Board<br>Video Demonstrations<br>Site/Industry Visit<br>Case Study |

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|---|---|---|---|
| 5 | TLO 5.1 Recommend relevant traction system for the given application with justification.<br>TLO 5.2 Select the relevant track electrification system for the specified traction services with justification.<br>TLO 5.3 Differentiate the salient features between the given types of track electrification system.<br>TLO 5.4 Draw the speed -time curve for the specified electric traction application.<br>TLO 5.5 Differentiate between the given types of traction services based on the given criteria .<br>TLO 5.6 Determine average and schedule speed for the given traction service. | **Unit - V ELECTRIC TRACTION**<br>5.1 Introduction of electric traction system, Requirements of ideal traction system<br>5.2 System of Track Electrification: DC; Single phase 25kV AC, Composite system.<br>5.3 Traction Mechanics : Block diagram of AC electric locomotive and function of each part, Nomenclature of Locomotivesiv<br>5.4 Crest, Average and Schedule Speed; definition and factors affecting them.<br>5.5 Traction services : Urban, suburban, main line service ( Main features and comparison between the three of them),Speed Time curve, Concept and applications of Trapezoidal and quadrilateral speed time curve( simple numerical based on Trapezoidal speed time curve)<br>5.6 Concept and function of Catenary wire ,Contact wire and Dropper, Material used for them, Simple Catenary construction, Definition and Need of Neutral Section, Current Collecting system: Diamond type pantograph and Faiveley type pantograph( Construction and Working)<br>5.7 Introduction of Metro and Mono Rail ( main features between the two of them). | Lecture Using Chalk-Board<br>Video Demonstrations<br>Site/Industry Visit<br>Presentations |

## VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|---|---|---|---|
| LLO 1.1 Identify the different lighting accessories required for various types of lamps. | 1 | *Identification of different lighting accessories required for various types of lamps. | 2 | CO1 |
| LLO 2.1 To compare the Lumen output of various lamps. | 2 | *Comparision of Lumen output of Fluorescent tube , Metal Halide, CFL and LED. | 2 | CO1 |
| LLO 3.1 To measure illumination at different locations in college using luxmeter and compare with standard illumination level as per SP 72 : 2023 (National lighting code) | 3 | *Measurement of illumination at different locations in college using luxmeter and compare with standard illuminationlevel as per SP 72: 2023.(National Lighting code). | 2 | CO1 |
| LLO 4.1 Design a heating element as per the given parameters. | 4 | *Design a heating element as per the given parameters . | 2 | CO2 |
| LLO 5.1 Identify the different electrical and safety equipment used for Arc welding | 5 | *Demonstation of different electrical and safety equipments used for arc welding. | 2 | CO2 |
| LLO 6.1 Identify the different components required for various heating furnaces . | 6 | *Identification of different components required for various heating furnaces. | 2 | CO2 |
| LLO 7.1 Write specification of Welding generator set and welding transformer. | 7 | *Selection of suitable current range of Welding generator set and Welding transformer for various thickness of metal job. | 2 | CO3 |

| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|---|---|---|---|
| LLO 8.1 Identify the different defects in arc welding job. | 8 | *Identification of different defects in arc welding job. | 2 | CO3 |
| LLO 9.1 Identify the different electrodes in arc welding. | 9 | *Identification of different electrodes used in arc welding. | 2 | CO3 |
| LLO 10.1 To estimate the size of motor as per the specified load cycle. | 10 | *Estimatiom of size of motor as per the specified load cycle. | 2 | CO4 |
| LLO 11.1 To identify the different components of elevator. | 11 | Identification of the different components of an Elevator. | 2 | CO4 |
| LLO 12.1 To identify the different components of Escalator. | 12 | Identification of different components of Escalator. | 2 | CO4 |
| LLO 13.1 To observe the different types of signals used in traction system.<br>LLO 13.2 To observe the raising and lowering of Faiveley type pantograph.<br>LLO 13.3 To observe the different parts of E.M.U | 13 | Visit to a traction loco shed and observe various types of system used in traction. | 6 | CO5 |
| LLO 14.1 Write the specification of oven.<br>LLO 14.2 Measure elimination of moisture from substance. | 14 | *Demonstrate indirect resistance Oven used in Laboratory. | 2 | CO2 |

**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 are to be performed to achieve desired outcomes.

## VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

**Assignment**

- Prepare power point presentation related to heating furnaces.
- Prepare power point presentation related to welding equipment and accessories.
- Prepare power point presentation on Mono and Metro rail systems in India.
- Collect Bombay Lift Act and understand rules to inspect electrical components.
- Select any one electric drive. Explain its suitability for any one industrial application through power point presentation.(Electrical and Mechanical Characteristics)

**Micro project**

- Prepare report on market survey of various types of lamps( specification, manufacturer, application and cost) and do the comparative analysis.
- Prepare a market survey of various drives( specification, manufacturer, application and cost).
- Design suitable lighting scheme for a laboratory or class room.
- Prepare market survey on Lift and Escalator (specification, manufacturer, application and cost)

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

## VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

| Sr.No | Equipment Name with Broad Specifications | Relevant LLO Number |
|---|---|---|
| 1 | Fluroscent Tube light, CFL and LED ( Bulb and Tube Light) of different suitable ratings | 1,2 |
| 2 | Suitable data to be given to calculate the size of motor for specified load cycle. | 10 |
| 3 | Visit to a Elevator company/You Tube videos/Concerned learning software and Website | 11 |
| 4 | Visit to a Escalator company/ YouTube videos/ concerned learning website or related software. | 12 |
| 5 | Loco shed/ Track Electrification system visit for observing components /equipment related to traction . | 13 |
| 6 | Digital Lux Meter (Upto LUX-100K) | 3 |
| 7 | Heating furnace/Oven of suitable ratings | 4,6 |
| 8 | Electrical welding machine of suitable rating | 5,7 |
| 9 | Welding workshop of Institute / Any small scale industry (Welding) visit to observe the various defects in arc welding and the different electrodes used for arc welding. | 8,9 |

## IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

| Sr.No | Unit | Unit Title | Aligned COs | Learning Hours | R-Level | U-Level | A-Level | Total Marks |
|---|---|---|---|---|---|---|---|---|
| 1 | I | ILLUMINATION | CO1 | 12 | 4 | 4 | 6 | 14 |
| 2 | II | ELECTRIC HEATING | CO2 | 14 | 4 | 6 | 6 | 16 |
| 3 | III | ELECTRIC WELDING | CO3 | 8 | 2 | 4 | 4 | 10 |
| 4 | IV | ELECTRIC DRIVES AND ELEVATORS | CO4 | 14 | 4 | 6 | 6 | 16 |
| 5 | V | ELECTRIC TRACTION | CO5 | 12 | 2 | 6 | 6 | 14 |
| **Grand Total** | | | | **60** | **16** | **26** | **28** | **70** |

## X. ASSESSMENT METHODOLOGIES/TOOLS

**Formative assessment (Assessment for Learning)**

- Two unit tests of 30 marks will be conducted and average of two unit tests are conducted. For formative assessment of Laboratory learning 25 marks. Each practicle will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

**Summative Assessment (Assessment of Learning)**

- End semester summative assessment of 25 marks for laboratory learning. End semester assessment of 70 marks through offline mode of examination.

## XI. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1 | PSO-2 | PSO-3 |
| CO1 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | | | |
| CO2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | | | |
| CO3 | 3 | 1 | 2 | 3 | 3 | 2 | 3 | | | |
| CO4 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | | | |
| CO5 | 3 | 1 | 3 | 3 | 3 | 1 | 3 | | | |

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr.No | Author | Title | Publisher with ISBN Number |
|---|---|---|---|
| 1 | H.Pratab | Art and Science of Utilization of Electrical Energy | Dhanpat Rai & Sons,New Delhi, ISBN: 9788177001440 |
| 2 | J.B. Gupta | Utilization of Electric Power and Electric Traction. | S.K. Kataria & Sons, New Delhi, ISBN: 978- 9350142585 |
| 3 | G. C. Garg | Utilization of Electric Power and Electric Traction. | Khanna Publishers, New Delhi, ISBN: 8174091645 |
| 4 | J. Upadhaya and S.N. Mahendra | Electric Traction | Allied Publisher Ltd., New Delhi, ISBN: 8177640054 |
| 5 | G.K. Dubey | Fundamentals of Electric Drive | Narosa Publishing House, New Delhi, ISBN: 8173190410 , 9788173190414 |
| 6 | V. K. Mehta | Principles of Power System | S. Chand, New Delhi, ISBN: 9788121924962 |
| 7 | H.Pratab | Modern Electric Traction | Dhanpat Rai & Sons,New Delhi, ISBN: 1234567147206 |
| 8 | S. Sivanagaraju & M. Balasubba Reddy & B. Srilatha | Generation and Utilization of Electrical Energy | Personal Education, New Delhi, ISBN: 9789332515673 |

## XIII . LEARNING WEBSITES & PORTALS

| Sr.No | Link / Portal | Description |
|---|---|---|
| 1 | https://www.youtube.com/watch?v=CoHVA7nr82A | Complete description of Arc Welding |
| 2 | https://www.youtube.com/watch?v=7GLiBwgVBLQ | Videos on Electric Traction |
| 3 | https://www.youtube.com/watch?v=fakGLu03jYg | Videos on Electric Traction |
| 4 | https://www.youtube.com/watch?v=BDMFsYnTdVI | Videos on Electric Locomotive with full description |
| 5 | https://www.youtube.com/watch?v=49rH3buD0bc | Video showing the working of Diesel Locomotive |
| 6 | https://www.youtube.com/watch?v=82EFMvYcbN4 | Videos on Electric Multiple Unit |
| 7 | https://www.youtube.com/watch?v=AAyLKnz4UJY | Videos to describe Electric Heating system |

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| Sr.No | Link / Portal | Description |
|---|---|---|

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

**MSBTE Approval Dt. 21/11/2024** **Semester - 4, K Scheme**