

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT
COURSE CURRICULUM

Course Title: Utilization of Electrical Energy
(Course Code: 3340903)

Diploma Program me in which this course is offered	Semester in which offered
ELECTRICAL ENGINEERING	FOURTH SEMESTER

1. RATIONALE

This course will enable the students to develop skills to Maintain / operate various Electrical equipments / gadgets / appliances in power, commercial and industrial sector. The students will be able to utilize electrical energy efficiently & economically. Essential theoretical and practical knowledge will be achieved by this course.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- i. To study the importance of good illumination in factory and flood lighting.
- ii. To study the different methods of electric heating and electric welding.
- iii. To study the analysis of electric circuits of various domestic appliances.
- iv. Select appropriate cables.

(The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency)

3. Course Outcomes:

Student will be able to:

- Explain the importance of good illumination in the factory and flood lighting.
- Compare different methods of electric heating and electric welding.
- Select Electric Drive for specific electrical applications
- Explain the working of various components in the Electric Traction system and list the advantages.
- Analyze the electric circuits of various domestic appliances.
- Apply various measures for economic aspects of utilizing electrical energy
- Select cables for specific application.

4. Teaching and Examination Scheme

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
4	2	0	6	ESE	PA	ESE	PA	100
				70	30	00	00	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I. ILLUMINATION	1a. Design various types of lighting scheme.	<p>1.1 Definitions of Terms Used in Illumination: Light, Luminous Flux, Luminous Intensity, Lumen, Candle Power, Illumination, Lox or Meter Candle, Mean Horizontal Candle Power (MHCP), Mean Spherical Candle Power (MSCP), Mean Hemispherical Candle Power (MHSCP), Reduction Factor, Lamp Efficiency, Specific Consumption, Glare, Space-Height Ratio, Utilization Factor, Maintenance Factor, Depreciation Factor, Waste Light Factor, Absorption Factor, Reflection Factor, Solid Angle.</p> <p>1.2 Laws of Illumination: - Law of Inverse Squares - Lambert's Cosine Law. (No Numerical)</p> <p>1.3 Sources of Light: Construction, Working and Applications of Following Lamps: - Incandescent Lamps. - Halogen Lamps. - Low Pressure Mercury Vapour Lamps (Fluorescent Tube). - High Pressure Mercury Vapour</p>

Unit	Major Learning Outcomes	Topics and Sub-topics
		<p>Lamps.</p> <ul style="list-style-type: none"> - Sodium Vapour Lamps. - Compact Fluorescent Lamps (C.F.L.) <p>1.4 Types of Lighting Schemes. Direct, Semi-direct, Semi-indirect, Indirect, General Lighting.</p>
<p>Unit– II ELECTRICAL HEATING AND WELDING</p>	<p>2a Explain principles types & equipments used for electrical heating and welding.</p>	<p><u>Electric Heating:</u></p> <p>2.1.1 Advantages of Electric Heating.</p> <p>2.1.2 Modes of Transfer of Heat:</p> <ul style="list-style-type: none"> - Conduction, Convection and Radiation. <p>2.1.3 Classification of Electric Heating Methods:</p> <p>2.1.4 Resistance Heating:(Construction & Operation)</p> <ul style="list-style-type: none"> - Direct Resistance Heating: Salt Bath Furnace. - Indirect Resistance Heating: Resistance Ovens, Requirements of Heating Element Material, Causes of Failure of Heating Elements, Methods of Temperature Control. - Applications of Resistance Heating. <p>2.1.5 Arc Heating: (Construction & Operation)</p> <ul style="list-style-type: none"> - Direct Arc Furnace: - Indirect Arc Furnace. - Applications of Arc Heating. <p>2.1.6 Induction Heating: (Construction & Operation)</p> <ul style="list-style-type: none"> - Core Type Induction Furnaces: Ajax Wyatt Furnace. - Coreless Induction Furnace. - Applications of Induction Heating. (Simple Numerical on Melting Furnaces) <p>2.1.7 Dielectric Heating:</p> <ul style="list-style-type: none"> - Principle of Dielectric Heating. - Advantages of Dielectric Heating

Unit	Major Learning Outcomes	Topics and Sub-topics
		<ul style="list-style-type: none"> - Limitations of Dielectric Heating. - Applications of Dielectric Heating. (Simple Numerical on Dielectric Heating) <p><u>Electric Welding:</u></p> <p>2.2.1 Methods of Electric Welding: Electric Arc Welding, Resistance Welding.</p> <p>2.2.2 Resistance Welding:</p> <ul style="list-style-type: none"> - Principle of Resistance Welding. - Advantages of Resistance Welding. - Types of Resistance Welding - (Only List) <p>2.2.3 Spot Welding Machine.</p> <p>2.2.4 Electric Arc Welding:</p> <ul style="list-style-type: none"> - Formation and Characteristics of Electric Arc. - Effect of Arc Length. - Arc Blow. <p>2.2.5 Arc Welding Machines:</p> <ul style="list-style-type: none"> - DC Welding Machines – MG Set, AC Rectified Welding Unit. - AC Welding Machines –Welding Transformer.
Unit– III ELEVATORS	3a Classify various types of elevator machines and elevator motors.	<ul style="list-style-type: none"> 3.1 Types of electric elevators 3.2 Size and shape of elevator car 3.3 Speed of elevators 3.4 Location of elevator machine 3.5 Types of elevator machines, elevator motors 3.6 Power transmission gears braking 3.7 Safety in elevators 3.8 Bombay lift act.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit-IV ELECTRIC DRIVES	4a. Select Electric Drive for specific applications.	4.1 Introduction: - What is drive? - Drives – Mechanical Drive and Electric Drive. 4.2 Advantages and Disadvantages of Electric Drive. 4.3 Factors Governing Selection of Electric Motors. 4.4 Nature of Electric Supply: 3- Φ & 1- Φ AC and DC. 4.5 Type of Drive: Group Drive & Individual Drive. 4.6 Nature of Load: Nature of the Mechanical Load, Matching of the Speed Torque Characteristics of the Motor with that of the Load, and Starting Conditions of the Load. 4.7 Mechanical Features: - Type of Enclosure as per IS - Type of Bearings - Type of Transmission for Drive - Noise Level. 4.8 Selection of Motor: 4.9 Load Equalization. (No Calculations)
Unit-V ELECTRIC TRACTION	5a. Explain the working of various components in Electric Traction system and list the advantages...	5.1 Requirements of an Ideal Traction System. 5.2 Traction Systems: Its advantages and Disadvantages. 5.3 Systems of Track Electrification: DC System, Composite System -Single Phase to Three Phase System and -Single Phase AC to DC System (Kando System). -Advantages and Disadvantages of Single Phase 25 KV AC System Over DC System. 5.4 Traction Mechanics: - Types of Services. - Speed Time Curve.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit-VI ECONOMY ASPECTS OF UTILIZING ELECTRICAL ENERGY	6a. Apply various measures for economic aspects of utilizing electrical energy.	6.1 Concept of P.F. & its usual values for m/c. 6.2 Causes & effects of low P.F. 6.3 Methods of improving P.F. 6.4 Most Economical P.F. & its calculations. 6.5 Types of tariff & its calculations (as per current norms of Electricity board).
Unit-VII DOMESTIC GADGETS	7a. Apply measure for energy conservation in domestic gadgets.	7.1 Principle of working, construction and testing of domestic appliances. (1) Electric iron. (2) Electric toaster. (3) Electric water heater. (4) Microwave oven. 7.2 Principle of working, construction and specification of following appliances. (1) Fans (Ceiling and Table fan) (2) Washing Machine. (3) Grinder/ Mixer/ juicer. (4) Vacuum Cleaner. (5) Flour Mill etc. (6) Air conditioner

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	ILLUMINATION	8				10
II	ELECTRICAL HEATING AND WELDING	10				12
III	ELEVATORS	4				7
IV	ELECTRIC DRIVES	10				10
V	ELECTRIC TRACTION	10				14
VI	ECONOMY ASPECTS OF UTILIZING ELECTRICAL ENERGY	6				7
VII	DOMESTIC GADGETS	4				5
	Total	56				70

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills (Outcomes in cognitive, psychomotor and affective domain) so that students are able to acquire the competencies.

Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of Programme Outcomes/Course Outcomes in affective domain as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	To Measure Illumination at different places in college by luxmeter.	2
2	I	Study the various lamps available in the market & collect the technical information.	2
3	I	Visit to nearby lamp manufacturing / testing Industry and prepare a report.	2
4	I	Prepare a report of different luminaries available in the market & collect the technical data (Visit Local market / Use internet for data collection).	2
5	I	Study the different lighting accessories required for various types of lamps.	2
6	I	Design an Illumination scheme for a conference room of medium size.	2
7	I	Design an Illumination scheme for a workshop for fine work of medium size.	2
8	I	Design an Illumination scheme for a medium size Hotel / Hospital /Shopping complex.	2
9	I	Given the data, design an Illumination scheme for a small building.	2
10	II	Prepare a technical report after visiting an industry, manufacturing electrical heating furnaces.	2
11	II	Prepare a report of specification of various heating furnaces used in industries.	2
12	II	Prepare a report of specification of various electrical welding machines available in college workshop.	2

13	III	Prepare a report on various elevators after visiting nearby elevators manufacturing/repairing industry.	2
14	III	compare various Electric Drives for Traction	2
15	IV	Given different load situations (at least 10) select the appropriate motor and justify.	2
16	IV	Given a specific load condition determine the rating of a motor (motor for a pump, motor for a lift).	2
17	V	Visit nearby electric-traction substation and prepare a report.	2
18	V	Study of various traction systems.	2
19	V	Tutorials on speed time curves.	2
20	VI	Improve the power factor of an induction motor using Static capacitor / synchronous condenser.	2
21	VI	Prepare a technical report on working of synchronous condenser for P.F. improvement in grid (substation).	2
22	VI	Given an energy bill (industrial / commercial) interpret in View of current norms.	2
23	VI	Prepare a technical report on working of synchronous condenser for P.F. improvement in grid (substation)	2
24	VII	List different types of cables used in college and prepare their specification list along with charts.	2
25	VII	List different types of cables used in HVAC and HVDC prepare their specification list along with charts.	2
26	VIII	Dismantling, assembly, testing, preparation of list of components, parts and their cost for: (any two) a) Electric oven. b) Electric toaster. c) Electric water heater. d) Microwave oven. e) Fans (ceiling and table fan) f) Washing Machine. g) Grinder / mixer / juicer. h) Vacuum cleaner. i) Flour Mill. j) Air conditioner	2
27	VIII	Visit servicing centers of manufacturing companies, write the procedure of servicing of any one of them.	2
28	VIII	Visit a manufacturing unit & prepare a report based on it.	2
29	VIII	For given specific application of any two equipments collect literature of different manufacturing company & prepare a comparative chart	2
30	VIII	Prepare test reports & bills for servicing of above any two equipments.	2
			60

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

1. Preparing journals based on experiments/tutorial in laboratory
2. Assignments for solving numerical
3. Identify different types of illumination schemes.
4. Ratings of various types of welding machines used in industry.
5. Prepare chart of various electrical equipment used for heating.
6. Seminar on elevators.
7. Seminar on latest electric traction in world.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- Industrial visit of Induction furnace company
- Visit Manufacture site of Single phase induction motor/Elevators

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Art & Science of Utilization of Electrical Energy	H. Partab	Dhanpat Rai & Sons
2.	Utilization of Electric Power & Electric Traction.	J. B. Gupta	S. K. Kataria & Sons
3.	Utilization of Electric Power & Electric Traction	G. C. Garg	Khanna Publishers
4.	Electric Traction	J. Upadhyay S. N. Mahendra	Allied Publisher Ltd.
5.	Fundamentals of Electrical Drives	G. K. Dubey	Narosa Publishing House.
6.	Electrical Power system	V.K.Mehta	S.Chand

B) List of Major Equipment/ Instrument with Broad Specifications

1. Three phase transformer : 2kVA, 415V / 415 V, 50 Hz, 2.8A
2. Three phase induction motor: 5 HP, 440 Volts, 1460 rpm, 8.0A, 50Hz, Squirrel cage.
3. Three phase induction motor: 2 HP, 440 Volts, 1460 rpm, 50Hz, 4.2 A Slip ring cage.
4. DOL starter, star delta starter, auto transformer starter.
5. Synchronous motor : 5HP, 3- Φ , 415 V, 50 Hz, 6.0 A, 1500 RPM, Excitation-120V DC
6. Single phase induction motor: 1 HP, 220 V, 50Hz, 1440 RPM .
7. Ceiling fan.
8. Various types of cables

B) List of Software/Learning Websites

1. www.nptel.iitm.ac.in
2. www.howstuffworks.com/

3. www.vlab.com

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

1. Prof. H C CHAWDA, RC TECHNICAL INSTITUTE, AHMEDABAD
2. Prof. R D PANCHAL, RC TECHNICAL INSTITUTE, AHMEDABAD
3. Prof. V S TEJWANI, G.P. RAJKOT.
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