GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Power Electronics Engineering

Subject Code: DI04024101

Subject Name: Energy Conservation and Audit

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	MOPEC

Prerequisite:	Concepts of voltage, current, power, energy, and efficiency, Working principles and losses in transformers and motors, Basics of power electronics.
Rationale:	Energy conservation is essential for sustainable development and cost-effective industrial operation. This subject enables students to understand the need for efficient energy use, learn practical methods to reduce losses, and apply power electronics techniques for energy saving. It also introduces energy audit procedures, BEE guidelines, and modern energy-efficient equipment, preparing diploma engineers to contribute to energy management and sustainable practices in industries.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Apply basic concepts of energy conservation to identify potential energy-saving areas in electrical and electronic systems.	R, U, A
02	Apply energy conservation techniques in electrical machines by using energy-efficient equipment, variable frequency drives, and automation systems.	R, U, A
03	Apply ECBC guidelines for efficient building design and propose methods for load management in electrical systems.	R, U, A
04	Conduct energy audits and prepare basic energy audit reports with suggestion of energy-saving measures.	R, U, A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
2	0	2	3	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Energy Conservation** Definition, importance, and objectives of energy conservation; Energy scenario (India & world); Energy resources and consumption trends; Role of power electronics in energy saving; Energy management concepts. BEE and its Roles. Star labeling: needs and its benefits.	7	24
2.	**Energy conservation in Electrical Machines and Power Electronic Drives.** Energy conservation techniques in Transformer by: Loading sharing, Parallel operation, Replacement by energy efficient transformers, Isolating technique and Periodic maintenance. Energy conservation technique in induction motor by: Improving Power supply quality, motor survey, reducing under load, Operating in star mode, Sizing to variable load, PF correction, Rewinding of motor. Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Automatic P.F. controller (APFC), intelligent P.F. controller (IPFC). Use of Variable frequency drives (VFD) for energy saving, Use of sensors and automation for energy management. Basics of Energy-efficient power electronics converters.	8	26
3	**Energy conservation Building Code and load management.** Energy conservation Building Code: definition, climate zone, aspects. ECBC guideline on electrical power equipment and lightning system. Energy efficiency measures in AC, lightning system. Electrical load management and maximum demand control, advantages, example.	7	24

4	**Energy Audit of Electrical systems.** Definition, objectives, and benefits of energy audit; Types of audits (walk-through, detailed); Energy accounting and benchmarking; Steps in energy audit, Introduction to ISO 50001 Energy Management System. Energy audit measuring instruments- Power quality analyzer, lux meter, energy meter, pf meter, Tachometer, Anemometer. Questionnaire for energy audit. Energy flow diagram (Sankey diagram).	8	26
	Total	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**60**	**10**			

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Guide Books no. 1,3,4 for National Certification Examination for Energy Managers and Energy Auditors	Bureau of Energy Efficiency (BEE)	Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Govt. of India)
2	India The Energy Sector	Henderson, P. D.	University Press, Delhi, 2016 ISBN: 978-0195606539
3	Energy Conservation and Audit	S. M. Chaudhari, S. A. Asarkar, M. A. Chaudhari	Nirali Prakashan ISBN: 9789388897860
4	Energy Management Handbook	Turner, W. C.	Fairmount Press, 2012 ISBN 9781304520708
5	Energy Management and Conservation	Sharma, K. V., Venkataseshaiah P	I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6	Energy Management	Singh, Sanjeey; Rathire, Unmesh	S K Kataria & sons, New Delhi ISBN-13: 9789350141014.

(b) Open-source software and website:

- www.youtube.com
- www.bee-india.nic.in
- https://nptel.ac.in
- www.mnes.nic.in
- https://swayam.gov.in
- https://shodhganga.inflibnet.ac.in
- www.worldenergy.org

Suggested Course Practical List:

S. No.	Practical
1.	Identify star labeled electrical apparatus and compare the data for various star ratings.
2.	Study different types of energy audit instruments.
3.	Measurement of electrical parameters (Voltage, Current, Power, Power Factor, Energy) using audit instruments.
4.	Study of Star Labeling System (BEE).
5.	Measure transformer efficiency and demonstration of energy conservation methods.
6.	Study of energy conservation techniques in induction motors.
7.	Demonstration of Soft Starter and Automatic Star–Delta Starter.
8.	Demonstration of Variable Frequency Drive (VFD) for energy saving in motor applications.
9.	Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.
10.	Use APFC unit for improvement of p. f. of electrical load.
11.	Collect electricity bill of a residential, commercial and industrial consumer and suggest suitable tariff for energy conservation and its impact on energy bill.
12.	Estimate energy saving by improving power factor and load factor for given cases.
13.	Prepare Energy Audit report of a Small Laboratory or Workshop.
14.	Prepare a sample energy audit questionnaire for the given industrial facility.
15.	Prepare an energy audit report (phase-1,2,3)

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications
1	Induction motor (3phase /1 phase)
2	Ammeter: AC/ DC 0-5-10Amp

S. No.	Equipment Name with Broad Specifications
3	Voltmeter: AC/DC, 0-150/300V, 0-250/500V
4	Wattmeter: Three phases double element 5/10Amp. 250/500V
5	Wattmeter: Single phase, single element 2.5/5Amp, 200/400V,
6	power factor wattmeter: Single phase, 5/10Amp, 250/500V
7	Three phase Power factor meters: AC, 415V, 50 Hz, 5-10 Amp
8	Load bank: Resistive. 3-phase, 5kW, 415V
9	Automatic power factor controller (APFC) Star- delta convertor
10	Star delta converter
11	Lux meter
12	Clip-on meter (amp, volts) digital/analog
13	CFL, LED of different ratings
14	Anemometer
15	Electronic regulators

Suggested Project List:

- Collect and analyze data on electrical consumption in the lab.
- Demonstrate energy saving by replacing conventional lamps.
- Smart lighting control system using pir sensor
- Design of an automatic power factor correction (APFC) panel for a small load
- IoT-based smart energy monitoring system
- Case study: industrial energy management practice

Suggested Activities for Students:

- Prepare a chart showing daily energy use in the college or home. Identify waste areas.
- Collect and display star-rated appliances and explain labeling importance.
- Create posters on “Save Energy – Save Future” or “Energy Conservation Techniques.”
- Develop a standard checklist for preliminary energy audits.

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