



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program

Level: UG

Branch: Minor/Hons. Energy Engineering

Subject Code: BE050AP011

Subject Name: Energy Conservation and Management

w. e. f. Academic Year:	2026-27
Semester:	5
Category of the Course:	Core Courses

Prerequisite:	Nil
Rationale:	This course focuses on simple and practical methods of saving energy and managing energy use in buildings and industries. It is designed in an easy-to-understand manner so that students from all engineering branches can learn the basics of energy conservation. The course emphasizes Indian conditions, GTU examination patterns, and commonly available technologies, standards, and data sources.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Understand the basic concepts of energy conservation, energy efficiency, and the need for energy management in India.	22
CO-2	Understand electrical energy consumption and basic conservation techniques related to lighting, motors, and power factor.	18
CO-3	Understand thermal and mechanical energy conservation methods used in boilers, HVAC and industrial systems.	15
CO-4	Explain energy audit concepts, types of audits, and simple energy audit procedures for buildings and industries	25
CO-5	Explain energy management practices, basic economic evaluation, and simple real-life case studies.	20

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
60	0	30	60	150	05	70	00	00	30	50	150

***Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBAManual.**

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination



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Content:

Sr. No.	Content	Total Hrs
1	Basics of Energy Conservation: Global & National Trends: Energy consumption patterns, fossil fuel depletion, and the rise of renewables. Meaning of energy conservation and energy efficiency, Importance of energy conservation, Major energy consuming sectors, Energy conservation potential, Role of engineers in saving energy, Legal Framework: The Energy Conservation Act (2001) and its features; role of Bureau of Energy Efficiency (BEE). Environmental Impact: Greenhouse effect, global warming, and carbon foot printing. India's National Energy Efficiency Mission, detailed case studies on renewable integration, and extended discussion on carbon trading and ESG frameworks.	14
2	Electrical Energy Conservation: Electrical energy consumption in buildings and industries, Load curve and demand management (basic idea), Power factor and power factor improvement, Energy efficient lighting systems (LEDs), Energy efficient motors and overview of IEC 60034-30-1, Basics of variable frequency drives (VFDs), Transformers loading, losses, and location optimization, Energy conservation in computers and office equipment, power factor correction, comparative analysis of lighting technologies, and case studies on industrial motor retrofits.	12
3	Thermal and Mechanical Energy Conservation Energy conservation in boilers, Steam distribution and condensate recovery, Furnaces and waste heat recovery (basic idea), Energy efficiency in HVAC systems, Insulation and reduction of heat losses, insulation material selection, Compressed air systems, Introduction to cogeneration, practical examples of waste heat recovery systems, cogeneration plants in India, and	09
4	Energy Audit, Economics and Project Management Meaning and need of energy audit, Types of energy audit: preliminary and detailed, Steps involved in energy audit, Data collection and basic measurements, Identification of energy saving opportunities, Reporting: Structuring a professional energy audit report., Developing Sankey diagrams to visualize energy flows, Financial Analysis: Simple Payback Period (SPP), Return on Investment (ROI), and Internal Rate of Return (IRR), Time Value of Money: Net Present Value (NPV) and Life Cycle Costing (LCC), Energy Performance Contracting (EPC): The role of Energy Service Companies (ESCOs), Introduction to ISO 50001, sample audit data, Sankey diagram – (introduction and significance only).	15
5	Energy Management and Case Studies Need of energy management, Role of energy manager, Energy conservation case studies in buildings, Energy conservation case studies in industries, Introduction to smart and digital energy management, smart grid and IoT-based energy management applications.	10
TOTAL		60



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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
35	30	35	0	0	0

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Capehart, B.L., Turner, W.C., Guide to Energy Management, Fairmont Press
2. Thumann, A., Handbook of Energy Audits, CRC Press
3. Rao, S. & Parulekar, B.B., Energy Technology, Khanna Publishers
4. Wadhwa, C.L., Generation, Distribution and Utilization of Electrical Energy, New Age International
5. Bureau of Energy Efficiency (BEE): *Study Material for Energy Managers and Auditors Examination (Books 1-4)*.
6. S.C. Tripathy: *Utilization of Electrical Energy and Conservation*.
7. W.C. Turner: *Steve Doty, Energy Management Handbook*.

(b) Open-source software and website:

1. Bureau of Energy Efficiency (BEE), Government of India.
2. Ministry of Power, Government of India.
3. MNRE, Government of India.
4. NPTEL Video Lectures.

Suggested PBL / Self-Learning Activities:

1. To understand the concept of energy conservation.
2. Study of major energy consuming sectors and energy conservation potential.
3. Study of load curve and demand management.
4. Analysis of electrical energy bills and demand charges.
5. Study of energy efficient lighting (LED v/s CFL v/s Tube light)
6. Case study on thermal energy conservation in boilers.
7. Study of energy losses in HVAC system.
8. Study of energy conservation opportunities for a classroom/ laboratory room.
9. Study about basic measuring instruments required for energy audit.
10. Study of energy audit concepts and types.
11. Study of need for energy management.



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List of Laboratory/Learning Resources Required:

Suggested Project List: Kotak -IIT Madras Save Energy Mission (KISEM). <https://kisem.org/case-studies>

Suggested Activities for Students: If any

List of suggested activities for Problem Based Learning:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs. Total= 10hrs.	Based on report submitted. Report Should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation=5hrs. Total= 10hrs.	Report /presentation based on the video Learning outcomes.
3.	Assignment writing g. Numerical based assignment is Preferable.	5 assignments of 4hrs. each. Total = 20hrs.	Based on the Correctness of submitted assignment.
4.	Problem solving/Coding using C,C++,MATLAB, Python, SCILAB, modelling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
5.	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based Assessment at the end of course. Based on the certificate produced.
6.	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10hrs.	Based on the depth of the solution submitted.
7.	Videos on Industrial safety/Disaster Management Aspects based on subject	Duration of video = 5hrs. Report preparation= 5hrs. Total= 10hrs.	Based on quiz/report submitted
8.	Technical paper reading and summarization of research papers based on relevant subject	5 research papers =20 hrs.	Summarize research paper and evaluation critical parameters



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9.	Poster/chart/power point preparation on technical topics	Duration=6 hrs.	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 hrs. Non-working=8hrs.	Based on inter department/external Evaluation.
11	Industrial exposure for 2-3days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration=15hrs. for industrial exposure Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr. per subject. Max. 3 hrs. per subject	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation=5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration=10 hrs.	Depending on the complexity of the Application/Software.
15.	Research paper publication	Duration=10 hrs.	Based on submission Of proof of publication.
16.	Up gradation/Reverse Engineering studies of existing equipment of the laboratory	Duration10 hrs.	Based on the Performance of the equipment
17.	Expert lecture/session	Duration3 hrs. For attending the lecture/session– 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted
18.	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of Explanation, clarity, and presentation style.
19.	Patent Search and Innovation Gap Identification	10h(Search + Report)	Based on number of relevant patents Analysed and Identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- The number of hours are suggestive. Faculty can sub-divide the number of hours based on the



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activity. However, total number of hours is fixed.

- Rubrics for the evaluation can be prepared by the faculty.
- Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.
