# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Minor/Hons. Program**
**Level: UG**
**Branch: Minor/Hons. Energy Engineering**
**Course/Subject Code: BE040AP011**
**Subject Name: Fundamentals of Energy Engineering**

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

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| **Prerequisite:** | Nil |
| **Rationale:** | This course is designed to equip students with the tools necessary for economic analysis and quantification of impacts of energy systems. Tools and techniques for project economics for an individual/ company perspective and macro-decision making for society, basic concepts of welfare economics and environmental economics that are necessary for energy systems analysis and their environmental impacts are covered. |

**Course Outcomes:**

| Sr. No. | CO statement | Marks% weightage |
|---|---|---|
| CO-1 | Explain global and Indian energy scenarios, sector-wise energy consumption, energy challenges, and estimation of energy use in buildings. | 20 |
| CO-2 | Apply energy economics principles, time value of money, and life cycle costing to evaluate energy generation and conservation projects. | 35 |
| CO-3 | Identify and analyze environmental impacts of energy systems, including air, water, and solid pollution, control methods, regulations, and climate issues. | 15 |
| CO-4 | Describe and differentiate energy systems across mechanical, electrical, and digital engineering domains, including energy conversion devices and integrated systems. | 15 |
| CO-5 | Assess energy efficiency, optimization opportunities, and energy management practices using basic energy audit concepts. | 15 |

**Teaching and Examination Scheme:**

| Teaching / Learning Scheme (in Hours per semester) | | | | | Total Credits = TH/30 | Assessment Pattern and Marks | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Theory | | Tutorial / Practical | | | |
| L | T | P | PBL* | TH | | ESE (E) | PA (M) | PA (I) | PBL (I) | ESE (V) | |
| 45 | 0 | 30 | 75 | 150 | 5 | 70 | 00 | 00 | 30 | 50 | 150 |

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

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

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| **1** | Introduction to Energy Engineering, Indian and Global Energy Scenario, Country Energy Balance, Energy Use Trends and Development, Classification and Sectorial Energy Consumption, Energy Challenges, Estimation of Energy Use in Buildings | **10** |
| **2** | Introduction to Energy Economics, Time Value of Money (TVM), Economic Evaluation Methods, Life Cycle Costing (LCC), Energy Cost Analysis, Primary Energy Analysis and Energy Chain, Life Cycle Assessment (LCA) and Net Energy Analysis, Case Studies and Applications | **20** |
| **3** | Air Pollution Fundamentals, Pollution Measurement and Control, Solid and Water Pollution, Environmental Management and Climate Issues, Future Energy Systems | **5** |
| **4** | Energy Resources, Mechanical Engineering Energy Systems, Electrical Engineering Energy Systems, Computer Engineering & Digital Energy Systems, Integrated Engineering Energy Systems, Energy Conversion Devices, Energy Efficiency & Optimization mechanical and electrical systems, Energy Audit & Management | **10** |
| | **TOTAL** | **45** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **40** | **30** | **30** | **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. **Rai,G.D.***Non-Conventional Energy Sources* Khanna Publishers, New Delhi
2. **Thumann, A., & Younger, W.** *Handbook of Energy Audits* CRC Press
3. **Capehart, B.L., Turner, W.C., & Kennedy, W.J.** *Guide to Energy Management* the Fairmont Press
4. **Peavy, H.S. & Row, R.G.** *Environmental Engineering* McGraw Hill
5. **Khan, B.H.** *Non-Conventional Energy Resources* McGraw Hill Education
6. **Wadhwa, C.L.** *Generation, Distribution and Utilization of Electrical Energy* New Age International
7. **Boyle, Godfrey (Ed.)** *Renewable Energy: Power for a Sustainable Future* Oxford University Press

**(b) Open-source software and website:**

1. Bureau of Energy Efficiency (BEE), Government of India
2. International Energy Agency (IEA)
3. Ministry of Power & Ministry of New and Renewable Energy (MNRE), Government of India
4. NPTEL Online Courses (IITs & IISc)
5. ISO 50001 – Energy Management Systems
6. IPCC Reports

**Suggested Course Practical List: If any**

1. To understand the concept of India's energy scenario.
2. To study various forms of energy and sectorial energy consumption.
3. To study the role of energy in growing economy.
4. To study simple payback period and time value of money.
5. To study energy generation cost and life cycle costing.
6. To learn different methods for life cycle assessment.
7. To study initial and annual costs and life cycle saving.
8. To determine the effect of operating and design parameters on emission.
9. To understand the procedure of environmental audits.
10. To study various future energy systems.

**List of Laboratory/Learning Resources Required:**

**Suggested Project List:**

**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. Numericals based assignment is preferable. | 5 assignments of 4hrs. each. Total = 20hrs. | Based on the correctness of submitted assignment. |

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| 4. | Problem solving/Coding using C, C++, MATLAB, Python, SCILAB,modeling 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 |
| 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 = 8 hrs. | Based on inter department/external Evaluation. |
| 11 | Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue | Duration = 15 hrs. 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. |

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| 16. | Upgradation/Reverse engineering studies of existing equipment of the laboratory | Duration 10 hrs. | Based on the Performance of the equipment. |
| 17. | Expert lecture/session | Duration 3 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 Analyzed 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 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.

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