# GUJARAT TECHNOLOGICAL UNIVERSITY

**Minor Degree – Energy**
**Subject Code: N115AP01**
**Semester – 5 (w.e.f. AY 2025-26)**
**Subject Name: Energy Conservation and Management**

**Prerequisite:** Nil

**Rationale:** The course is prepared to provide detailed understanding of energy conservation and management, 3Es (Energy, Economics and Environment) and their interaction, energy audit and financial management.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 2 | 0 | 5 | 70 | 0 | 30 | 0 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | **Energy Scenario:**<br>Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.<br>**Energy Conservation Act 2001 and related policies:**<br>Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction. | 06 |
| 2 | **Energy Monitoring and Targeting:**<br>Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS) | 05 |
| 3 | **Energy Management & Audit:**<br>Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering, awareness about ISO 50001: Energy Management standard | 06 |
| 4 | **Energy Efficiency in Thermal Utilities and systems:**<br>**Boilers:** Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency | 24 |

| | | |
|---|---|---|
| | calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation.<br>**Steam System:** Assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment of steam system, thermo-compressor, steam pipe insulation, condensate pumping, steam dryers.<br>**Furnaces:** Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery. Forging furnace heat balance, Cupola, non-ferrous melting, Induction furnace, performance evaluation of a furnace.<br>**Insulation and Refractories:** Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss. Cold insulation.<br>**Heat Exchangers:** Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc.<br>**Waste Heat Recovery:** Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.<br>**Cogeneration:** Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine.<br>**Heating, Ventilation, Air conditioning and Refrigeration (HVAC&R) System:** Factors affecting Refrigeration and Air conditioning system performance and savings Opportunities, Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system and saving potential, heat pumps and their applications, performance assessment of window and split room air conditioners and star labels. | |
| 5 | **Energy and environment, air pollution, climate change:**<br>United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF). | 04 |

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

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **14** | **14** | **28** | **14** | **0** | **0** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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.

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**Reference Books:**


1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, CRC Press
2. Handbook of Energy Audits, Albert Thumann, The Fairmont Press.
3. Bureau of Energy Efficiency Reference book: No.1, 2, 3, 4.
4. Energy Management Handbook, W.C. Turner, John Wiley and Sons
5. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by E. J. Wilson and D Gerard, Blackwell Publishing.
6. Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication
7. ISO5001: Energy Management standard


**Course Outcomes:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | To summarized the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation. | 14 |
| CO-2 | To infer the concept of energy monitoring and targeting. | 12 |
| CO-3 | To apply the knowledge of energy audit for the energy management and operation of energy audit instruments. | 14 |
| CO-4 | To analyze the energy saving area and improvement in efficiency of various thermal utilities and systems. | 50 |
| CO-5 | To apprise various climate change protocols, environmental agencies and schemes | 10 |

**Open-source Software/learning website:**

1. https://nptel.ac.in/courses/112/105/112105221
2. https://beeindia.gov.in
3. www.powermin.nic.in
4. www.teriin.org
5. https://geda.gujarat.gov.in