# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering (Part Time)**
**Subject Code: 2950902**
**Semester – 5**
**Subject Name: Energy Conservation**

**Type of course:** Professional Elective Course

**Prerequisite:** Fundamentals of power systems, electrical machines and power electronics.

**Rationale:** The course provides basic understanding of energy audit and management. The consumption of energy is increasing day by day. One way to cope up with the increase in energy demand is to increase the production of energy which demands more investment and the other way is to conserve the energy because energy conserved/saved is energy generated. Energy conservation means reduction in energy consumption but not compromising with the quality or quantity of energy production. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved by this course.

**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 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1. | **Energy Audit Methodology and recent trends.** General Philosophy, need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy, Economics of implementation of energy optimization projects, it's constraints, barriers and limitations, Report-writing, preparations and presentations of energy audit reports, Post monitoring of energy conservation projects, MIS, Case-studies / Report studies of Energy Audits, Guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit recommendations, Case studies of implemented energy cost optimization projects in electrical utilities as well as thermal utilities. Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy. | **10** |
| 2. | **Electrical Distribution and Utilization:** Electrical Systems, Transformers loss reductions, parallel operations, T & D losses, P.F. improvements, Demand Side management (DSM), Load Management, Harmonics & its improvements, Energy efficient | **11** |

| | | |
|---|---|---|
| | motors and Soft starters, Automatic power factor Controllers, Variable speed drivers, Electronic Lighting ballasts for Lighting, LED Lighting, Trends and Approaches. Case Studies related to Power factor improvement, Electric motors, Drives, Industrial/Commercial Lighting system, etc. with respect to energy conservation | |
| 3. \ | **Thermal Systems:**<br>Boilers- performance evaluation, Loss analysis, Water treatment and its impact on boiler losses, integration of different systems in boiler operation. Advances in boiler technologies, FBC and PFBC boilers, Heat recovery Boilers- it's limitations and constraints.<br>Furnaces- Types and classifications, applications, economics and quality aspects, heat distributions, draft controls, waste heat recovering options, Furnaces refractory- types and sections. Thermic Fluid heaters, need and applications, Heat recovery and its limitations. Insulators- Hot and Cold applications, Economic thickness of insulation, Heat saving and application criteria. Steam Utilization Properties, steam distribution and losses, steam trapping, Condensate, Flash steam recovery. | **11** |
| 4. | **System Audit of Mechanical Utilities:**<br>Pumps: types and application, unit's assessment, improvement option, parallel and series operating pump performance. Energy Saving in Pumps & Pumping Systems.<br>Blowers: types & application, its performance assessment, series & parallel operation applications & advantages. Energy Saving in Blowers<br>Compressors: types & applications, specific power consumption, compressed air system & economics of system changes. Energy Saving in Compressors & Compressed Air Systems<br>Cooling towers: types and performance assessment & limitations, water loss in cooling tower. Energy Saving in Cooling Towers .<br>Case Studies of Energy Audit & Management in Industries | **10** |

**Suggested Specification table with Marks (Theory): (For BE only)**

| **Distribution of Theory Marks (%)** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 15 | 30 | 30 | 15 | 10 | - |

**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.

**Reference Books:**

1. Energy Audit and Management, Volume-I, IECC Press

2. Energy Efficiency in Electrical Systems, Volume-II, IECC Press
3. Energy Management: W.R.Murphy, G.Mckay, Butterworths Scientific
4. Energy Management Principles, C.B.Smith, Pergamon Press
5. Industrial Energy Conservation, D.A. Reay, Pergammon Press
6. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience
7. Industrial Energy Management and Utilization, L.C. Witte, P.S. Schmidt, D.R. Brown, Hemisphere Publication, Washington, 1988
8. Hand Book of Energy Audits, Albert Thumann, P.E., C.E.M. William J. Younger, C.E.M., CRC Press

**Course Outcomes:**

At the end of this course, students will have the ability to

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Demonstrate the basic knowledge of energy audit and management. | **20** |
| CO-2 | Identify the energy conservation opportunities | **15** |
| CO-3 | Assess the energy saving & conservation in different electric system | **25** |
| CO-4 | Analyze the heat utilization, saving and recovery in different thermal system | **25** |
| CO-5 | Prepare energy audit report. | **15** |

**List of Experiments:** Not Applicable

**Major Equipment:** Not Applicable

**List of Open Source Software/learning website:**

https://beeindia.gov.in/
http://nptel.ac.in/
https://lbre.stanford.edu/sem/energy_conservation