FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2020-21

Programme: **Bachelor of Engineering (Electrical Engineering)**

Semester: **VII**

Course Code: **202050706**

Course Title: **Energy Conservation and Audit**

Course Group: **Professional Elective Course-III**

Course Objectives: 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 as energy conserved/saved is twice the 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, and different approaches of energy conservation in industries, economic aspects of energy conservation projects and energy audit and measuring instruments in the commercial and industrial sector will be achieved through this course.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 09	25 / 09	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

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Sr. No.	Contents	Hours
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.	**11**
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 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	**11**
3	**Thermal Systems:** 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 - its limitations and constraints. Furnaces- Types and classifications, applications, economics and quality aspects, heat distributions, draft controls, waste heat recovering options	**9**
4	**System Audit of Mechanical Utilities:** Pumps: types and application, unit's assessment, improvement option, parallel and series operating pump performance. Energy Saving in Pumps & Pumping Systems. Blowers: types & application, its performance assessment, series & parallel operation applications & advantages. Energy Saving in Blowers, Compressors: types & applications, specific power consumption, compressed air system & economics of system changes. Energy Saving in Compressors & Compressed Air Systems. Cooling towers: types and performance assessment & limitations, water loss in cooling tower. Energy Saving in Cooling Towers. Case Studies of Energy Audit & Management in Industries	**11**

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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

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
10	**40**	**30**	**10**	**10**	**-**	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Identify and assess the energy conservation/saving opportunities in different electric system	**20**
CO-2	Demonstrate skills required for energy audit and management.	**20**
CO-3	Prepare energy flow diagrams and energy audit report	**20**
CO-4	Suggest cost-effective measures towards improving energy efficient and energy conservation.	**20**
CO-5	Identify and assess the energy conservation/saving opportunities in different electric system	**20**

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List of Suggested Practical:

1	To study the various aspects of Energy conservation.
2	Computing Efficiency of DC Series Motor
3	Computing Efficiency of Transformer.
4	Computing Efficiency of Induction Motor.
5	To study energy performance assessment of lightning system like LED lighting device and to do a case study of illumination systems.
6	To study of various measuring instruments for carrying out Energy Audit.
7	Evaluating the Energy Conservation opportunity through SPB and find out the Simple payback period for a given case study/example.
8	To prepare a Home Energy Audit using standard sheet and give the answers of Energy Audit Questionnaire.
9	To Identify the Energy Conservation opportunities in a commercial Building [Lab, or classrooms, department, or institute] and prepare a technical report on it.
10	To study the various energy management systems prevailing in Sugar Industry and Identify the various EC methods useful in Sugar Industry.
11	To study the Thermal and system Audit of Mechanical Utilities.
12	Industry visit and study of Energy Policy statement.

Supplementary learning Material:	
1	https://beeindia.gov.in
2	https://www.electrical4u.com/
3	www.nptel.ac.in
4	https://interestingengineering.com/electrical-engineering-salaries-worldwide

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	Jun-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

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