CVM UNIVERSITY
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FACULTY OF ENGINEERING & TECHNOLOGY

Second Year Master of Engineering

Semester III

Course Code: 102350312

Course Title: Energy Management and Audit

Type of Course: Open Elective - I

Course Objectives: 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 in commercial and industrial sector will be achieved by this course.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	2	0	4	40/16	20/08	60/24	30/12	150/60

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

Detailed Syllabus:

Sr.	Contents	Hours
1	Energy Audit Methodology and recent trends: General understanding, 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, Energy Audit Definition as per EC act-2001, Objective, Need and Types of energy audit, Benchmarking. Roll of BEE, Energy Auditors and managers. Management : Top management commitment & support, Energy policy & planning, Evaluating Energy Performance, Management Tools for Effective Implementation-5S, KAIZEN, TPM, TQM, ISO 50001, Financial analysis: techniques, Role of ESCOs, Application of Industry 4.0, Waste management. Project management and financial analysis technique with Examples: critical path method, pert analysis. Energy Monitoring & Targeting: Definition, Key elements, CUSUM analysis.	10

2	Financial Analysis: Simple Payback, IRR, NPV, Discounted Cash flow; 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. Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy. Case studies of implemented energy cost optimization projects in electrical utilities as well as thermal utilities.	**06**
3	Energy Conservation in Electrical System: T & D Losses, Losses in transformers and their reductions and efficiency improvement, Loading efficiency calculations, parallel operations, Demand Side management (DSM), Load Management, Energy efficient motors, Energy saving during starting, Soft starters, Automatic power factor Controllers, Variable speed drivers, Energy Conservation in lighting system. LED Lighting and it's trends and approaches. Different Case Study of Electrical Energy audit and management of commercial and industrial sites/projects.	**08**
4	Energy Efficiency Performance Analysis of Thermal Utility: Study of Steam System, Types of boiler with Energy efficiency performance analysis, Types of furnace with Energy efficiency performance analysis, Types of insulation and refractory with Energy efficiency performance analysis, Types of heat exchanger with Energy efficiency performance analysis, Types of turbines with Energy efficiency performance analysis.	**08**
5	Audit of Mechanical Utilities: Pumps, types and application, parallel and series operating pump performance. Energy Saving in Pumps & Pumping Systems. Blower types & application, its performance assessment, series & parallel operation applications & advantages. Energy Saving in Blowers & applications, Energy Saving in Compressors & Compressed Air Systems, Cooling towers, its types and performance assessment & limitations, water loss in cooling tower. Energy Saving in Cooling Towers. Case study of Energy Audit & Management in Industries (Boilers, Steam System, Furnaces, Insulation and Refractory, Refrigeration and Air conditioning, Cogeneration, Waste Heat recovery etc.)	**08**

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

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
10	20	20	25	15	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.

Reference Books:

1	Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience
2	Energy efficiency in electrical utilities, Guide book EA-EM, BEE, India.
3	Energy efficiency in thermal utilities, Guide book EA-EM, BEE, India.
4	Energy performance assessment for equipment and utility systems, Guide book EA-EM, BEE,
5	Amlan Chakrabarti, Energy Engineering and management, PHI Publication.
6	Engineering Economics & Costing by Susmita Mishra, PHI Publication.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Identify the energy management skills and strategies in the energy management system	**20**
CO-2	Identify the critical areas where energy conservation is required and provides various techniques.	**25**
CO-3	Find out the payback period, depreciation cost for a given energy conservation equipment & projects.	**20**
CO-4	Prepare a sample energy audit report (walk through and detailed).	**20**
CO-5	Development of Energy Conservation skills in Thermal and Mechanical Unit	**15**

List of Practicals / Tutorials:

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1	Tutorial on Study & Analysis of Present Energy Crisis and action carried out by Government.
2	Tutorial on Study and analysis of Energy Conservation act and different ISO for Energy Conservation and Audit.
3	Tutorial on Financial Terms for Energy Conservation Projects.
4	Tutorial on implemented energy cost optimization projects in electrical utilities and thermal utilities.
5	Tutorial on T & D loss calculation
6	Tutorial on Transformer efficiency improvement by loss minimization.
7	Tutorial on Energy Efficient Motor performance calculations.
8	Tutorial on Thermal Efficiency calculation & improvement for Thermal Utilities.
9	Tutorial on Energy Saving in Blowers, Compressors & Compressed Air Systems.
10	Case study of Energy Audit & Management in various Industries and their comparative study.

Supplementary learning Material:	
1	E-materials available at the website of NPTEL- http://nptel.ac.in/
2	www.beeindia.org.
3	www.ea-cm.org

Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-21
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22