

COURSE TITLE	ENERGY AUDIT
COURSE CODE	01EE0720
COURSE CREDITS	3

Objective:

- 1 To impart foundational knowledge and comprehension of energy auditing principles and practices within industry

Course Outcomes: After completion of this course, student will be able to:

- 1 Identify energy conservation opportunities in different industries.
- 2 Apply methods to conserve thermal energy in industry.
- 3 Evaluate the effect of various solutions on reduction in energy with respect to suggested improvement.
- 4 Estimate key parameters and prepare flow diagram and audit report.

Pre-requisite of course:None

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	ENERGY AUDIT METHODOLOGY AND RECENT TRENDS General Philosophy, need of Energy Audit and Management, EC Act, 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, Financial Analysis: Simple Payback, IRR, NPV, Discounted Cashflow; 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	11

Contents : Unit	Topics	Contact Hours
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, Study of 4 to 6 cases of Electrical Energy audit and management, Power factor improvement, Electric motors, Fans and blowers, Cooling Towers, Industrial/Commercial Lighting system, etc	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- it's limitations and constraints, 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	10
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, Bloomers (Blowers) types & application, its performance assessment, series & parallel operation applications & advantages, Energy Saving in Blowers Compressors, types & applications, specific power consumption, compressed air system & economic of system changes, 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, Study of 4 to 6 cases of Energy Audit & Management in Industries, Boilers, Steam System, Furnaces, Insulation and Refractory, Refrigeration and Air conditioning, Cogeneration, Waste Heat recovery etc, Study of Energy Audit reports for various Industries and Organizations	10
Total Hours		42

Textbook :

- 1 Energy Audit and Management, Bureau of Energy Efficiency, IECC Press, 2019
- 2 Energy Efficiency in Electrical Systems, Bureau of Energy Efficiency, IECC Press, 2019
- 3 Energy Management, W.R.Murphy, G.Mckay, Butterworths Scientific, 2003
- 4 Energy Management Principles - 2nd edition, C.B.Smith, Pergamon Press , 2013

Textbook :

- 5 Industrial Energy Conservation, D.A. Reay, Pergamon Press, 1979

References:

- 1 Energy Management Handbook, Energy Management Handbook, W.C. Turner, John Wiley and Sons, 2018
- 2 Industrial Energy Management and Utilization, Industrial Energy Management and Utilization, L.C. Witte, P.S. Schmidt, D.R. Brown, CRC Press, 1987
- 3 Hand Book of Energy Audits, Hand Book of Energy Audits, Albert Thumann, P.E., C.E.M. William J. Younger, C.E.M, River Publishers, 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs, etc
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the classroom
- 3 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, and Virtual Laboratory

Supplementary Resources:

- 1 <https://beeindia.gov.in/>
- 2 <http://nptel.ac.in/>
- 3 https://lbre.stanford.edu/sem/energy_conservation
- 4 <https://ocw.mit.edu/collections/energy/>