

Branch Name:	Mechanical Engineering
Program Code:	ET101
Course Name:	Energy Conservation and Management
Course Code:	2ET1010506T
Pre-requisite Course:	Zeal to learn the subject

Course Objectives:

1. To comprehend fundamental energy concepts: learn about different forms of energy, energy conversion.
2. To assess energy use patterns: analyze energy consumption in various sectors such as residential, commercial, and industrial.
3. To develop energy-saving measures: learn to design and implement strategies for reducing energy consumption in different settings.
4. To assess cost-benefit analysis: perform financial analysis related to energy conservation measures, including return on investment and payback periods.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
03	03	-	-	03	24	60	16	40	-	-	-	-	100

Subject Contents

Sr. No.	Topic	Total Hours	Weightage (%)
1	Introduction: 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. Energy Conservation Act 2001 and Related Policies: 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.	04	13
2	Financial Management and Energy Monitoring & Targeting: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return,	07	20

	cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) Energy Monitoring and Targeting: 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).		
3	Energy Management & Audit: 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.	06	15
4	Energy Efficiency in Thermal Utilities and Systems: Boilers: Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency 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, Thermic fluid heaters, super critical boilers. Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment more details, installation, thermo-compressor, steam pipe insulation, condensate pumping, steam dryers 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, hot air generators. 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. Heat Exchangers: Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc. Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential. Cogeneration: Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine. Heating, Ventilation, Air-conditioning (HVAC) and Refrigeration 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, section on ventilation system, ice bank system, and performance assessment of window and split room air	24	40

	conditioners, Star labeled pumps, cold storage refrigeration, and humidification system.		
5	Energy and Environment, Air Pollution, Climate Change: United Nations Framework Convention on Climate Change (UNFCCC), 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	12

Reference Books:

1. Dale R Patrick, Stephen W Fardo, Energy Conservation Guidebook, 3rd Edition, CRC Press, 2014.
2. Albert Thumann, Handbook of Energy Audits, 6th Edition, The Fairmont Press, 2003.
3. W.C. Turner, John Wiley and Sons, Energy Management Handbook, A Wiley Interscience Publication, 1982.
4. E.J. Wilson and D. Gerard, Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation, Blackwell Publishing, 2007.
5. J. Krieder and A. Rabl, Heating and Cooling of Buildings - Design for Efficiency, McGraw Hill Publication, 1994.
6. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanagertraining.com).
7. Bureau of Energy Efficiency Reference book: No.1, 2, 3, 4

E-Resources:

1. <https://nptel.ac.in/courses/112105221/>
2. <http://nptel.iitm.ac.in/>
3. www.bee.com
4. www.powermin.nic.in
5. <https://geda.gujarat.gov.in/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Appreciate the availability of various energy resources in the nature.	1 Remembering
CLO2	Understand the basic knowledge of different terms & principles of energy conservation, audit and management.	2 Understanding
CLO3	Recognize the need of energy balance in various process cycles.	5 Evaluating
CLO4	Classify the energy losses and their economic implication on plant/processes.	3 Applying
CLO5	To understand efficient heat & electricity utilization, saving and recovery in different thermal and electrical system.	5 Evaluating
CLO6	To prepare energy audit report for different energy conservation instances.	5 Evaluating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	M						M	M					M	
CLO2		M											M	
CLO3						M	H				M			M
CLO4			M	M					M					L
CLO5						M					L		M	
CLO6				M	L				M	M		L		M

H: High, M: Medium, L: Low