SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering Department

B. Tech. Semester VI

Course Name: **Energy Conservation and Management** **Course Code: BTME14612**

Type of course: Professional Elective Courses

Prerequisite: Basics of Environment Studies, Basics of Mechanical Engineering, Thermodynamics

Rationale of course: This course is prepared to provide detailed understanding of 3Es (Energy, Economics and Environment) and their interaction. Students will learn and understand energy conservation, energy management, energy audit, financial management and to enhance efficiency in different thermal utilities and systems.

Teaching and Examination Scheme:

Teaching scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	00	00	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Energy Scenario:** 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 its features, schemes of Bureau of Energy Efficiency (BEE)	5	12 %

Sr. No.	Topics	Teaching Hrs.	Module Weightage
2	**Energy Management & Audit:** General principles of energy management and energy management planning, definition, energy audit, need, types of energy audit. conducting energy audit (pre-audit, audit and post-audit), energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies(Energy efficiency analysis), optimizing the input energy requirements, fuel and energy substitution, energy audit instruments metering, monitoring, evaluating and following up energy saving measures/ projects, case study.	**6**	**12 %**
3	**Financial Management :** Investment-need, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs)	**5**	**12 %**
4	**Energy Conservation:** Energy conservation in pumps, fans (flow control), compressed air systems, refrigeration & air conditioning systems.	**3**	**7 %**
5	**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.	**13**	**28 %**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	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 of steam system, thermo- compressor, steam pipe insulation, condensate pumping and steam dryers.		
6	**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, multiple effect evaporators, condensers, distillation column, etc., energy saving in heat exchanger. **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.	**13**	**28%**

Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**30**	**25**	**15**	**10**	**5**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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:

Sr. No.	Title of book /article	Author(s)	Publisher	Publication Year	Publication Edition
1	Energy Conservation Guidebook	Dale R Patrick, Stephen W Fardo,	Rivers publishers	2020	3rd
2	Handbook of Energy Audits,	Albert Thumann,Terry Niehus,William J.Younger	River Publishers	2012	9th
3	Bureau of Energy Efficiency	BEE	BEE	-	-
4	Energy Management Handbook	W.C. Turner, John Wiley and Sons,	River publication	2020	9th
5	Energy management and conservation	K.V.Sharma & P Venkataseshaiah	Dream tech Press	2020	-

Course Outcomes (COs):

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Summarize the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation	12%
CO-2	Apply the knowledge of energy audit for the energy management and operation of energy audit instruments	13 %
CO-3	Infer the concept of financial management and their terminology.	12 %
CO-4	Review energy conservation in different devices like pumps, fans and refrigeration & air conditioning systems.	7 %
CO-5	Identify the energy saving area and improvement in efficiency of various thermal systems	28 %
CO-6	Analyse the waste heat recovery systems and implementation of insulation, refractories and cogeneration with the systems.	28 %

Mapping of COs with Program Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO-1	3	0	0	0	0	3	2	1	1	1	1	2	3	1	3
CO-2	3	2	0	0	0	1	1	2	1	1	2	2	1	1	2
CO-3	0	1	0	0	0	1	1	1	1	2	2	2	1	1	2
CO-4	3	1	1	1	0	1	1	1	1	1	3	3	1	1	3
CO-5	3	2	1	0	0	1	1	1	2	1	3	2	1	1	3
CO-6	3	2	0	0	0	1	2	1	1	1	3	2	1	1	3
Rationale*	**15**	**8**	**2**	**1**	**0**	**8**	**8**	**7**	**7**	**7**	**14**	**13**	**8**	**6**	**16**

***Rationale - Mapping of COs with POs and COs with PSOs:**

It will help to develop engineering knowledge of energy conservation, energy management, energy audit and financial management. It also enhance the project management and finance skills and apply the life-long knowledge for technological change.

This course highly maps with Program outcomes 1, 2,6,7,11,12 and Program Specific Outcomes 3. It states that the course will develop engineering knowledge, problem analysis, the engineer and society, environment and sustainability, project management and finance, life-long learning and finally it will lead to, apply their technical, managerial and other soft skills in their professional life.

Assignments to be given as per the requirement of the course.

List of Open learning website:

1. https://nptel.ac.in/courses/112105221
2. https://nptel.ac.in/courses/108106022
3. https://onlinecourses.nptel.ac.in/noc20_mm20/preview
4. www.beeindia.gov.in