

B.E Semester: 7 Automobile Engineering
Subject Name: Energy Conservation and Audit (MA703-N-A)
[Dept. Elect.-3]

A. Course Objective:

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, different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved through this course.

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	<p>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.</p> <p>Basics of Energy and its various forms: Electricity basics – DC & AC currents, Electricity tariff, Load management and Maximum demand control, Power factor. Thermal basics –Fuels, Thermal energy contents of fuel, Temperature & Pressure, Heat capacity, Sensible and Latent heat, Evaporation, Condensation, Steam, Moist air and Humidity & Heat transfer, Units and conversion.</p>
2	<p>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.</p>
3	<p>Financial Management and Project Management: Financial Management: Investment-need, appraisal and criteria, 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)</p>

	<p>Project Management: Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification.</p> <p>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)</p>
4	<p>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</p>
5	<p>Energy Efficiency in Thermal Utilities and systems:</p> <p>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.</p> <p>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,</p> <p>Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.</p> <p>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.</p> <p>Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential</p> <p>Cogeneration: Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine</p> <p>Heating, Ventilation, Air-Conditioning (HVAC) and Refrigeration System: Factors affecting Refrigeration and Air conditioning system performance and savings Opportunities.</p> <p>Vapour Absorption Refrigeration System: Working principle, types and comparison with vapour compression system, ice bank system, and performance assessment of window and split room air conditioners, cold storage refrigeration, and humidification system.</p>
6	<p>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).</p>

Total hours (Theory):48
Total hours (Practical):32
Total hours:80

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1 st ,2 nd ,3 rd .	Unit 1	20%	1
2	4 th ,5 th	Unit 2	10%	2
3	6 th ,7 th ,8 th ,9 th	Unit 3	25%	3
4	10 th ,11 th	Unit 4	15%	4
5	12 th 13 th , 14 th	Unit 5	20%	5
6	15 th ,16 th	Unit 6	10%	6

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal Weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
7	The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures. Suggested list of experiment is given below

F. List of Experiments :

1	Computing efficiency of DC motor/Induction Motor/Transformer
2	Calculating the efficiency of boiler / blowers / compressors etc.
3	Draw the energy flow diagram for an industry/shop floor division.
4	Study of various energy efficient equipment like LED lighting devices, Energy Efficient motors, Electronics ballast etc.
5	Soft starting of an induction motor
6	Study of Variable frequency drive based IM speed control for energy conservation.
7	Industry visit with an aim of (i) Studying various energy management systems prevailing in a particular industry/Organization (ii) Identifying the various energy conservation methods useful in a particular industry
8	Studying the various energy conservation methods useful in power generation, transmission and distribution
9	Study of APFC panel or Estimating the requirement of capacitance for power factor improvement.
10	Evaluating the energy conservation opportunity through various methods like simple payback period IRR and NPV.
11	Determine depreciation cost of a given energy conservation project/equipment
12	Study of various measuring instruments used for energy audit : Lux meter, Power analyzer, flue gas analyzer
13	Identifying the energy conservation opportunities in a lab, department or institute.

14	Prepare a sample energy audit questionnaire
15	Prepare a sample energy audit report
16	Prepare a technical report on energy conservation act 2003

F. Students Learning Outcomes:

1	Identify and assess the energy conservation/saving opportunities in different electric system
2	Identify and assess energy conservation opportunities in thermal system
3	Demonstrate skills required for energy audit and management.
4	Prepare energy flow diagrams and energy audit report
5	Suggest cost-effective measures towards improving energy efficient and energy conservation.

G. Text Books & 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
8	Hand Book of Energy Audits, Albert Thumann, P.E., C.E.M. William J. Younger, C.E.M., CRC Press