



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICSENGINEERING

COURSE DESCRIPTOR

Course Title	ENERGY AUDIT AND MANAGEMENT				
Course Code	AEE503				
Programme	B.Tech				
Semester	VI	EEE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Chief Coordinator	Dr. Mule Laxmidevi Ramanaiah, Associate Professor				
Course Faculty	Dr. Mule Laxmidevi Ramanaiah, Associate Professor				

I. COURSE OVERVIEW:

Energy audit and management deals Principles of energy audit and conservation; Energy efficiency in buildings; Energy efficient motors, lighting, instruments and significance of energy economics. Communication and marketing strategies, opportunities for renewable source, very good management strategies for conservation, giving good motivation for employs, maintaining up to date records of audit for effective management, it also deals with internal and external bench marking, it also deals with energy and material balance.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE003	III	Power Generation Systems	4
UG	AHS015	V	Business Economics and Financial Analysis	3

III. MARKSDISTRIBUTION:

Subject	SEE examination	CIA Examination	Total marks
Energy Audit And Management	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✗	Chalk & Talk	✓	Quiz	✓	Assignments	✗	MOOCs
✓	LCD / PPT	✓	Seminars	✗	Mini Project	✗	Videos
✗	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weight age in terms of marks distribution. The question paper pattern is as follows. Two full questions with “either” or “choice” will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Discussion
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Discussion, assignment
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Discussion
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	Discussion, seminar
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	Discussion
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2	Discussion, assignment
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Discussion, assignment
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2	Assignment

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	Problem Solving: Able to utilize the knowledge of energy audit and management in innovative, dynamic and challenging environment, for the research based team work.	2	Discussion
PSO2	Professional Skills: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems.	2	Assignment
PSO3	Modern Tools in Electrical engineering: The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test, maintain power system and applications.	2	Seminar

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Outline the principles and objectives of energy management.
II	Illustrate the techniques, procedures, evaluation and energy audit reporting.
III	Devise energy policy planning and implementation
IV	Analyse energy balance sheet and management information System.

IX. COURSE OUTCOMES (COs)

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Conceptual knowledge of the need and approach of energy audit and management.	CLO 1	Demonstrate knowledge on auditing practices, management measures and economics of energy.
		CLO 2	Analyze auditing practices, management measures and economics of energy.
		CLO 3	Design an appropriate energy management measures in commercial and industrial applications.
CO 2	Capability to integrate various options and assess the business and policy environment regarding energy conservation and energy auditing	CLO 4	Provide feasible solutions for problems associated with energy auditing and management through proper investigation and interpretation of data.
		CLO 5	Use appropriate techniques for energy auditing and management.
		CLO 6	Solve energy auditing and management problems with societal relevance.
CO 3	Advocacy of strategic and policy recommendations on energy conservation and energy auditing	CLO 7	Consider environment and sustainability in energy auditing and management.
		CLO 8	Follow relevant rules and regulations in practicing energy audit and management.
		CLO 9	Communicate effectively on energy audit in written and graphical forms.
CO 4	Knowledge of energy balance and information management	CLO 10	Consider financial issues in energy audit and management.
		CLO 11	Devise energy policy planning and implementation.
		CLO 12	Analyze energy balance sheet and management information System.
CO 5	Discuss the instruments required for energy auditing	CLO 13	Know about Instruments for audit and monitoring energy and energy savings, types and accuracy.
		CLO 14	Knowledge on marketing and communicating training and planning.
		CLO 15	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
AEE503.01	CLO 1	Demonstrate knowledge on auditing practices, management measures and economics of energy.	PO11	2
AEE503.02	CLO 2	Analyze auditing practices, management measures and economics of energy.	PO1,PO11	2
AEE503.03	CLO 3	Design an appropriate energy management measures in commercial and industrial applications.	PO1,PO11	2
AEE503.04	CLO 4	Provide feasible solutions for problems associated with energy auditing and management through proper investigation and interpretation of data.	PO1,PO4	2
AEE503.05	CLO 5	Use appropriate techniques for energy auditing and management.	PO1,PO3	2
AEE503.06	CLO 6	Solve energy auditing and management problems with societal relevance	PO6	2
AEE503.07	CLO 7	Consider environment and sustainability in energy auditing and management.	PO7	2
AEE503.08	CLO 8	Follow relevant rules and regulations in practicing energy audit and management.	PO8	2
AEE503.09	CLO 9	Communicate effectively on energy audit in written and graphical forms.	PO10	2
AEE503.10	CLO 10	Consider financial issues in energy audit and management.	PO11	2
AEE503.11	CLO 11	Devise energy policy planning and implementation.	PO3	1
AEE503.12	CLO 12	Analyze energy balance sheet and management information System.	PO4	2
AEE503.13	CLO 13	Know about Instruments for audit and monitoring energy and energy savings, types and accuracy.	PO11	2
AEE503.14	CLO 14	Knowledge on marketing and communicating training and planning.	PO10	3
AEE503.15	CLO 15	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO3	3

3 = High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)										
	PO1	PO3	PO4	PO6	PO7	PO8	PO10	PO11	PSO1	PSO2	PSO3
CO 1	2							2			
CO 2	2	2	2	2					2	2	
CO 3					2	2	2				
CO 4		1	2					2			
CO 5		3					3	2			2

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CLO 1											2			
CLO 2	2										2			
CLO 3	2										2			
CLO 4	2			2										
CLO 5	2		2									2	2	
CLO 6						2						2		
CLO 7							2							
CLO 8								2						
CLO 9										2				
CLO 10											2			
CLO 11			1											
CLO 12				2										
CLO 13											2			2
CLO 14											3			
CLO 15			3											

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES-DIRECT

CIE Exams	PO1,PO3,PO4,PO6,PO7,PO8,PO10,PO11,PSO1,PSO2,PSO3	SEE Exams	PO1,PO3,PO4,PO6,PO7,PO8,PO10,PO11,PSO1,PSO2,PSO3	Assignments	PO1,PO3,PO4,PO6,PO7,PO8,PO10,PO11,PSO1,PSO2,PSO3	Seminars	PO1,PO3,PO4,PO6,PO7,PO8,PO10,PO11,PSO1,PSO2,PSO3
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES-INDIRECT

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

XV. SYLLABUS :

UNIT-I	GENERAL ASPECTS
General philosophy: Need of energy audit and management, definition and objective of energy management, general principles of energy management, energy management skills, energy management strategy; Energy audit: need, types, methodology and approach, energy management approach, understanding energy costs, bench marking, energy performance, matching energy usage to requirements, maximizing system efficiency, optimizing the input energy requirements, fuel and energy substitution.	
UNIT-II	PROCEDURES AND TECHNIQUES , EVALUATION OF SAVING OPPURTUNITIES AND ENERGY AUDIT REPORTING
Data gathering: Level of responsibilities, energy sources, control of energy and uses of energy, facts, figures and impression about energy / fuel and system operations, past and present operating data, special tests, questionnaire for data gathering; Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of energy inputs and rejections; Evaluations: Heat transfer calculations, evaluation of electric load characteristics, process and energy system simulation, determining the savings in Rs, noneconomic factors, conservation opportunities, estimating cost of implementation; Audit report: The plant energy study report, importance, contents, effective organization, report writing and presentation.	
UNIT-III	ENERGY POLICY PLANNING AND IMPLEMENTATION
Policy planning: Force field analysis, energy policy purpose, perspective, contents and formulation, location of energy manager, top management support, managerial functions, role and responsibilities of energy manager, accountability. Motivating: Motivation of employees, requirements for energy action planning; Implementation: Designing, barriers, strategies, marketing and communicating training and planning.	
UNIT-IV	ENERGY BALANCE AND MIS
Energy balance: First law of efficiency and second law of efficiency, facility as an energy system, methods for preparing process flow, materials and energy balance diagram, identification of losses, improvements; MIS: Energy balance sheet and management information system (MIS) energy modeling and optimization.	
UNIT-V	ENERGY AUDIT INSTRUMENTS
Instruments: Instruments for audit and monitoring energy and energy savings, types and accuracy.	
Text Books:	
<ol style="list-style-type: none"> 1. W R Murphy, G Mckay, "Energy Management", Butterworth's, 2nd Edition, 2009. 2. C B Smith, "Energy Management Principles", Pergamon Press, 2nd Edition, 1981. 3. I G C Dryden, "Efficient Use of Energy", Butterworths, 1st Edition, 1982. 4. AV Desai, "Energy Economics", Wiley Eastern, 1st Edition, 1991. 	
Reference Books:	
<ol style="list-style-type: none"> 1. D A Reay, "Industrial Energy Conservation", Pergammon Press, 1st Edition, 1977. 2. W C Turner, "Energy Management Handbook, John Wiley and Sons, 6th Edition , 2006. 3. L C Witte, P S Schmidt, D R Brown, "Industrial Energy Management and Utilization", Hemisphere Publication, Washington, 1st Edition, 1988. 	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No.	Topics to be covered	CLOs	Reference
1	Understand the need of energy audit and management	CLO1	T3:9.4.1
2	Outline the objectives of energy management	CLO1	T3:9.4.1
3	Describe the principles of energy management	CLO2	T3:9.4.3
4	Identify energy management approach or strategies	CLO2	T4:9.2
5-6	Understand energy costs	CLO2	T4:9.2
7	Explain Bench marking	CLO2	T4:9.2
8	Justify matching energy usage to requirements	CLO3	T4:9.4
9	Evaluate the methods to maximizing system efficiency	CLO3	T4:9.3&9.5
10	Analyze fuel and energy substitution	CLO3	T4: 9.3&9.5
11-12	Explain the different energy sources	CLO3	T4: 9.3&9.5
13	Assess the Control of energy and uses of energy	CLO4	T4:9.1
14	Describe energy / fuel system operations	CLO5	T4:9.8
15	Elaborate the Questionnaire for data gathering	CLO5	T4:9.9.1
16-17	Explain Incremental cost concept	CLO5	T4:9.8
18-19	Detail mass and energy balance	CLO5	T4:9.10
20	Evaluate electric load characteristics	CLO5	T4:9.11.2
21-22	Determine the savings in Rs	CLO5	T2:9.12
23	Determine the savings in Rs	CLO6	T4:9.4.12
24-25	Summarize the audit report	CLO7	T4:10.3
26	Explain location of energy manager	CLO7	T2:10.4
27	Describe top management support	CLO7	T4:10.4
28	Define the roles and responsibilities of energy manager	CLO8	T4:10.4
29	Explain motivation of employees	CLO8	T4:10.5
30	Summarize Energy action planning and implementation	CLO8	T4:10.6
31	Analyze marketing and communicating training	CLO8	T4:10.7
32	Recollect First law of efficiency and second law of efficiency	CLO8	T3.10.5
33-34	Describe Facility as an energy system	CLO9	T4:10.13
35-36	Detail the methods for preparing process flow	CLO9	T4:10.13
37-38	Identify losses and improvements	CLO9	T4:10.16

39	Explain Energy balance sheet	CLO9	T4:10.17
40-41	Inspect Management information system (MIS)	CLO10	T4:13.1
42-44	Examine Energy modeling and optimization	CLO5	T4:13.2
45-46	Illustrate Instruments for audit	CLO13	T4:13.2
47-48	Simplify monitoring of energy	CLO13	T4:13.2
49	Explain Energy savings	CLO13	T4:13.3
50-51	Illustrate the methods for measuring instruments types and accuracy	CLO13	T4:13.6

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	Write and present energy audit report	Seminars/NPTEL	PO10,PO11	PSO2

Prepared by:

Dr. Mule Laxmidevi Ramanaiah, Associate Professor

HOD, EEE