

COURSE NAME : ELECTRICAL ENGINEERING GROUP
COURSE CODE : EE/EP
SEMESTER/YEAR : FIFTH
SUBJECT TITLE : ENERGY CONSERVATION AND AUDIT
SUBJECT CODE :

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

- External

@ - Internal

* On Line Examination

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rationale:

Technological development in all sectors has caused imbalance in energy generation and it's consumption. Energy conservation is a scientific tool provided to minimize the energy imbalance. This is one of the rapid emerging field in the area of electrical engineering hence this has been included as core technology subject.

The contents on energy conservation techniques in lighting systems, motors, transformers and transmission – distribution lines will be useful to reduce energy losses and wastage in residential, commercial and industrial sectors.

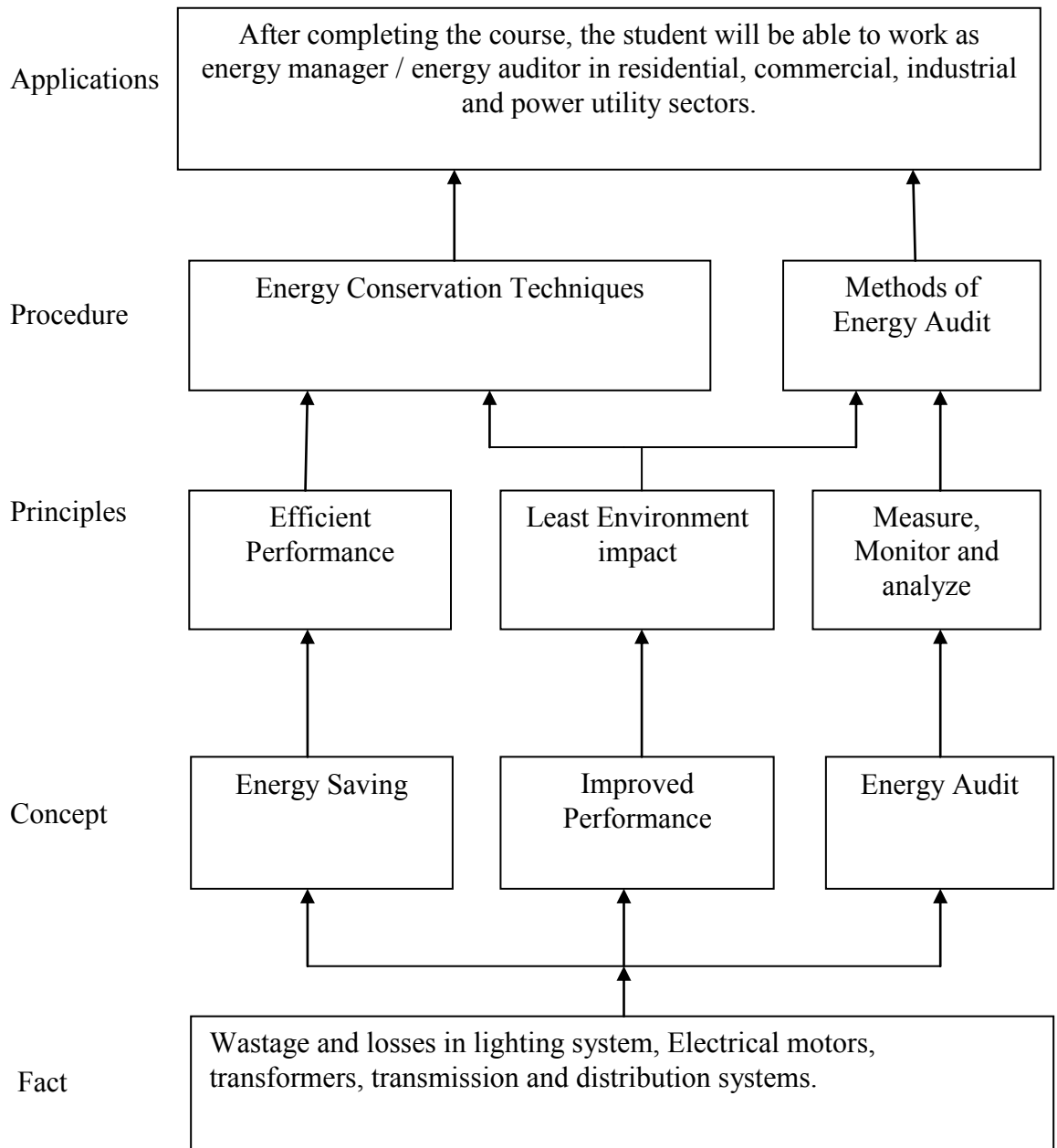
The topic on energy audit will be an useful tool to participate in energy conservation program of the nation.

General Objectives:

The students will be able to :

1. Identify the energy losses and wastage.
2. Suggest the energy conservation techniques in various sectors.
3. Find the opportunity for saving in energy consumption through tariff structure.
4. Prepare energy audit report.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
<u>Topic 1 : Energy Conservation</u> Specific Objectives: <ul style="list-style-type: none">➤ Identify the need of Energy Conservation.➤ State functions of Government organization working for ECA. Contents: <ol style="list-style-type: none">1.1 Preset energy scenario.1.2 Need of energy conservation.1.3 State the meaning of term Energy Conservation.1.4 Energy Conservation Act – 2003.1.5 Functions of Government Organization (NPC, MNRE, BEE, MEDA).	02	04
<u>Topics 2: Energy Conservation in Lighting system</u> Specific Objectives: <ul style="list-style-type: none">➤ Assess existing lighting system➤ Identify energy conservation techniques in lighting system.➤ Suggest methods to improve energy conservation Contents: <ol style="list-style-type: none">2.1 Basic terms used in Lighting system (Illumination).2.2 Recommended Luminance levels2.3 Procedure for assessing existing Lighting system in a facility.2.4 Energy Conservation techniques in lighting system.<ul style="list-style-type: none">• By replacing Lamp sources.• Using energy efficient luminaries.• Using light controlled gears.• By installation of separate transformer / servo stabilizer for lighting.• Periodic survey and adequate maintenance programs.• Energy Conservation techniques in fans, Electronic regulators.	06	12
<u>Topic 3 : Energy Conservation techniques in Electrical Motors</u> Specific Objectives: <ul style="list-style-type: none">➤ Select electrical motors for suitable application.➤ Energy conservation techniques for improving the performance of motor by various methods. Contents: <ol style="list-style-type: none">3.1 Construction, Power flow and working of Induction motor.3.2 Factors governing the selection of Induction motor.3.3 Need for energy conservation in Induction motor.3.4 Various energy conservation techniques in Induction motor.<ul style="list-style-type: none">• By improving Power quality.• By motor survey.	06	14

<ul style="list-style-type: none"> • By matching motor. • By minimizing the idle and <ul style="list-style-type: none"> ○ redundant running of motor. • By operating in star mode. • By rewinding of motor. • By improving mechanical <ul style="list-style-type: none"> ○ power and transmission ○ efficiency. <p>3.5 Energy Efficient motors.</p> <ul style="list-style-type: none"> • Comparison with conventional Induction motor 		
<p><u>Topic 4: Energy Conservation techniques in transformer.</u></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ List out the methods to improve performance of transformer. ➤ Suggest energy conservation techniques to improve transformer performance <p>Contents:</p> <p>4.1 Need of energy conservation in transformer.</p> <p>4.2 Methods (related to material, design) to improve the performance of transformer.</p> <p>4.3 Energy conservation techniques related to transformer.</p> <ul style="list-style-type: none"> • Loading sharing • Parallel operation • Isolating techniques <p>4.4 Energy efficient transformers.</p> <ul style="list-style-type: none"> • Amorphous transformers • Epoxy Resin cast transformer (Dry type of transformer). • Periodic maintenance. 	04	08
<p><u>Topic 5 : Energy conservation in transmission and distribution system.</u></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State scenario of losses in transmission and distribution system ➤ Identify Energy conservation opportunities ➤ Suggest methods for energy conservation. <p>Contents:</p> <p>5.1 Scenario of transmission and distribution losses at state level, national level and at global level.</p> <p>5.2 Types of losses in transmission and distribution system (commercial and technical losses)</p> <p>5.3 Energy conservation techniques in transmission and distribution system related to technical losses.</p> <ul style="list-style-type: none"> • By reducing I^2R losses. • By compensating reactive power flow. • By optimizing distribution 	06	12

<ul style="list-style-type: none"> ○ voltage. • By balancing phase currents. • By using energy efficient <ul style="list-style-type: none"> ○ transformers. <p>5.4 Energy conservation techniques related to commercial losses.</p>		
<p><u>Topic 6 : Relation Between Tariff And Energy Conservation.</u></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Identify the opportunities to reduce energy bill through selection of tariff structure ➤ Select appropriate tariff structure to reduce energy bill <p>Contents:</p> <p>6.1 Types of tariff structure.</p> <p>6.2 Terms involved in tariff.</p> <p>6.3 Specific tariff:</p> <ul style="list-style-type: none"> • Time-off-day tariff • Peak-off-day tariff • Power factor tariff • Maximum Demand tariff • Load factor tariff <p>6.4 Application of tariff system to reduce energy bill.</p> <p>6.5 Simple numerical based on power factor and load factor tariff.</p>	06	14
<p><u>Topic 7 : Energy Conservation by Cogeneration</u></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Classify cogeneration systems. ➤ Selection of appropriate cogeneration system to reduce energy bill <p>Contents:</p> <p>7.1 What is cogeneration?</p> <p>7.2 Need for cogeneration.</p> <p>7.3 Classification of cogeneration system on the basis of sequence of energy use.</p> <ul style="list-style-type: none"> • Topping cycle • Bottoming cycle <p>7.4 Classification of cogeneration system on the basis of technology.</p> <ul style="list-style-type: none"> • Steam turbine cogeneration. • Gas turbine cogeneration • Reciprocating engine cogeneration. <p>7.5 Factors governing the selection of cogeneration system.</p> <p>7.6 Advantages of cogeneration.</p>	04	12
<p><u>Topic 8 : Energy Conservation Equipment.</u></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ List out energy conservation equipments. ➤ Select proper energy conservation equipments in various applications. <p>Contents:</p> <p>8.1 What is energy conservation equipment?</p>	06	12

<p>8.2 Energy conservation equipment related to Lighting system.</p> <ul style="list-style-type: none"> • Centralized Control Equipment (Microprocessor based). • Occupancy sensors/Motion Detectors. • Control gears: Dimmers, Regulators, and Stabilizers). <p>8.3 Energy conservation equipment related to electrical motors: Construction, working and advantages of each energy conservation Equipment listed below:</p> <ul style="list-style-type: none"> • Soft starter: For induction motors • Power Factor Controller • Static capacitor • Automatic star delta starter • Variable Frequency Drives. <p>8.4 Energy conservation equipments in T&D system: Working principle and operation of</p> <ul style="list-style-type: none"> • Maximum Demand Controller • KVAR Controller • Automatic Power Factor controller. 		
<p><u>Topic 9 : Energy Audit.</u></p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ Select energy audit instruments. ➤ Prepare/Develop questionnaire for energy audit. ➤ Apply ABC analysis in energy projects. ➤ Calculation of simple pay back period. ➤ Write energy audit report. <p>Contents:</p> <p>9.1 Energy flow diagrams and its significance.</p> <p>9.2 Energy audit instruments and their use.</p> <p>9.3 Prepare questionnaire for energy audit projects.</p> <p>9.4 ABC analysis and it's advantages referred to energy audit projects.</p> <p>9.5 Energy Audit procedure (walk through audit and detailed audit).</p> <p>9.6 Calculation of simple pay back period (Simple numerical)</p>	08	12
Total	48	100

Practical:

Skills to be developed:

Intellectual Skills:

- 1.
- 2.
- 3.

Motor Skills:

- 1.
- 2.
- 3.

List of Practicals:

1. Collect the information about energy conservation act from IEE 2003.
2. Prepare a write up on role of Energy Manager and Energy Auditor.
3. Collect of information by market survey and prepare report on rating, luminous output, cost, list of manufacturers of various types of energy efficient luminaries (FTL, CFL, LED, Sodium Vapour, HPMV etc.)
4. Make a comparative study of energy efficient control gears and ballasts used in lighting system on the basis of energy efficiency, cost, life, energy saving and saving in energy bill
5. Visit to any organization where energy conservation program is implemented (Hospitals, workshops, institutes, commercial building, residential building etc.)
6. Using various energy audit instruments used for measurement of electrical, mechanical and thermal energy parameters, carryout energy audit and prepare a report as a case study for Residence, Small workshop, Public Library, Hospital etc.

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher
1	S. Sivanagraju M. Balasubba Reddy D. Srilatha	Generation And Utilization Of Electrical Energy	Pearson, New Delhi
2	P. H. Henderson	India - The Energy Sector	University Press.
3	W. C. Turner	Energy Management Handbook	Wiley Press.
4	B. G. Desai J. S. Rana A. V. Dinesh R. Paraman	Efficient Use And Management Of Electricity In Industry	Devki Energy Consultancy PVT. Ltd

2. Websites:

1. Website of bureau of energy and efficiency : www.bee-india.nic.in
2. Website of Akshay Urja News Bulletin : www.mnes.nic.in
3. Notes on energy management on : www.energymanagertraining.com
4. www.greenbusiness.com
5. www.worldenergy.org