

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: ENERGY CONSERVATION & AUDIT
(COURSE CODE: 3350902)**

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	5 th Semester

1. RATIONALE

Energy is the root of civilization. Development of country depends upon the key input for economic and social transformation. Energy must be cheap and easily available at any time. We need energy to cook our food, light our homes at night, for agricultural, irrigation, transportation and any activities in society. In industry, energy is badly needed to run machinery for production and services.

At present, whole world experiences shortage of fossil fuel reserves. The problems of increasing energy demand and limited supply of energy sources can only be solved by energy conservation. It is an indirect way of increasing the availability and it is considered as a new source of energy. It is today's demand to bridge the gap between demand and supply by energy conservation techniques and eliminate shortage of power.

One unit of electrical energy saved would amount to generation of 1.3. units of energy by considering transmission and other losses. "Energy conserved means additional installed capacity." There are various approaches for energy conservation viz domestic, industrial, commercial agricultural etc.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Manage, Audit and Conserve energy in Industry, Power Generation, Transmission and Distribution.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- i. Suggest methods of energy conservation.
- ii. Use different methods of energy conservation.
- iii. Use energy saving devices.
- iv. Calculate and find costing of energy conservation project.
- v. Conserve energy in power generation, transmission and distribution.
- vi. Prepare energy audit report.
- vii. Apply Tools for energy audit and recommend measures for energy conservation.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I. Elements of Energy Conservation and Management	1a. Identify different methods used for energy conservation. 1b. Use different methods of energy conservation. 1c. Explain energy management concept.	1.1 Concept of energy conservation. 1.2 Conservation of electrical energy. 1.3 Energy conservation in different areas. 1.4 Energy management concept. 1.5 Elements of energy management. 1.6 Different approaches of energy management, Energy balance and organization for energy management. 1.7 Energy conservation Act 1.8 Introduction of Bureau of Energy Efficiency
Unit– II Energy Conservation Approaches in Industry	2a. Improve power factor in electrical system. 2b. Select energy efficient electrical equipments in industries.	2.1 Improvement in power factors in electrical system. 2.2 Improved illumination design by use of energy efficient light sources. 2.3 Use of energy efficient electric motors. 2.4 Reduction in heat loss in motor control centre (starters, main switches, fuse, cables etc) 2.5 Energy saving in the welding equipment. 2.6 Use of PAM motors for speed control in traction. 2.7 Energy Conservation in Traction System by Variable Voltage Variable Frequency for AC Traction System, by Chopper Controlled for DC Traction System 2.8 Use of electronic control in industrial drives. 2.9 Energy saver technology and equipments.
Unit– III Technology Economic Evaluation of Energy Conservation	3a. Calculate and find costing of energy conservation project. 3b. Do Case study of energy conservation.	3.1 Calculation and costing of energy conservation project. 3.2 Depreciation cost, sinking fund method. 3.3 Cost evaluation by ROI and pay back method etc.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Option		3.4 Case study
Unit-IV Energy Conservation in Power Generation Transmission and Distribution	4a. Conserve energy while generating electrical power. 4b. Reduce transmission and distribution line losses.	4.1 Performance improvement of existing power plant. 4.2 Use of combined cycle power plants. 4.3 Use of co-generation plants, Use of small hydro power plants. 4.4 Improved power transmission lines & reduction in line losses. 4.5 Power quality-monitoring systems. 4.6 Energy conservation by demand side management different approaches.
Unit-V Energy Audit	5a. Describe concept of energy audit in detail . 5b. Use different tools of electrical energy audit.	5.1 Energy audit-a concept. 5.2 Detailed energy audit. 5.3 Preliminary energy audit. 5.4 Detailed energy audit reporting & remedial measures. 5.5 Tools of electrical energy audit. 5.6 Diagnostic approaches.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Elements of Energy Conservation and Management	10	04	04	04	12
II	Energy Conservation Approaches in Industry	16	08	06	04	18
III	Technology Economic Evaluation of Energy Conservation Option	12	06	05	05	16
IV	Energy Conservation in Power Generation Transmission and Distribution	10	04	06	04	14
V	Energy Audit	8	02	02	06	10
	Total	56	24	23	23	70

Legends: R = Remember U = Understand; A = Apply and above levels (Bloom's revised 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.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course**

Outcomes related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours. required
1	I	Energy conservation by energy efficient motors.	4
2	I	Energy conservation by power factor improvement.	4
3	II	Energy conservation by optimum loading of motor and proper control of motors.	4
4	II	Energy conservation by good illumination design.	2
5	III	Project cost evaluation case study no 1.	4
6	III	Demand side management Case study no 2.	4
7	III	Energy saving in starters Case study no 3.	2
8	VI	Energy audit and techniques.	2
9	V	Energy conservation in power station by combined cycle method and cogeneration.	4
10	II	Study of pole amplitude motor.	4
11	IV	Energy conservation by improving load curves.	4
12	II	Energy conservation in the electric arc furnaces and welding	4
13			2
14		Energy saving by using electronic ballast as compared to conventional choke.	2
15	II	Make a survey of any one establishment to identify different methods used for energy conservation.	2
16	V	Prepare Energy audit report for Industry/workshop/ Institute or its on section.	2
17			
18		Ask to search on the website of power ministry and MERC (Maharashtra Electricity Regulatory Commission) for Electricity act 2003 and collect the information regarding role of energy manager, energy auditor and prepare power point presentation/report.	
19		List energy saving equipments for domestic and commercial applications	
20	V	List the different equipments used in energy auditing	
Total Hours			28

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- i. Prepare journals based on practical performed in laboratory.
- ii. Assignments on solving numerical.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i) Industrial visit to power station and substation to find out the necessary measure which are being taken to conserve energy.

- ii) Give some field-based projects
- iii) Give some internet based projects.
- iv) Show video/animation films.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Renewable energy sources and conservation Technology	N. G. Bansal Kleemon & Meliss	TMH Publication
2.	Energy Technology Non conventional Renewable & conventional energy	S.Rao – Parulkar1	Khanna – publishers
3.	Electric energy utilization and conservation	S.C. Tripathi	T.M.H., Publisher
4.	A text book of power plant engineering A special appendix 1998 edition.	Arora and S. Domkundwar	Khanna publication
5.	Fundamental of ELECTRICAL DRIVES	G K Dubey	Narosa Publication

B) List of Major Equipment/ Instrument with Broad Specifications

i. Power Analyzer	3 phase / 1 phase measurement True RMS Voltage 600/1200 V True RMS Current 80 A Power measurement (Active power, reactive power & apparent power) Power factor measurement Frequency Measurement RS-232 serial communication LCD display
ii. Lux Meter	
iii.	
iv.	
v.	
vi.	
vii.	

C) List of Software/Learning Websites

- i. www.sskphdmm.com
- ii. www.nptel.iitm.ac.in
- iii. http://powermin.nic.in/acts_notification/energy_conservation_act/introduction.htm
- iv. www.beeindia.in
- v. <http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Industrial%20Automation%20control/pdf/L-31%28SM%29%20%28IA&C%29%20%28%28EE%29NPTTEL%29.pdf>
- vi. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led_advantage.pdf
- vii. <http://www.ledsmagazine.com/articles/2005/01/benefits-and-drawbacks-of-leds.html>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. S. V. Jagani**, Lecturer in Electrical Engineering, Govt. Polytechnic, Dahod
- **Prof. T. A. Patel**, Lecturer in Electrical Engineering, Govt. Polytechnic, Dahod
- **Prof. H. C. Chawda**, Lecturer in Electrical Engineering, RC Technical Institute, Ahmedabad.

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Mrs.) C S Rajeshwari**, Head of Department of Electrical and Electronics Engineering.
- **Prof. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering.