w.e.f. Academic Year 2009-10 **'E' Scheme**

CURRICULUM FOR

ADVANCE DIPLOMA IN ENERGY MANAGEMENT AND AUDIT (ER)

SCHEME - E

DURATION: ONE & HALF YEARS PATTERN: PART TIME - SEMESTER

Eligibility: -1. Any Diploma / Degree in Engineering / Technology from a recognized statutory Board / University or its equivalent or
2. Science Graduate from recognised University with 1 Year Relevant Experience.

(To be implemented from the Academic Year 2009 – 2010)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION. MUMBAI
(AUTONOMOUS)
ISO 9000-2008Certified
49, Kherwadi, Aliyawer Jung Marg, Mumbai – 400 051

MSBTE - Final Copy Dt. 25/05/2009

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

TEACHING AND EXAMINATION SCHEME

COURSE NAME : ADVANCE DIPLOMA IN ENERGY MANAGEMENT AND AUDIT

COURSE CODE : ER

DURATION OF COURSE : ONE & HALF YEAR **WITH EFFECT FROM 2009 - 10**

SEMESTER : FIRST **DURATION : 16 WEEKS**

PATTERN : PART TIME - SEMESTER **SCHEME : E**

SR. NO.	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									
				TH	TU	PR	PAPER HRS	TH (1)		PR (4)		OR (8)		TW (9)		SW (16009)
								MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
1	Renewable Energy Sources	RES	13225	05	--	--	03	100	50	--	--	--	--	--	--	50
2	Fundamentals of Thermal Utilities	FTU	13226	05	--	02	03	100	50	25 #	12	--	--	25@	12	
3	Fundamentals of Electrical Utilities	FEU	13227	05	--	02	03	100	50	25 #	12	--	--	25@	12	
			TOTAL	**15**	**--**	**04**	**--**	**300**	**--**	**50**	**--**	**--**	**--**	**50**	**--**	**50**

Student Contact Hours Per Week: **19 Hrs.**

Theory and Practical periods of 60 minutes each.

Total Marks **: 450**

@ Internal Assessment, # External Assessment

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, ,OR-Oral, TW- Termwork, SW- Sessional Work

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subject are to be converted out of 50 marks as sessional work.
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code Number for TH, PR, OR and TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

TEACHING AND EXAMINATION SCHEME

COURSE NAME : ADVANCE DIPLOMA IN ENERGY MANAGEMENT AND AUDIT

COURSE CODE : ER

DURATION OF COURSE : ONE & HALF YEAR **WITH EFFECT FROM 2009 - 10**

SEMESTER : SECOND **DURATION : 16 WEEKS**

PATTERN : PART TIME - SEMESTER **SCHEME : E**

SR. NO.	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									
				TH	TU	PR	PAPER HRS	TH (1)		PR (4)		OR (8)		TW (9)		SW (16010)
								MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
1	Energy Management & Instrumentation	EMN	13228	05	--	02	03	100	50	25#	12	--	--	25@	12	50
2	Energy Audit	EAD	13288	05	--	01	03	100	50	--	--	--	--	25@	12	
3	Evaluation of Utility Systems	EUS	13289	05	--	02	03	100	50	--	--	25#	12	25@	12	
			TOTAL	**15**	**--**	**05**	**--**	**300**	**--**	**25**	**--**	**25**	**--**	**75**	**--**	**50**

Student Contact Hours Per Week: **20 Hrs.**

Theory and Practical periods of 60 minutes each.

Total Marks **: 475**

@ Internal Assessment, # External Assessment

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, ,OR-Oral, TW- Termwork, SW- Sessional Work

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subject are to be converted out of 50 marks as sessional work.
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code Number for TH, PR, OR and TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

TEACHING AND EXAMINATION SCHEME

COURSE NAME : ADVANCE DIPLOMA IN ENERGY MANAGEMENT AND AUDIT

COURSE CODE : ER

DURATION OF COURSE : ONE & HALF YEAR **WITH EFFECT FROM 2010 - 11**

SEMESTER : THIRD SEMESTER **DURATION : 16 WEEKS**

PATTERN : PART TIME - SEMESTER **SCHEME : E**

SR. NO.	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									
				TH	TU	PR	PAPER HRS	TH (1)		PR (4)		OR (8)		TW (9)		SW (16011)
								MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
1	Energy Conservation Techniques	ECT	13290	05	--	02	03	100	50	50#	25	--	--	25@	12	50
2	Project & Financial Management	PFM	13291	05	--	--	03	100	50	--	--	--	--	--	--	
3	Project	PRJ	13292	--	--	06	--	--	--	--	--	50#	25	50@	25	
			TOTAL	**10**	**--**	**08**	**--**	**200**	**--**	**50**	**--**	**50**	**--**	**75**	**--**	**50**

Student Contact Hours Per Week: **18 Hrs.**

Theory and Practical periods of 60 minutes each.

Total Marks **: 425**

@ Internal Assessment, # External Assessment

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, ,OR-Oral, TW- Termwork, SW- Sessional Work

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subject are to be converted out of 50 marks as sessional work.
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code Number for TH, PR, OR and TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

Course Name **:- Advance Diploma in Energy Management & Audit.**

Course Code **:- ER**

Semester **:- First**

Subject Name **:- Renewable Energy Sources**

Subject Code **:-13225**

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER	TH	OR	PR	TW	TOTAL
05	--	--	03	100	--	--	--	100

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- The resources that supply energy are essential to human survival. A living harmony between the equitable availability of energy services to people about preservation of the earth for future generation. This subject presents an overview of the available energy source viz. conventional & non- conventional sources of energy.

Objectives:- The Students will be able to:

1. Understand need to differentiate between conventional, Non-conventional & renewable energy sources.
2. Reason out why the non-conventional energy sources need to be used as replacement to conventional form of energy.
3. To know the importance & role of Government all over the world to promote use of the renewable energy sources.

Contents: Theory

Chapter No	Details	Hours	Marks
1.	**Energy Situation & renewable energy sources** 1.1 Energy Sources 1.2 Energy Scenario 1.3 Need of renewable energy Sources	06	10
2.	**Solar Energy** 2.1 Solar Energy potential, solar radiation and Measurement, types of solar energy collectors 2.2 Solar water heating systems 2.3 Solar air heating and cooling systems 2.4 Solar thermal energy conversion 2.5 Solar photo voltaic system 2.6 Other applications of solar energy like distillation, pumping, furnace, green house etc.	20	24
3.	**Wind Energy** 3.1 Scope for Wind energy in India 3.2 Basic principles of wind energy conversion 3.3 Site selection considerations 3.4 Basic components of wind energy conversion system 3.5 Types of wind machines 3.6 Performance of Wind machines 3.7 Application of Wind Energy 3.8 Solar wind hybrid system	20	24
4	**Biomass and Biogas energy** 4.1 Introduction 4.2 Biomass conversion technologies. 4.3 Methods of obtaining energy from biomass 4.4 Biogas generation 4.5 Classification of biogas plants 4.6 Factors affecting yield of biogas plants 4.7 Properties & Characteristics of Biogas 4.8 Utilization of Biogas	20	24
5	**Other sources of renewable energy** 5.1 Tidal Energy 5.2 Geothermal Energy 5.3 Magneto – Hydro Dynamic energy 5.4 Chemical energy Sources 5.5 Hydrogen Energy	10	12
6	**Role of Government Agencies** 6.1 Role of State & Central Govt. agencies 6.2 Facilitators 6.3 Scope for Entrepreneurship Development	04	06
	Total	**80**	**100**

References:

Sr. No.	Author	Title	Publisher
01	G. D. Rai	Solar Energy Utilization	Khanna & Khanna , New Dehli
02	G. D. Rai	Non conventional energy source	Khanna & Khanna , New Dehli
03	J. W. Tester & M. Drate	Sustainable Energy	Prentice Hall of India, New Dehli
04	M. J. Driscoll	Sustainable Energy	Prentice Hall of India, New Dehli
05	M. W. Golay, W. A. Peters	Sustainable Energy	Prentice Hall of India, New Dehli
06	V. K. Methta	Principles of Power system	S.Chand Co.Ltd., New Dehli

Course Name :- Advance Diploma in Energy Management & Audit.

Course Code :- ER

Semester :- First

Subject Name :- Fundamentals of Thermal Utilities.

Subject Code :- 13226

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	02	03	100	25#	--	25@	150

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- Thermal utilities in industry encompasses a wide variety of fuels in addition to different types of agro residues and associated equipment and systems. Thermal energy constituting a significant portion of energy bill in many industries offers huge potential of energy savings.

Objectives:- The Students will be able to focus on basic principles of thermodynamics, heat transfer for various thermal related applications in industry and other places.

Contents: Theory

Chapter No.	Details	Hours	Marks
1.	**Stiochometry** 1.1 Dimensional Analysis:- Dimensions & System of units 22 mole atomic weigh, molecular Weight, equivalent weight. 1.2 Fuels & Combustion:- Properties of liquid, Coal, gaseous fuels, combustion of Oil, Coal& Gas, Combustion Controls, Fuel Consumption & heat recovery. 1.3 Properties of air: - Psychometric, Chart & Theoretical methods. 1.4 Energy & material balance:- Material balances, definition of terms, electrochemical reactions, metallurgical applications energy and thermo chemistry, energy balances, heat capacity of gases, gaseous liquids, liquids, liquid mixtures, concept of latent heat.	22	28
2.	**Boiler, Furnaces & stream Systems** 2.1 Boiler accessories & mountings (in brief) (water tubes & fire tube) type & performance evaluations methods blow down techniques. 2.2 Furnaces, Classification of Furnaces, Performance evaluation 2.3 properties of steam, steam piping features, selection, operation & maintenance of steam traps, use of steam	22	28
3.	**Basics of thermodynamics and heat transfer** 3.1 Laws of thermodynamics 3.2 thermodynamic cycles and its operations duel, Otto diesel and ranking cycles. 3.3 Laws of conduction, convection and its applications.	20	24
4	**Unit Operation** 4.1 Distillation. 4.2 Absorption & Stripping 4.3 Extraction & leaching 4.4 Crystallization 4.5 Drying 4.6 Evaporation 4.7 Vapor absorption Chiller	16	20
	Total	**80**	**100**

Assignments: 1. Determination of Heat Balance of diesel/petrol engine.
2. Study of different parameters affecting boiler efficiency.
3. Determination of calorific value of fuel by Bomb calorimeter.
4. Determination of the properties of air.
5. Determination of dryness fraction of steam by Throttling & Separating Calorimeter.
6. Determination of heat transfer coefficient in natural/ forced convection.
7. Determination of overall heat transfer coefficient or effectiveness of plane and fin tube heat exchanger.
8. Study of various parameters affecting the performance of steam distribution system.

References:

Sr. No.	Author	Title	Publisher
01	B. Bhatt, S. M Vora	Stoichiometry	Tata McgrawHill
02	K. V. Narayan	Staichiometry & process calculation	Prentice Hall
03	Melvin H. Chiogioji	Industrial Energy Conservation	Marcel Dekker
04	W. Trinks	Industrial Furnaces	John Wiley
05	Ardra,Domkundwar	Power Plant Engineering	Dhanpat Rai & Sons
06	P. K. Nag	Power Plant Engineering	Tata McgrawHill
07	V. M. Domkundawar	Heat and Man transformer	Dhanpat Rai & sons,Dehli
08	Holman	Heat and Man transformer	Dhanpat Rai & Sons, Dehli
09	V. M. Domkundawar	Refrigeration and Air conditioning	Dhanpat Rai & Sons, Dehli
10	O.P. Gupta	Fuels, Furnaces & Refractories	--
11	Murgai, Chandra	Boiler operations	--
12	Oliver Loyl	Efficient use of steam	--

Course Name **:- Advance Diploma in Energy Management & Audit.**

Course Code **:- ER**

Semester **:- First**

Subject Name **:- Fundamentals of Electrical Utilities**

Subject Code **:- 13227**

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	02	03	100	25#	--	25@	150

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- This subject is intended to provide over all view of electrical power supply link from generation to end use. Selection of energy efficient electrical systems for operation & control is essential for saving in bills & thus it enumerates energy saving opportunities in industry.

Objectives:- The Students will be able to:

1. Identify electrical utilities & their basic principle & understand their operation.
2. Provide guidelines for efficient use of electrical energy.
3. Assess performance of electrical machines & equipments.

Contents: Theory

Chapter No	Details	Hours	Marks
1.	**Introduction** 1.1 Introduction to Electric Power Supply Systems. 1.2 Electricity Billing 1.3 Electrical Load Management & Maximum Demand control 1.4 Power factor improvement & Benefits 1.5 System Distribution losses 1.6 Analysis of Electrical Power System	10	12
2.	**Electrical Machines** 2.1 Motors 2.1.1. Introduction 2.1.2 Motor Types 2.1.3 Motor Characteristics 2.1.4 Motor Efficiency 2.1.5 Motor Selection 2.1.6 Energy Efficiency Motors 2.1.7 Factors affecting energy efficiency & minimizing motor losses 2.1.8 Speed control of Induction Motors 2.1.9 Motor load survey 2.1.10 Rewinding effects on motor efficiency 2.2 D. G. Sets 2.2.1 Induction Generators 2.2.2 Synchronous Generators 2.2.3 D. C. Generators	14	20
3.	**HVAC, Refrigeration & Cooling** 3.1 Introduction 3.1.1 Types of Refrigeration System 3.1.2 Common refrigerants & Properties 3.1.3 Compressor Types & Application 3.1.4 Selection of a suitable Refrigeration Plant 3.1.5 Performance Assessment of refrigeration plants 3.1.6 Factors affecting performance & energy efficiency of refrigeration plants 3.2 Cooling Towers 3.2.1 Introduction 3.2.2 Cooling Tower Performance 3.2.3 Efficient System Operation 3.2.4 Flow Control Strategies	18	24
4	**Lighting System** 4.1 Introduction 4.2 Basic Terms & features 4.3 Lamp Types & features	12	16

	4.4 Recommended Luminance levels for various tasks / activities 4.5 Methodology of liquates system – energy efficiency study 4.6 Case Examples		
5	**Compressors & Pumps** 5.1 Compressor types 5.2 Compressor Performance 5.3 Compressed Air System Components 5.4 Efficient Operation of Compressed Air Systems 5.5 Pump Types, Pump curves 5.6 System Characteristics 5.7 Factors affecting pump performance 5.8 Efficient pumping system operation 5.9 Flow Control Strategies 5.10 Fans & Blowers 5.10 1 Introduction 5.10.2 Fans Types 5.10.3 Fan Design & Selection Criteria 5.10.4 Flow control Strategies	18	20
6	**Melting Furnaces** 6.1 Principles of Operation 6.2 Arc Furnace 6.3 Induction Furnace 6.4 Channel Furnace 6.5 Low frequency, Medium frequency furnaces	08	08
	Total	**80**	**100**

Assignments:

1. Calculation of Electricity bills for various consumers.
2. Determination of rating of Power factor improvement devices.
3. Verify the characteristics of 3 phase induction motor.
4. Study of various starters for Induction Motors.
5. Methods of Speed control of induction motor.
6. Case Study of Refrigeration system.
7. Case study of illumination system (lighting loads).
8. Study of Efficient operation of compressed air system.
9. Visit report on different types of arc furnaces.

Reference Books:

Sr. No.	Author	Title	Publisher
01	V. K. Mehta	Electrical Power	Khanna & Khanna Publishers,New Dehli
02	S. L. Uppal	Electrical Power	Khanna & Khanna Publishers,New Dehli
03	H. Partab	Art & Science of utilization of Electrical Energy	DhanapatRai & Sons, New Dehli
04	www.bee-india.com	Fundamentals of electrical system	Bureau of Energy Efficiency

Course Name :- **Advance Diploma in Energy Management & Audit.**

Course Code :- **ER**

Semester :- **Second**

Subject Name :- **Energy Management And Instrumentation**

Subject Code :- **13228**

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	02	03	100	25#	--	25@	150

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- Application of energy management principles**,** skills, strategies as well as monitoring and targeting are essential in studying this subject. With advancement in computer technology, it is now essential to apply the software techniques to energy management. This subject enables the students to learn simulation packages commonly used in energy management.

Objectives:- By learning this subject a student will be able to

(i) Define principles and objectives of energy management.

(ii) Monitor various elements of energy.

(iii) Measure different parameters in energy auditing by various meters.

(iv) Develop motor skills for use of simulation packages on energy management.

Contents: Theory

Chapter No.	Details	Hours	Marks
1.	**Energy Management** 1.1 Definition and Objective of Energy Management 1.2 Principle of Energy Management 1.3 Energy Management skills 1.4 Energy Management Strategies	04	08
2.	**Initializing and Organizing** 2.1 Managing Energy Management Programmers 2.2 Organizing Energy Management Programmers 2.3 Initializing Energy Management Programmers 2.4 Initializing Planning, Leading, Controlling, Promoting, Monitoring and Reporting.	06	12
3.	**Energy Monitoring and Target** 3.1 Definition 3.2 Elements of Monitoring and Targeting System 3.3 A rationale for Monitoring, Target and Reporting 3.4 Data and Information Analysis 3.5 Relating Energy Consumption and Production 3.6 Cumulative 3.7 Case Study	18	20
4	**Energy Audit Instruments** 4.1 Principal and working of Electrical Measuring Instruments (Voltmeter, ammeter ,Power Factor meter, Tri-vector meters for , Speedometer contact / non- contact type) 4.2 Flue gas analyzer , Principal of measurements by 4.2.1 Chemical Methods 4.2.2 Electronic Methods 4.3 Temperature Measurement 4.3.1 Contact type methods 4.3.2 Non – Contact type methods 4.4 Pressure and velocity Measurement (Bourdon gauge, Manometers, Anemometer) 4.5 Flow Measurement of steam, water and air 4.6 Humidity Measurement and leak Detectors	22	24
5	Methods of Measurement 5.1 Power Measurement Methods 5.2 Speed Measurement Methods 5.3 Air Flow Measurement Methods 5.4 Water Flow Measurement Methods 5.5 Chemical Method for analysis of line gases 5.6 Electronic Method for analysis of line gases 5.7 Temp. Measurement Methods 5.8 Pressure Measurement Methods	18	20

	5.9 Velocity Measurement Methods 5.10 Lax Measurement Methods 5.11 Water / Steam / air Leakage detecting method		
6	**Computer Simulation Techniques** 6.1 For Lighting System 6.2 For HVAC System 6.3 For piping / pressure drop Calculation 6.4 For energy Monitoring 6.5 For boiler performance Calculation	12	16
	Total	**80**	**100**

Assignments:

1. Determination water flow by vantage turbine, orifice.
2. Measurement of power by two / single wattmeter method.
3. Measurement of flue gas parameter.
4. Measurement of Light intensity using Lux- meter.
5. Measurement of air flow by anemometer and pitot-tube.
6. Calculation of specific energy consumption norms.
7. Optimization of building envelops using computer simulation.

References:

Sr. No.	Author	Title	Publisher
01	Wayne C Turner	Energy Management Hand book	Wiley Inter Science Publication.
02	--	General Aspects of Energy Management & Energy Audit	Bureau of Energy Efficiency
03	A. K. Sawhney	Electrical Measurements	Khanna Publications
04	Golding	Electrical Measurements	--
05	Salil K. Ghosal, Shyamal Sanyal, Siddharth Datta	Introduction to chemical Engg.	--
06	Coulson & Richardson	Chemical Engg.	--
07	A. K. Kulkarni	Fluid Flow	--

Course Name :- Advance Diploma in Energy Management & Audit.

Course Code :- ER

Semester :- Second

Subject Name :- Energy Audit

Subject Code :- 13288

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	01	03	100	--	--	25@	125

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- World wide, the stocks of fossil fuels are depleting. In such scenario, it becomes essential to judiciously use the available stocks & look at other sources of energy viz. renewable.

In this context the energy audit becomes an important tool to evaluate / assess the present consumption of energy & then suggest cost effective measures to reduce the consumption without affecting product & quality.

Objectives:- The Students will be able to learn various technically proven ways to conserve energy & then prioritize them based on the cost benefit analysis.

Contents: Theory

Chapter No	Details	Hours	Marks
1.	**Energy Scenario** 1.1 Introduction 1.2 Types of energy sources 1.3 Indian energy Scenario 1.4 Energy V/s economic growth 1.5 Energy Policies, pricing & reforms. 1.6 Energy security 1.7 Energy strategy for future	06	10
2.	**Basic of energy & its various forms** 2.1 Various forms of energy 2.2 Terms & definitions used in electrical energy 2.3 Terms & definitions used in thermal energy] 2.4 Energy – Units & Conversion	04	06
3.	**Energy Management (Audit)** 3.1 Definition & Objectives of energy management 3.2 Principles of energy management 3.3 Energy Management Skills. 3.4 Energy Management Strategy 3.5 Energy Audit - Types & Methodology 3.6Energy Audit Reporting format 3.7 understanding energy carts 3.8 Bench marking & energy performance 3.9 Matching energy usage to requirement 3.10 Maximizing System 3.11 Fuel & energy Substitution	22	24
4	**Material & Energy Balance** 4.1 Sankey Diagram & its use 4.2 Method for preparing process flow chart 4.3 Facility as an energy system 4.4 How to carry out material & energy balance 4.5 Case Study	10	16
5	**Energy Action Planning** 5.1 Key Elements 5.2 Force Field Analysis 5.3 Energy Policy 5.4 Organizing – Location of energy Manager 5.5 Top Management Support 5.6 Energy Manager – Responsibilities & duties to be assigned under energy conservation Act 2001 5.7 accountability 5.8 Motivation of Employees 5.9 Requirements for Energy Action Planning 5.10 Information System	18	20

	5.11 marketing & Communicating 5.12 Planning & Training.		
6	**Global Environmental Concerns** 6.1 Global Environmental Issue 6.2 Ozone layer depletion 6.3 Global Warming 6.4 Climate change problem –United Nations frame work convention on climate change (UNFCCC) 6.5 Global Climate Change – Theory the Kyoto protocol 6.6 The conference of the porties (COP) 6.7 Clean Development Mechanism (CDM) 6.8 Prototype Carbon Fund (PCF) 6.9 Sustainable Development.	20	24
	Total	**80**	**100**

Assignments:

1. Study various types of energy sources.
2. Objectives of energy security
3. Study of importance of energy management
4. To study the steps in energy audit.
5. To understand energy charts
6. Prepare process flow chart.
7. Case study of material for energy balance.
8. Role & responsibilities of energy manager.
9. Energy conservation acts.
10. Report on marketing, planning & training.
11. Valuation of climate change problem.

References:

Sr. No.	Author	Title	Publisher
01	--	Encyclopedia of Energy	Mc-Graw Hill
02	G. D. Rai	Non-conventional Energy Sources	Khanna & Khanna Publishers,New Dehli
03	Paul O'Callaghan	Energy Management	--

04	Albert Thumann, P. E., C. E. M., D 'Paul Mehta	Hand Book of Energy Engg.	--
05	Parivesh	--	Oct. 2002 Edition
06	Wayne c. Turner	Energy Management Handbook	A Wiley Interscience Publication John Wiley & Sons.
07	--	Handbook on Energy audit & Management	TERI Press

www.global warming.org
www.eia. doe.gov/kids/btudef.html
www.bp.com/centres/energy
www.kat marsoftware.com

Course Name **:- Advance Diploma in Energy Management & Audit.**

Course Code **:- ER**

Semester **:- Second**

Subject Name **:- Evaluation Of Utility Systems**

Subject Code **:- 13289**

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			**Examination Scheme**					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	02	03	100	--	25#	25@	150

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- Evaluation of energy systems focuses on practical methods of assessing performance in the field. Performance assessment requires application of variety of instruments & numerous ways by which different parameter could be assessed.

Objectives:- The Students will be able to:

a) Carry out systematic & comprehensive performance assessment.
b) Identify areas for improvement.
c) Apply the identified improved measures for various applications**.**

Contents: Theory

Chapter No	Details	Hours	Marks
1.	**Performance Evaluation of Boilers & Furnaces** 1.2 Steam load calculation 1.3 Flue gas analysis 1.4 Fuel flow & its property measurement 1.5 Temperature measurement 1.6 Calculations of direct & indirect efficiency based on gross & net calorific value.	10	12
2.	**Cogeneration** 2.1 Classification of steam & gas turbines 2.2 Different cogeneration methods & classification 2.3 Factors affecting cogeneration 2.4 Case study.	10	12
3.	**Waste Heat Recovery** 3.1 Classification of waste heat based on temperature & preparation of Sankey diagram 3.2 Determination of waste heat potential 3.3 Waste heat recovery equipment 3.4 Impact of waste heat on environment. .	08	12
4	**Electrical Machines** 4.1 Performance evaluation of induction motors as per relevant codes 4.2 Performance evaluation of transformer as per relevant codes 4.3 Performance evaluation of electric furnace as per relevant codes	14	16
5	**Pumps** 5.1 Pump selection 5.2 System losses calculations 5.3 Series & parallel pumping operation 5.4 Pumping head rationalization 5.5 Performance assessment technique	14	16
6	**Fans Blowers & Compressors** 6.1 Measurement of air change 6.2 Duct sizing in AHU (air handling unit) 6.3 Flow & pressure measurement location 6.4 Leakage testing of compressor 6.5 Pump-up test 6.6 Parametric evaluation of compressor	12	16

	6.7 Performance testing of fans, blowers & compressors		
7	**HVAC & Lighting System** 7.1 Specific energy calculations of chillers 7.2 COP determination 7.3 Selection of luminaries 7.4 Optimum use of luminaries 7.5 Lighting efficiency calculations 7.6 Determination technique for installed load efficiency ratio 7.6 Case study.	12	16
	Total	**80**	**100**

Assignments:

1. Indirect Efficiency testing of boiler.
2. Performance characterizing of purpose intense and parallel
3. Performance evaluate of single or two stage comprador
4. Performance evaluate of bilker
5. Deform nation of installed load efficacy for lighting system.
6. Efficiency and Regulation of transformer

References:

Sr. No.	Author	Title	Publisher
01	www.bee-india.com	Energy Performance Assessment for Equipment and Utility Systems	Bureau of Energy Efficiency
02	Oliver Lyle	Efficient use of steam	--
03	B. L. Theraja A.K. Theraja	Text Book Of Electrical Technology	S. Chand Publications.
04	Mr. Ashutosh Pandey	Process Plant Utility	Vipul Prakashan
05	H. Partab	Art & science of Utilization of Electrical Energy	Dhanpat Rai & Sons.

Course Name **:- Advance Diploma in Energy Management & Audit.**

Course Code **:- ER**

Semester **:- Third**

Subject Name **:- Energy Conservation Techniques**

Subject Code **:- 13290**

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	02	03	100	50#	--	25@	175

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- By fast depletion of fossil fuels and a tremendous gap between supply and demand it is essential to adopt conservation techniques in industries and commercial as well as residential areas. This subject gives basic concepts of energy conservation and its techniques.

Objectives:- The Students will be able to:

(i) Understand Energy Conservation Act 2001 and its features.

(ii) Identify area of energy conservation.

(iii) Adopt conservation methods in various systems.

Contents: Theory

Chapter No	Details	Hours	Marks
1.	**Introduction** 1.1 Energy conservation & its importance 1.2 The Energy conservation Act 2001 & its features	08	12
2.	**Waste Minimization & Resource Conservation** 2.1 Need of waste minimization 2.2 Waste minimization method & its classification 2.3 Effects of waste environment & Role of pollution control board 2.4 Case study.	10	16
3.	**Energy Conservation Methods in Electrical System** 3.1 Motors 3.2 Power factor improvement techniques 3.3 Effects of harmonics 3.4 Star-Delta conversion techniques 3.5 Variable speed drive (VSD) 3.6 Energy conservation in electric furnaces. 3.7 Pumps, Compressors, Fans & Blowers 3.8 Lighting systems 3.9 HVAC systems	24	30
4	**Energy Conservation In Thermal System** 4.1 Boiler & furnace 4.2 Steam distribution system 4.3 HVAC 4.4 Waste heat recovery 4.5 Insulation of pipes 4.6 Condensate recovery 4.7 Fuel Handling 4.8 Other heat based application 4.9 Case Study	26	30
5	**Energy Conservation in Housing & Commercial Building** 5.1 In Lighting System 5.2 Water heating system 5.3 Optimization cooking method 5.4 Energy efficient building	12	12
	Total	**80**	**100**

Assignments:

1. Assessment of energy conservation potential in various systems (One or more case studies per topic)
    a. Boiler and steam system
    b. Electrical system
    c. Electrical Utility systems

d. Thermal based unit operations

2. Preparation of Energy Management Plan for entire manufacturing facility (One case study)

References:

Sr. No.	Author	Title	Publisher
01	Wayne C. Turner	Energy Management Handbook	--
02	Oliver Lyle	Efficient use of steam	--
03	S.K. Awasthi	Energy Conservation in the Chemical & Allied Industries	South Asian Publishers, New Delhi
04	Melvin H. chiogioji	Industrial Energy Conservation	--
05	Energy Summit 94 - Confederation of Indian Industry	--	--
06	Chopey	Energy Management Handbook	--
07	www.bee-india.com	Fundamentals of electrical system	Bureau of Energy Efficiency

Course Name **:- Advance Diploma in Energy Management & Audit.**

Course Code **:- ER**

Semester **:- Third**

Subject Name **:- Project and Financial Management**

Subject Code **:- 13291**

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			**Examination Scheme**					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
05	--	--	03	100	--	--	--	100

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 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rational:- The recommendation of Energy Audit will be meaningful only when they are Implement able. For this to happen, financial management becomes necessary, as the primary object of any organization would be to maximize the wealth at minimum cost.

Objectives:- The student will be able to correlate technical recommendations with financial aspects, packaging so as to make the investment in energy in cost effective manner.

Contents: Theory

Chapter No	Details	Hours	Marks
1.	**Project Implementation** 1.1 Elements of project management 1.2 Principles of project planning relevant to energy projects 1.3 Project planning & monitoring techniques	18	24
2.	**Basics of Finance** 2.1 Importance of Finance 2.2 Basic Instrument of Finance debt & equity 2.3 Financing & Investment Decisions 2.4 Capital Budgeting 2.5 Goals objects of Finance function 2.6 Profit maximization 2.7 Wealth maximization 2.8 Organization of Finance function 2.9 Duties & Responsibilities of Finance Executive 2.10 Resuming Duties 2.11 Non resuming Duties	22	24
3.	**Financial Management** 3.1 Assessment of cost of project 3.2 Determination of means of Financing 3.3 Sensitivity Analysis 3.4 Cash how statement	18	24
4	**Options for Financing EE Projects** 4.1 Introduction of Financing options 4.2 Financing option for implementing energy efficiency projects 4.3 Financing equity/cash accrual 4.4 Loans from banks/institutions 4.5 Third party Financing (ESCO)	12	16
5	**Introduction to Environmental issues** 5.1 Industrialization & it's effects on ozone layer depletion 5.2 Introduction to UNFCC's & Kyoto protocol 5.3 CDM – Market Related Instrument to tackle global Warming. 5.4 CDM – A possible source to finance EE project	10	12
	Total	**80**	**100**

References:

Sr. No.	Author	Title	Publisher
01	Prasanna Chandra	Project Management	Tata Mcgraw Hill, New Delhi
02	Prasanna Chandra	Financial Management	Tata Mcgraw Hill, New Delhi
03	S. Choudhary	Project Management	Tata Mcgraw Hill, New Delhi
04	S. Choudhary	Project Planning, Analysis Selection Implementation & Review	Tata Mcgraw Hill, New Delhi
05	Sinka	Project Management	--

Course Name :- Advance Diploma in Energy Management & Audit.

Course Code :- ER

Semester :- Third

Subject Name :- Project

Subject Code :-13292

TEACHING AND EXAMINATION SCHEME:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	06	--	--	--	50#	50@	100

With the knowledge of Renewable energy sources, Fundamentals of Electrical Utilities, Fundamentals of Thermal Utilities, Energy Audit, Project &Financial Management and Evaluation of Utilities Students are able to undertake PROJECCT.

Project has to be carried out in-group of maximum three members. Based on project group has to present two seminars-

a. First seminar after planning and testing stage.
b. Second seminar after technical assessment and audit.

Based on the project student has to submit a complete detailed project report in bounded form. Students can select any small-scale industry or specific unit of any large industry or any commercial complexes as project assignment. Project must involve both thermal system and electrical systems. Students are expected to carryout performance tests and performance evaluations and technical assessments. Students also expected to carry out energy audit and financial aspects of the project. They have to recommend energy monitoring and targeting systems. They should also consider aspects of Energy Conservations and use of Renewable Energy Sources.

It is suggested that, students can carryout the project under the guidance of any energy managers or any energy-auditing firms.

List of Equipments required as per subjects

Sr. No.	Details of Equipments	Remarks
Subject: Fundamentals of Thermal Utilities		
1.	Four Stroke Single Cylinder Petrol Engine OR Four Stroke Single Cylinder Diesel Engine	Mandatory (Any one)
2.	300kg/lit, liquid/solid/gas fuel fired non IBR boiler	Mandatory
3.	Bomb Calorimeter	--
4.	Air Conditioner Test Rig	Mandatory
5.	Throatlating or Separating Calorimeter	--
6.	Heat Transfer Coefficient by Natural/Forced convection equipment	Mandatory
7.	Tube and Tube Water to Air Heat Exchanger	Mandatory
8.	Steam Trap Model	--
9.	Steam Distribution System (Chart)	Mandatory
10.	Electrical Furnace details (Chart)	Mandatory
11.	Burner Alignment in Furnaces (Chart)	Mandatory
12.	Boiler System (Chart)	Mandatory
13.	Co-generation Scheme (Chart)	Mandatory
14.	Fluidized Bed Boiler (Chart)	Mandatory
15.	Recuperators (Chart)	Mandatory
16.	Regenerators (Chart)	Mandatory
17.	Heat Pipe (Chart)	Mandatory
Subject: Fundamentals of Electrical Utilities		
1.	Synchronous Motor	Mandatory
2.	Three Phase Capacitor Bank	Mandatory
3.	Three Phase Induction Motor /Generator	Mandatory
4.	3-Phase Autotransformer Starter	Mandatory
5.	Star/Delta Starter	Mandatory
6.	Direct Online Starter	Mandatory
7.	Rotor Resistance Starter	--
8.	Pole Changing of 3-phase Induction Motor	Mandatory

Sr. No.	Details of Equipments	Remarks
Subject: Evaluation of Energy Systems		
1.	Orsat apparatus or electronic flue gas analyzer	Mandatory
2.	Various Heat Exchanges (Chart)	Mandatory
3.	Different Types of Turbines (Chart)	Mandatory
4.	Electric Motor Elements (Chart)	Mandatory
5.	Compressor Parts (Chart)	Mandatory
6.	Compressed Air System (Chart)	Mandatory
7.	Various Types of Fans and Blowers (Chart)	Mandatory
8.	Pump Impeller (Chart)	Mandatory
9.	Refrigeration System (Chart)	Mandatory

10.	Different Lighting Systems & Fixtures (Chart)	Mandatory
11.	Boiler Models (Chart)	Mandatory
12.	Double Pump Testing with Series or Parallel Operation Facility	Mandatory
13.	Gas-Turbine Model (Non working)	--
14.	Single Stage or Two Stage Compressor System	Mandatory
15.	Calculation of Transformer Efficiency & Regulation	Mandatory
16.	Vapour Compression based water chiller	--
Subject: Energy Management and Instrumentation		
1.	Anemometer	Mandatory
2.	Lux Meter	Mandatory
3.	Power Analyzer	Mandatory
4.	Turbine Flow Meter	Mandatory
5.	Thermometer (Contact / Non-contact type)	Mandatory
6.	Tachometer (Contact / Non-contact type)	Mandatory
7.	Pressure Gauges	Mandatory
8.	Ammeter (AC / DC)	Mandatory
9.	Voltmeter (AC / DC)	Mandatory
10.	Power Factor meter	Mandatory
11.	Tong Tester	Mandatory
12.	Earth Tester	Mandatory
13.	Energy meter	Mandatory
14.	Tri-vector meter	Mandatory
15.	Stroboscope	Mandatory
16.	Multimeter	Mandatory
17.	Pitot tube and manometer	Mandatory
18.	Water Flow Meter	Mandatory
19.	Leak Detector	Mandatory

Faculty Qualification:

Subjects	Faculty
• Renewable Energy Sources • Fundamentals of Electrical utilities • Fundamentals of Thermal utilities	Engineering Graduate from Electrical Engg. / Mechanical Engg. / Chemical Engg. with three years experience.
• Energy Audit • Energy Conservation Techniques • Energy Management and Instrumentation • Project & Financial Management • Evaluation of Energy systems	• Engineering Graduates From relevant branch with certified as Energy auditor / Energy Manager by BEE • M.Tech. / M.E. in Energy Systems / Energy Management.