GONDWANA UNIVERSITY, GADCHIROLI

TEACHING AND EXAMINATION SCHEME (SEMESTERPATTERN CHOICE BASED CREDIT SYSTEM)

PROGRAM : MASTER OF TECHNOLOGY IN ENERGY MANAGEMENT SYSTEMS
PROGRAM CODE : PEM
FACULTY : ENGINEERING & TECHNOLOGY
DURATION : TWO YEARS

I – SEMESTER

Unique Subject Code (USC)	Course type	Subject	Teaching Scheme				Examination Scheme									
			Hours per week			No. of Credits	Theory						Practical			
			L	Field Work/ Assignment/ Tutorial	P		Duration of Paper (Hrs.)	Max. Marks			Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
									Sessional							
								ESE	MSE	IE			TW	PEE		
PEMS 11	**C**	Energy Scenario & Policies	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
PEMS 12	**C**	Alternate Energy Systems – I	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
PEMS 13	**C**	Alternate Energy Systems – II	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
PEMS 14x	**P**	Elective – I	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
Laboratories/ Practical																
PEMS 15	**C**	Energy Lab – I	-	-	2	1	-	-	-	-	-	-	50	50	**100**	50

PEMS 16	**E**	Seminar	-	-	2	1							50	-	**50**	25
		TOTAL	12	08	4	18	-	**400**					**150**			
		SEMESTER TOTAL	**24**		**18**	**550**										

Elective – I (x): (a) Energy Conservation (b) Batteries and Fuel Cells (c) MHD Power Generation

GONDWANA UNIVERSITY, GADCHIROLI

TEACHING AND EXAMINATION SCHEME (SEMESTERPATTERN CHOICE BASED CREDIT SYSTEM)

PROGRAM : MASTER OF TECHNOLOGY IN ENERGY MANAGEMENT SYSTEMS
PROGRAM CODE : PEM

FACULTY : ENGINEERING & TECHNOLOGY
DURATION : TWO YEARS

II – SEMESTER

Unique Subject Code (USC)	Course type	Subject	Teaching Scheme				Examination Scheme									
			Hours per week			No. of Credits	Theory						Practical			
			L	Field Work / Assignment/ Tutorial	P		Duration of Paper (Hrs.)	Max. Marks	Max. Marks		Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
									Sessional							
								ESE	MSE	IE			TW	PE		
PEMS 21	**C**	Integrated Energy Systems	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
PEMS 22	**C**	Energy Modeling & Project Management	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
PEMS 23	**C**	Energy Audit & Management	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
PEMS 24x	**P**	Elective – II	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-

Laboratories/ Practical																
PEMS 25	**C**	Energy Lab – II	-	-	2	1	-	-	-	-	-	-	50	50	**100**	50
PEMS 26	**E**	Seminar	-	-	2	1							50	-	**50**	25
TOTAL			12	08	4	18	-	**400**					**150**			
SEMESTER TOTAL			**24**		**18**	**550**										

Elective – II (x): (a) Project, Planning & Design of Renewable Energy Systems (b) Environmental Science & Engineering (c) Energy Analysis

GONDWANA UNIVERSITY, GADCHIROLI

TEACHING AND EXAMINATION SCHEME (SEMESTERPATTERN CHOICE BASED CREDIT SYSTEM)

PROGRAM: MASTER OF TECHNOLOGY IN ENERGY MANAGEMENT SYSTEMS PROGRAM CODE : PEM
FACULTY : ENGINEERING & TECHNOLOGY
DURATION : TWO YEARS

III – SEMESTER

Unique Subject Code (USC)	Course type	Subject	Teaching Scheme				Examination Scheme									
			Hours per week			No. of Credits	Theory						Practical			
			L	Field Work/ Assignment/ Tutorial	P		Duration of Paper (Hrs.)	Max. Marks			Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
									Sessional							
								ESE	MSE	IE			TW	PE		
PEMS 31	**C**	Self Study Course	-	2	-	4	3	70	10	20	**100**	50	-	-	-	-
PEMS 32x	**P**	Elective – III	3	2	-	3+1	3	70	10	20	**100**	50	-	-	-	-
Laboratories/ Practical																
PEMS 33	**E**	Industrial Training	-	5	-	5	-	-	-	-	-	-	150	50	**200**	100
PEMS 34	**E**	Pre Dissertation	-	6	-	5							100	50	**150**	75
		TOTAL	3	15	-	18	-	**200**					**350**			
SEMESTER TOTAL			**18**			**18**	**550**									

Elective – III (x): (a) Advance Power Electronics (b) Energy Efficient Building (c) Data Analysis (d) Thermal Storage System (e) Neural Network & Fuzzy Logic

GONDWANA UNIVERSITY, GADCHIROLI

TEACHING AND EXAMINATION SCHEME (SEMESTERPATTERN CHOICE BASED CREDIT SYSTEM)

PROGRAM : MASTER OF TECHNOLOGY IN ENERGY MANAGEMENT SYSTEMS
PROGRAM CODE : PEM
FACULTY : ENGINEERING & TECHNOLOGY
DURATION : TWO YEARS

IV – SEMESTER

Unique Subject Code (USC)	Course type	Subject	Teaching Scheme				Examination Scheme									
			Hours per week			No. of Credits	Theory						Practical			
			L	Field Work/ Assignment/ Tutorial	P		Duration of Paper (Hrs.)	Max. Marks	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
								ESE	MSE	IE			TW	PEE		
PEMS 41	E	Final Dissertation	-	10	-	18	-	-	-	-			150	200	350	175
SEMESTER TOTAL			1o			18	350									

GONDWANA UNIVERSITY, GADCHIROLI

TEACHING AND EXAMINATION SCHEME

(SEMESTERPATTERN CHOICE BASED CREDIT SYSTEM)

PROGRAM : MASTER OF TECHNOLOGY IN ENERGY MANAGEMENT SYSTEMS
PROGRAM CODE : PEM
FACULTY : ENGINEERING & TECHNOLOGY
DURATION : TWO YEARS

I – SEMESTER

Course Code: PEMS11
Course Title: ENERGY SCENARIO & POLICIES

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Global and National level energy issues. Role of energy in socio-economic developments. Energy, GDP, GNP and their interrelations. Energy sources, demand and availability. Energy Consumption in various sectors, its changing pattern in present, past and future. Sector-wise energy consumption pattern. Conventional and non – conventional energy sources, their importance and utilization pattern.

Energy Pricing & Impact of Global Variations. Energy Productivity (National & Sector wise productivity). Energy security, Vision and Crisis issues.

Impact of Energy on Economy and Environment. Energy Policies of G-8 Countries, G-20 Countries, OPEC Countries, EU Countries. International Energy Treaties (Rio, Montreal, Kyoto), INDO-US Nuclear Deal.

Power sector reforms & Energy policies in India, Energy Conservation Act-2001 & its features, Electricity Act-2003 & its features. Framework of Central Electricity Authority (CEA), Central & States Electricity Regulatory Commissions (CERC & ERCs), National & State Energy Policy, Industrial Energy Policy.

Reference Books

1. Energy for a sustainable world: Jose Goldenberg, Thomas Johansson, A. K. N. Reddy, Robert Williams (Wiley Eastern).
2. Energy policy: B. V. Desai (Wiley Eastern),
3. TEDDY Year Book Published by Tata Energy Research Institute (TERI),
4. World Energy Resources: Charles E. Brown, Springer2002.
5. „International Energy Outlook" -IEA annual Publication

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS12**
Course Title: **ALTERNATE ENERGY SYSTEMS - I**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Radiation, Global, Beam and Diffuse Radiation, Hourly, Daily and Seasonal variation of solar Radiation, Estimation of Solar Radiation, Measurement of Solar Radiation, Solar Energy & Environment. Various Methods of using solar energy – Thermal, Photovoltaic, Photosynthesis. SPV principle and basics. P-V cell, module and their different characteristics. Introduction to different SPV systems.

Solar thermal devices principles and applications. Box type cooker, flat plate collector, concentrators, air heater, thermal energy storage, Solar pond, their Economic Analysis. Present & Future Scope of Solar energy technology.

Fuel cell – Principle of working, construction and applications. Introduction to mini and micro hydro system.

Reference Books

1. Solar Photovoltaic: Fundamentals, Technologies & Applications – Chetan Singh Solanki (PHI Publication)
2. Solar Energy, Principal of thermal collection and storage – Suhas P.Sukhatme. (Tata McGraw Hill Publication)
3. Solar Energy –J.P.Garg & Prakash (Tata McGraw Hill Publication)
4. Solar thermal energy systems – Sodha,Mathur,Malik Wielly (Eastern Ltd)
5. Terrestrial Solar Photovoltaic – Tapan Bhattacharya (Narosa Publishing House)

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS13**
Course Title: **ALTERNATE ENERGY SYSTEMS - II**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Wind Energy fundamentals & power analysis, wind resource assessment, Power Conversion Technologies and applications, Wind energy fundamentals, Principles of Aerodynamics of wind turbine blade, Wind turbine type, Wind turbine technology & components of WTG, Modern wind turbine control & monitoring system, Wind farm basics, selection and economics.

Energy Generation and utilization through Bio-mass, biofuels Principles & Application**.** Importance of biogas technology, Different Types of Biogas Plants. Aerobic and anaerobic bioconversion processes. Tidal, ocean and wave energy systems.

Reference Books

1. Wind Energy Systems – G.L.Johnson (Prentice Hall,1985)
3. Wind Energy Conversion System –Freris L.L (Prentice Hall,1990) Wind turbine Technology : Fundamental concepts of wind turbine technology- Spera D.A.(ASME Press NY,1994)
4. Wind Machines –frank Eldridge (Van Nostrand Reinold International company Londan)
5. Wind Turbine Engineering Design –David M.Eggleston & Forrest S.Stoddare (Van Nostrand Reinold International company Londan)
6. Energy Technology –S.Rao & Dr.B.B.Parulekar.
7. Biomass as fuel –L.P.White (Academic Press 1981)
8. Thermo chemical processing of Biomass – Bridgurater A.V.
9. Biomass Gasification Principles and Technology ,Energy technology review No.67 –T.B.Read (Noyes Data Corp.1981)
10. Biomass Gasification And Pyrolysis: Practical Design And Theory , Prabir Basu ISBN**:** 0123749883 ISBN-13**:** 9780123749888, Academic Press.

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS14x**
Course Title: **ENERGY CONSERVATION (ELECTIVE – I)**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Fundamentals of Electric Energy and their principles. Load Management, Power Factor improvement in the context of energy conservation. Electricity tariff and its structure, Electric Drive efficiency and factors affecting performance. Energy efficient drives, VSDs, VFDs. Fans and blowers, Pumps and Pumping Systems, Cooling Towers. Illumination fundamentals, Polar Curves, Light sources, lighting schemes, luminance requirements. Street, factory and flood lighting.

Concepts of Energy, Heat and Work, Ideal gas law, 1^{st} and 2^{nd} law of thermodynamics (Closed and Open Systems). Thermal energy using fossil fuels. Conversion of Thermal Energy to Mechanical Energy & Power. Role of boilers & turbines in energy conservation. Waste Heat Recovery concept, advantages and applications. Predictive and preventive maintenance in energy conservation

Reference Books

1. Power Plant Engineering by Damkodwar.
2. Utilization of Electrical Power by R.K.Rajput, Laxmi Publications
3. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)
4. BEE Reference book: no.1/2/3/4.
5. Energy Conversion systems: Begamudre, Rakoshdas
6. The Watt Committee on Energy (Reports), Edited by M.A. Laughton CRC Press
7. Heat and Thermodynamics – M.W. Zemansky (McGraw Hill Publication)
8. Principles of Energy Conversion: A.W. Culp (McGraw Hill International edition.)
9. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS14x**
Course Title: **BATTERIES AND FUEL CELLS (ELECTIVE – I)**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Basic concepts:- Components of cells and batteries, Classification of cells and batteries, Operation of a cell, Specifications Free energy, theoretical cell voltage, specific capacity, specific energy, energy density, memory effect, cycle life, shelf life, state of charge (SOC) and depth of discharge (DOD), internal resistance and coulombic efficiency.

Electrochemical principles and reactions, electrical double layer, discharge characteristics of cell and polarization, Electrode processes and Tafel polarization, thermodynamic background and Nernst equation.

Primary and secondary batteries Zn/C, Zn/air, alkaline cells, lithium primary batteries, lead acid, Ni/Cd, Ni/MH and Lithium secondary batteries (Components, Chemistry and Performance characteristics)

Applications of storage batteries. Fuel cell fundamentals, The alkaline fuel cell, Acidic fuel cells, SOFC (components, chemistry and challenges) Emerging areas in Fuel cells Fuel cell outlook, Applications of fuel cells Industrial and commercial

Reference Books

1. Hand Book of Batteries and Fuel cells, 3rd Edition, Edited by David Linden and Thomas. B. Reddy, McGraw Hill Book Company, N.Y. 2002.
2. Modern Electrochemistry 2A, Fundamentals of Electrodics, 2nd Edition, John O'M Bockris, Amulya K. N. Reddy and Maria Gamboa Aldeco, Kluwer Academic Publishers, Newyork.
3. Principles of Fuel Cells, by Xianguo Li, Taylor & Francis, 2006
4. Fuel Cells, Principles and Applications, Viswanathan, B. and Scibioh, Aulice M, Universities Press, 2006

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS14x**
Course Title: **MHD POWER GENERATION (ELECTIVE – I)**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents
Principle of MHD power generation, Properties of working fluids, MHD equation and types of MHD duct, Losses in MHD generators, Diagnostics of parameters, MHD cycles, MHD components (air heater, combustion chamber, heat exchanger, diffuser, insulating materials and electrode walls, magnetic field etc.) Economics and applications of MHD, Liquid metal MHD generators.

Reference Books

1 .M.H.D. power generation: engineering aspects [Unknown Binding]:-Gerard Joseph. Womack (Taylor & Francis, 1975)
2. Magneto hydrodynamic electrical power generation: - Hugo K. Messerle (J. Wiley, 08-Aug-1995)
3. MHD power generation: selected problems of combustion MHD Generators: - Rolf Bünde, Jürgen Raeder (Springer-Verlag)
4. Magneto hydrodynamic Energy Conversion, by Richard J. Rosa, McGraw-Hill, 1968.
5. MHD Power Generation, by G.J. Womack, Chapman and Hall Ltd London, 1968.
6. Direct Energy Conversion, by Sutton, McGraw-Hill, 1966.

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS15**
Course Title: **ENERGY LAB - I**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
-	-	02	02	01

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
-	-	-	-	50	50	100

The following Experiments shall be performed during the Term Work of this Laboratory:

1) Determination of power transformer efficiency
2) Loss estimation of Induction motor
3) Loss estimation of Synchronous Machine
4) V & Inverted V characteristics of Synchronous Machine
5) Study of Illumination of different luminaries and their comparative analysis
6) Determination of efficiency of boiler
7) Study of heat exchangers.
8) Study of variable speed drives
9) Study of diesel generator set.
10) Measurement of load and power factor for the electrical utilities.

***** The evaluation for TERM WORK (TW) shall be as mentioned below :

(i)	Timely completion	:	20
ii)	Attendance	:	10
iii)	Internal Viva Examination	:	20
	T o t a l	:	50

***** The evaluation for Performance & Oral Examination (POE) shall be based on Candidate's performance in performance of the experiment and/ or Viva Voce to be conducted in the presence of External Examiner.

Name of the Program: **I Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS16**
Course Title: **SEMINAR**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
-	-	2	02	01

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
-	-	-	-	50	00	50

II – SEMESTER

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS21**
Course Title: **INTEGRATED ENERGY SYSTEMS**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

National and rural level energy consumption pattern. Projection of energy demands, Energy consumption pattern in Agriculture and Industry. Substitution of conventional sources by alternative sources and more efficient modern technologies. Potential, availability as well as capacity of non-conventional sources of energy and other modern applications. Integration of different energy systems.

Energy storage devices, battery sizing. Stand alone and grid connected, Decentralized Distributed Generation of electricity,

Reference Books

1. Solar Photovoltaic : Fundamentals, Technologies & Applications – Chetan Singh Solanki (PHI Publication)
2. Solar Energy, Principal of thermal collection and storage – Suhas P.Sukhatme. (Tata McGraw Hill Publications).
3. Energy Technology – S.Rao & Dr.B.B.Parulekar
4. Laurie Barrtom, Renewable Energy Sources for fuels and Electricity, Island Press 1993.
5. R. Hunter and G. Elliot Wind-Diesel Systems, Cambridge University Press, 1994.
6. Renewable Energy: Sources for Fuels and Electricity by Thomas B Johansson

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS22**
Course Title: **ENERGY MODELING & PROJECT MANAGEMENT**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Basic concept of econometrics and statistical analysis, Econometric techniques used for energy analysis and forecasting with case studies from India; Input – Output Analysis Basic concept , concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy. Energy Modeling Interdependence of energy-economy-environment;

Modeling concept, and application, Methodology of energy demand analysis; Methodology for energy forecasting; Energy demand forecasting,

Energy Economics and Policies: National and regional energy planning; Integrated resource planning; Energy pricing, Project Evaluation & Management.

Reference Book

1. Chandhok, H. L. (1990): *India Data Base: The Economy*, Living Media Books, New Delhi.
2. Brahmananda, P. R. (1982): *Productivity in the Indian Economy: Rising Inputs for Falling Outputs*, Himalaya Publishing House, Delhi.
3. Goldar, B. N. (1986): *Productivity Growth in Indian Industry* Allied Publishers, New Delhi.
4. Brahmananda, P. R. and V. R. Panchamukhi (eds.), *The Development Process of Indian Economy*, Himalaya Publishing House, Mumbai.
5. Project Evaluation Criteria and Cost – Benefit Analysis (Edited), Oxford & IBH Publishing Co., New Delhi, Second Revised and enlarged edition. 1989
6. Econometric - Models – Techniques and Applications, „Foreword" by Jan Tinbergen, Indus Publishing Co., New Delhi. 1994
7. Munasinghe M., Meier P., "Energy Policy Analysis and Modeling", Cambridge University Press, New York, 2008.
8. James Stock, Mark Watson, "Introduction to Econometrics", 2nd ed., Pearson Education, New Delhi, 2006.
9. Ashok V. Desai (Editor) Energy Models, Wiley Eastern Ltd. (1990).
10. Jyoti Parikh, Energy Models for 2000 and Beyond, Tata McGraw Hill Publishing Company Limited (1997).
11. Ashok V. Desai (Editor) Energy Economics and Planning, Wiley Eastern Ltd. (1990).
12. Modeling approach to long term demand and energy implication: J.K.Parikh. Tata McGraw Hill Publishing Company Limited .

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS23**
Course Title: **ENERGY AUDIT & MANAGEMENT**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

General Philosophy and 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

Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, 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.

The plant energy study report- Importance, contents, effective organization, report writing and presentation.

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.Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy

Reference Books

1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
2. Energy Management Principles: C.B.Smith (Pergamon Press).
3. Efficient Use of Energy: I.G.C.Dryden (Butterworth Scientific)
4. Energy Economics -A.V.Desai (Wieley Eastern)
5. Industrial Energy Conservation: D.A. Reay (Pergammon Press)
6. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley Interscience Publication)
7. Industrial Energy Management and Utilization – L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington)
8. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
9. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice Hall)
10. Handbook on Energy efficiency –
11. ASHRAEE Energy Use (4 Volumes)
12. CIBSI Guide –Users Manual (U.K.)
13. CRC Handbook of Energy Efficiency – CRC Press.

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS24x**
Course Title: **PROJECT, PLANNING & DESIGN OF RENEWABLE ENERGY SYSTEMS (ELECTIVE – II)**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Photovoltaic system design, mathematical modeling. Converter topologies, buck, boost type. Their salient features. Battery system designing, charge controller designing and Battery controller designing.

Application wise change in design parameters,

Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, Various aspects of wind turbine design, Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation.

Concept of non-conventional system project planning, designing, cost analysis, pre feasibility analysis and environmental analysis.

Reference Books

1. Rene Codoni, Hi-Chun Park and K.V. Ramani (Editors) Integrated Energy Planning: A Manual, Vols. I, II & III. Asian and Pacific Development Centre, Kuala Lumpur (1985).
2. M.S. Kumar (Editor) Energy Pricing Policies in Developing Countries: Theory and Empirical Evidence, International Labour Organisation (1987)
3. Mohan Munasinghe and Peter Meir, Energy Policy Analysis and Modeling, Cambridge University Press (1993).
4. Harry Campbell and Richard Broron, Benefit- Cost Analysis, Cambridge University Press (2003)
5. Chan S. Park, Contemporary Engineering Economics, Prentice Hall Inc (2002)

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS24x**
Course Title: **ENVIRONMENTAL SCIENCE & ENGINEERING (ELECTIVE – II)**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Environmental degradation due to energy production and utilization, Primary and Secondary pollution such as SOx, NOx, SPM in air, depletion of ozone layer, global warming, biological damage due to environmental degradation. Potential sources of pollution in thermal power plant, air, water, land pollution and their due estimation.

Environmental pollution limits guidelines for thermal power plant pollution control. Various pollution control equipments. Their working principle and selection criteria, designing the pollution control system, methods and limitation. Water pollution in thermal power plant, physical and chemical methods of pollution Control. Land pollution. Effect of land pollution, measurement of land pollution. Limitations and advantages of pollution control systems.

Hydrothermal plant environmental assessment and rehabilitation measures. Nuclear power plants and environmental pollution, pollution control measures. International Standards for Quality of air and norms for exhaust gases. Industrial waste and effluent treatment, as a source of energy.

Reference Books

1. Management of Energy Environment Systems -W.K.Foell (John Wiley and Sons).
2. Energy Management and Control Systems -M.C.Macedo Jr. (John Wiley and Sons).
3. Environmental Impact Analysis Handbook -J.G.Rau, D.C.Wood (McGraw Hill).
4. Energy & Environment – J.M. Fowler, (McGrawHill)
5. Energy and Environment: Modeling and Simulation: - Bilas Kanti Bala, Nova Publishers, 1998

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS24x**
Course Title: **ENERGY ANALYSIS**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	02	-	05	04

Evaluation System

Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	20	70	100	-	-	-

Contents

Energy theory of value: Principles and systems of energy flows, Methods of energy analysis, Energy intensity method, Process analysis input-output method based energy accounting, Energy cost of goods and services energy to produce fuels: Coal, Oil, Natural Gas, Energy to produce electricity, Energy cost of various modes of passenger & freight transportation.

Industrial energy analysis: Aluminum, Steel, Cement, Fertilizers, Energetics of materials recycling, Energetics of renewable energy utilization (case studies), General energy equation, Energy loss, Reversibility & irreversibility, Pictorial representation of energy.

Energy analysis of simple processes, Expansion, Compression, Mixing and separation, Heat transfer, Combustion, Energy analysis of thermal and chemical plants, Thermo economic applications of energy analysis and national energy balance.

Reference Books

1. A.G. Thomas (editor), Energy Analysis, IPC Science and Technology Press Ltd. 1977.
2. I. Bousted and G.F. Hancock, Handbook of Industrial Energy Analysis, Ellis Horwood 1979.
3. A. Bejan, Entropy Generation through Heat and Fluid Flow, John Wiley & Sons 1982.

Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS25**
Course Title: **ENERGY LAB - II**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
-	-	02	02	01

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
-	-	-	-	50	50	100

The following Experiments shall be performed during the Term Work of this Laboratory:

1) Study of solar collector.
2) Study of solar hot water systems
3) Study of solar box type cooker
4) Performance evaluation of box type and concentrating type solar cooker.
5) Characteristics of SPV system.
9) Study of Lead Acid Battery as a energy storage.
10) Study of Performance of Solar Lamp.
11) Measurement of Intensity of solar radiation
12) Energy Content in Wind (Prototype Wind Mill of 500W)
13) Bio-gas Production from Kitchen waste.

***** The evaluation for TERM WORK (TW) shall be as mentioned below :

(iv)	Timely completion	:	20
(v)	Attendance	:	10
(vi)	Internal Viva Examination	:	20
	T o t a l	:	50

***** The evaluation for Performance & Oral Examination (POE) shall be based on Candidate" s performance in performance of the experiment and/ or Viva Voce to be conducted in the presence of External Examiner.

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Name of the Program: **II Semester M. Tech. (Energy Management Systems)**
Course Code: **PEMS26**
Course Title: **SEMINAR**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
-	-	2	02	01

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
-	-	-	-	50	00	50

Name of the Program: M. Tech. (Energy Management Systems)

DETAILED EVALUATION PROCEDURE

EXAMINATION	PROCEDURE OF EVALUATION
MSE (MID SEMESTER EXAMINATION) **(10-MARKS)**	The Mid Semester Examination marks shall be awarded by the concerned Subject Teacher on the basis of candidate" s performance in the written examination conducted by the Department. Usually, the MSE" s of two subjects shall be held on the same day. This will be ONE HOUR examination.
(IE) INTERNAL EVALUATION **(20-MARKS)**	The marks allotted for IA shall be awarded by the concerned Subject Teacher on the basis of Candidates performance in: Alertness/ response in the Class (05) Attendance (05) Assignments/ Tutorials (10)
(ESE) END SEMESTER EXAMINATION **(70-MARKS)**	The ESE shall be conducted by the University, as per schedule floated by it, as per its governing rules & regulations. This will be THREE HOURS written examination. The Theory paper of ESE shall comprise of EIGHT questions in all, out which the Candidate shall be required to answer ANY FIVE. All the Questions shall carry equal marks (14).
(TW) TERM WORK	The TERM WORK (TW) shall be there for the practical passing head and other passing Heads, for which theory evaluation is not there. The procedure of evaluation is already mentioned under the syllabus of respective head.
POE (PERFORMANCE & ORAL EXAMINATION)	The POE shall be there for all the passing heads where TW is there. The procedure of evaluation is already mentioned under the syllabus of respective head.