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Name of Program: M. Tech (Renewable Energy)

Session 2018-19

Subject Code	Category	Subject Name	Teaching &Evaluation Scheme								
			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE201		Wind power generation	60	20	20	30	20	3	1	2	5

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.
*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
This course aims to give students in depth understanding of wind generators, their integration to electric grid, related technical and economic challenges and also develop capability in the students to design wind power generation systems and make students aware with the challenges of the field,

Course Outcomes (COs): Upon completion of the course, the student will be able to
1. Adequately trained to research Wind power generation systems,
2. Skilled both theoretically and practically to use this subject for the application in wind power generation systems.

Syllabus

UNIT I: Introduction: Review of wind resource assessment, basic laws and concepts of aerodynamics (2-D, 3-D aerodynamics). Description and performance of the horizontal–axis wind machines, description and performance of the vertical–axis wind machines. Site Selection – Wind climatology, terrain features, surface roughness etc.

UNIT-II: Micro siting of wind turbines, site Identification, wind mast installation. Annual Energy Output estimation Uncertainties in estimation. Probabilities of Estimation. Betz criterion, Analysis of wind regimes – statistical analysis of wind regimes, Dynamics of data acquisition. Time distribution, Frequency distribution. Statistical Modelling.

UNIT III: Wind Power Project Planning & Structuring: Bank ability of Projects: Promoters, Financing, Balance Sheet, Non-Recourse or Project Finance, Leasing, Taxation Issues. Electricity off Take Arrangements & Structures: PPA with utility, Captive, Group Captive, Open Access & Merchant Sale Project Contracts: Wind Turbine Supply Contracts, Works Contracts, E&C Contract, O&M Contract

UNIT IV: Risk Mitigation Indemnities & Liabilities Power Curve Measurement, Project Management:

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Project Implementation Activities, Pert/ CPM/ MS Projects, Quality Assurance in Project Implementation. Evaluation & analysis, Implementation & monitoring, Performance indices.

UNIT V: Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection, Concept of wind form & project cycle, Cost economics & viability of wind farm.

Text Books:

1. Jain P. "Wind Energy Engineering", McGraw-Hill, 2011.
2. Johnson GL. "Wind Energy Systems, (Electronic Edition)", Prentice Hall Inc, 2006
3. Burton T. Sharpe D. Jenkins N. Bossanyi E. "Wind Energy Handbook", John Wiley, 2001 Jha AR. Wind Turbine Technology, CRC Press, Taylor & Francis, 2011.

Reference Books:

1. Nag P K. Power Plant Engineering, 3rd Edition, Tata McGraw Hill, 2008.
2. Bansal RK, "A textbook of fluid mechanics and hydraulic machines", Laxmi Publications, 2005, New Delhi.
3. Hussian Z. Abdullah MZ. Alimuddin Z, "Basic Fluid Mechanics and Hydraulic Machines".

LIST OF EXPERIMENTS:

1. Study of the aero generator operation in function of the wind speed variation.
2. Generator angle of incidence variation.
3. Operation differences using the three available blades configurations (aero generator with 6, 3 or 2 blades).
4. Operation differences depending on the angle of the blades.
5. Load variation influence on the aero generator.
6. Study of the voltage, power and current.
7. Study of V, I, W in function of different loads.
8. Efficiency experimental determination (depending on: number of blades, angle of the blades, generator´s angle; among others).
9. Wind energy measurement.
10. Familiarization with the regulator parameters.
11. Study of the power generated by the aero generator depending on the wind speed.
12. Study of the power generated by the aero generator depending on the air incident angle.
13. Connection of loads to direct voltage.
14. Study of the grid utility inverter.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE202		Hydro power generation	60	20	20	30	20	3	1	2	5

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.
*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
This course aims to make students aware about the uses of small and micro hydro plants and also identification of hydro as a competitive conventional source of energy.

Course Outcomes (COs): Upon completion of the course, the student will be able to
1. Adequately trained to research hydro power generation systems.
2. Skilled both theoretically and practically to use this subject for the application in hydro power generation systems.
3. Aware about the implications and new techniques for their mitigations, for the operation of a hydro power plant.

Syllabus

UNIT I: Introduction to Hydropower, Hydrology – descriptive hydrology, hydrograph, mass curve, storage, dams, Classification of Hydropower Plants, Small Hydropower, Systems: Overview of micro, mini and small hydro systems Status of Hydropower Worldwide Advantages and Disadvantages of Hydropower, Selection of site for hydroelectric plant, Hydrological cycle, Essential elements of a hydroelectric power plant.

UNIT II: Classification of Fluids, Characteristic of Water, units of Pressure, Pascal's law, applications of Pascal's law, Hydraulic press, Pressure measurement Types of fluid flow, stream line and turbulent flow Velocity Equation, Bernoulli's Equation, Power Equation, Continuity Equation, Cavitations, venturi meter, orifice meter, Pitot tube.

UNIT III: Components of hydropower plants Hydraulic Turbines: Types and Operational Aspects Classification of Hydraulic Turbines, Theory of Hydroturbines; Francis, Pelton, Kaplan and Propeller Turbine; differences between impulse and reaction turbines; Operational Aspects of Turbines Efficiency and selection of turbines, Types of generators - synchronous and induction, transformers,

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protection & control, transmission and distribution system. Dam and Spillway, Surge Chambers, Penstock, Tailrace.

UNIT IV: Site selection, environmental aspect, run-of-the-river and storage schemes; diversion structures, power channels, desilting arrangements, forebay tank and balancing reservoir, penstock and power house; transmission and distribution system.

UNIT V: Economics: cost structure, Initial and operation cost. Environmental issues related to small and large hydropower plants, Potential of hydro power in North East India.

Text Books:

1. Jiandong T, "Mini hydropower", John Wiley, 1997.
2. Wagner H. Mathur J. "Introduction to Hydro energy Systems: Basics, Technology and Operation", Springer, 2011.
3. S. Rao & B. B. Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005.

Reference Books:

1. Jack J. Fritz, "Small and Mini HydroPower Systems", McGraw-Hill.
2. Bryan Leyland, "Small Hydroelectric Engineering Practice", CRC Press; 1 edition (11 February 2014)

LIST OF EXPERIMENTS:

1. To perform a detailed study on the pumped storage hydro power plant.
2. To operate the given hydropower plant and find out the terminal voltage and frequency.
3. To synchronize the given power plant with grid system.
4. Determine the active, reactive and apparent power of given power plant.
5. Detect of mains harmonics oscillations and neutral conductor current.
6. To regulate the power both in generator and motor of given power plant.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE203		Issues in Grid Integration of Power from Renewable Energy Sources	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs): Grid integration is an important power system aspect. The various challenges and related issues must be addressed to the students for better understanding of the renewable energy sources and their applications. Keeping this in mind, the course has been developed to make students conversant with various devices / machines used for solar / wind power generation. Also, the integration related aspects will be discussed in detail.

COURSE OUTCOMES:

After the successful completion of this course students will be able to

1. Understand the logic of mini/micro grids, and smart grids
2. Understand the, Issues in integration of synchronous generator, Induction Generator, Converter based sources.
3. Manage Network voltage, power quality , frequency mismatch issues

Syllabus

UNIT -1

Introduction

Introduction to renewable energy grid integration, concept of mini/micro grids, and smart grids

UNIT-2

Synchronous Generator based sources:

Review of synchronous generators, Introduction to power system stability problems: rotor angle stability, voltage stability and voltage collapse, classification of stability. Modellingof synchronous machines: dq transformations, synchronous machine representation in stability studies.

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UNIT -3

Induction Generator based sources:

Introduction to induction machines: electrical characteristics, slip, speed-torque characteristics etc.

Self excited induction generator, Constant speed Induction generators, Variable speed Induction generators, Doubly fed Induction generators.

UNIT- 4

Converter based sources:

Introduction to power electronic devices, AC/DC converters, PWM, THD. Permanent magnet synchronous generator, solar PV systems, fuel cell, aquaelectrolizer.

UNIT -5

Grid Integration:

Issues in integration of synchronous generator based, induction generator based and converter based sources together. Network voltage management (discusses the issue of voltage levels). Power quality management (voltage dips, harmonics and flickers).Frequency management. Influence of WECS on system transient response.

Text Books:

1. Brendan Fox et. al.: *Wind Power Integration connection and system operational aspects*, IET Power and Energy Series 50 2007.
2. Marco H. Balderas (ed.): *Renewable Energy Grid Integration*, Nova Science Publishers, New York, 2009
3. Nick Jenkin, Janaka Ekavayake: *Wind Energy Generation Modeling and Control* ,Wiley and Sons
4. AJ Wood and BF Wollenberg: *Power Generation, Operation and Control* ,John Wiley & Sons, New York, 1996.

References:

1. M. Klobasa, *"Analysis of demand response and wind integration in Germany's electricity market"* IET Renew. Power Generation., Vol. 4, No.1, pp. 55–63 55, 2010
2. A. Helander1, H. Holttinen, J. Paatero," *Impact of wind power on the power system imbalances in Finland*" IET Renew. Power Generation., Vol. 4, No. 1, pp. 75–84, 2010
3. B.V. Mathiesen H. Lund," *Comparative analyses of seven technologies to facilitate the integration of fluctuating renewable energy sources*", IET Renew. Power Generation. Vol. 3, NO. 2, pp. 190–204, 2009.
4. Morales1, X. Robe1, M. Sala, P. Prats, C. Aguerri, E. Torres," *Advanced grid requirements for the integration of wind farms into the Spanish transmission system"* IET Renew. Power Generation, Vol. 2, No. 1, pp. 47–59, 2008.
5. M. Thomson and D.G. Infield *"Impact of widespread photovoltaic generation on distribution systems"*, IET Renew. Power Generation, Vol. 1, No.1, pp. 33–40, 2007.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers				
MTRE204		Software Simulation Lab	-	-	-	100	50	0	0	8	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Outcomes:

1. Write a program on MATLAB to Compute cell's current from voltage ,suns and temp
2. Write a program on MATLAB to plot PV curves
3. Design a Simulink model on Single diode photovoltaic generator with MPPT (Maximum Power Point Tracking)
4. Design a Simulink model on PV string partial shading and plot its I-V and P-V curve
5. Implement model of variable pitch wind turbine
6. Simulation of Solar cell on PC1D Software
7. Study of software HOMER and its different models of renewable energy for Simulation of major energy equipments
8. Use of application software RETScreen Simulation of major energy equipments

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE211		Batteries & Fuel Cells	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs):
The course aims to provide students with the fundamental knowledge on the emerging energy technologies. This course is an elementary introduction to batteries and fuel cell, the cornerstone of electro-mobility and renewable energy, the main drivers of sustainable development.

Course Outcomes (COs):
After the successful completion of this course students will be able to:

1. Understand the operation of electrochemical systems for the production of electric energy, i.e. batteries.
2. Analyze the underlying concepts, design, working and applications of fuel cell technology.
3. Understand the emerging trends in batteries.
4. Analyze the different types of fuel cells like acidic fuel, storage cell, lithium technology etc. and its commercial and industrial applications.
5. Apply further innovations in battery design, including novel battery and fuel cell technology which led to vast new applications.

Syllabus

UNIT -I
Battery- Storage Cell Technologies, Storage cell fundamentals, Characteristics, Emerging trends in batteries.

UNIT –II
Specifications-Storage cell definitions & specifications, Carbon-zinc & alkaline cells, Mercury, zinc-air, & silver oxide button cells, Lead acid, Edison, NiCad & NiMH cells, Lithium technology.

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UNIT -III

Applications- Storage cell summary, Applications of storage cell- Industrial

UNIT -IV

Fuel cell fundamentals, Alkaline fuel cell, Acidic fuel cells, SOFC- Emerging areas in Fuel cells

UNIT -V

Fuel cell outlook, Sources, Comments, & Revision history, Applications–Industrial and commercial.

Text Books

1. David Linden and Thomas. B. Reddy, "Hand Book of Batteries and Fuel cells", McGraw Hill Book Company, 3rd Edition, N.Y.2002.
2. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij M. Volfkovich, "Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors", John Wiley & Sons, Inc., 2015
3. Xianguo Li, "Principles of Fuel Cells", Taylor & Francis, 2006
4. Viswanathan B. and Scibioh, Aulice M, "Fuel Cells, Principles and Applications", Universities Press, 2006

Reference Books

1. R.M. Dell, David Anthony James Rand, "Understanding Batteries", RSC (RSC Paperbacks), 1st Edition, 2001.
2. Vielstich, "Handbook of fuel cells: Fuel cell technology and applications", Wiley, CRC Press, 2003.
3. Erik Kjeang, "Microfluidic Fuel Cells and Batteries", Springer, 2014.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE212		Sustainable building & cogeneration	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs):
The objective of the course is to Critically analyse, synthesise and reflect on sustainable building theory and recent developments, both local and international, To extend and challenge knowledge and practice, Professionally communicate and justify sustainable building design principles, strategies, solutions and/or outcomes,

Course Outcomes (COs): Upon completion of this course students will be able to:

- Explain basic concepts related to sustainability and environmental concerns.
- Identify major steps involved in the construction and commissioning of sustainable buildings.
- Apply analytical, design and communication skills to devise and justify design solutions for sustainable building projects.
- Understand the concept of cogeneration and its design parameters.

Syllabus

UNIT I **[6 Hrs]**

Concept of green buildings features of green building rating systems in India: LEED, GRIHA. Sustainable site, water, energy, material and indoor environment issues for green buildings;

UNIT II **[7 Hrs]**

Intent and documentation for credits/points for green rating systems; Difference in evaluation and documentation for new construction, existing buildings, core and shell projects. Green home rating system, green factory rating, green neighbourhood concept; Concept of Net zero energy building, net zero community

UNIT III **[6 Hrs]**

Energy Conservation Building Code: requirements of code, applicability, compliance options: prescriptive, trade-off, whole building performance routes for compliance

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UNIT IV **[7 Hrs]**

The concept of cogeneration, main design parameters for cogeneration, cogeneration alternatives, Bottoming and topping cycles, Steam turbine plants, Gas turbine plant, Diesel and gas engine plants,

UNIT V **[8 Hrs]**

Thermodynamic evaluation, Combined cycle applications, Sterling engine, Industry / utility cogeneration, Trigeneration, Techno economic and Environ-mental aspects, Cogeneration in sugar, textile, paper and steel industry.

Text Books:

1. C. J. Kibert, "Sustainable Construction: Green Building Design and Delivery, 2nd Edition, Wiley 2008.
2. M.M. EI Wakil, "power plant Technology", McGraw hill.

Reference Books:

1. David JC Maykay, "sustainable energy",version 3.5.2.
2. Energy Cogeneration Hand Book for Central Plant Design by George Polimeros

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE213		Geo Thermal and Ocean Energy	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs):

The objective of the course is to to understand the importance of geothermal energy derived from the interior heat of the Earth, utilisation of geothermal resources, construction of geothermal power plant, concepts of different ocean energy conversion systems and OTEC resources, site selection.

Course Outcomes (COs): Upon completion of this course students will be able to:

- Explain the principles that underlie the ability of geothermal energy to deliver useable energy
- Understand geothermal energy conversion systems.
- Outline the technologies that are used to harness the power of geothermal energy
- Different ocean energy conversion systems and OTEC resources,
- Understand and pursue further research work behind the development of non conventional energy sources as a part of their research work.

Syllabus

UNIT I **[6 Hrs]**

Introduction of Geothermal Energy, Geothermal resources; definition and classification.

UNIT II **[6 Hrs]**

Hydrothermal system, hot dry rock systems, Geo-pressured reservoirs, Magma energy, Dry rock and hot aquifer analysis .

UNIT III **[7 Hrs]**

Utilization of geothermal resources, Direct utilization; Swimming bathing & balneology, space conditioning, district heating.

UNIT IV **[7 Hrs]**

Geothermal heat pump; basic concept of heat pump, air conditioner, heating and cooling mode in heat pump, Heat pump with geothermal resources; typical GHP loop configuration

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UNIT V **[7 Hrs]**

Ocean Thermal: Introduction, OTEC history and technology progress, working principle, resources & site requirement.

Text Books:

1. G.N.Tiwari & M.K. Ghosal. "renewable energy resourses", Alpha science international,2005.
2. Godfrey Boyle, "Renewable energy", Oxford University Press, 2nd edition, 2010

Reference Books:

1. Roland Wengenmayr, Thomas Buhrke," Renewable energy: Sustainable energy concepts for the future", Wiley-VCH, 1st edition, 2008.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE221		Life Cycle Assessment of Renewable Energy Systems	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs):
Governments are setting challenging targets to increase the production of energy and transport fuel from sustainable sources. The emphasis is increasingly on renewable sources including wind, solar, geothermal, biomass based biofuel, photovoltaics or energy recovery from waste

Course Outcomes (COs): Upon completion of this course students will be able to:

1. Financial evaluation.
2. Study of energy analysis methodologies.
3. Environmental analysis.
4. Data quality of embodied energy.

Syllabus

UNIT I
Financial evaluation: simple pay back analysis, return on investment, time based value of money, NPV method, annuity method, calculation of IRR.

UNIT II
Energy analysis: concept of embodied energy, energy analysis methodologies: process chain analysis.

UNIT III
Input-output method, inventory method; cumulative energy demand, energy yield ratio, energy payback.

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UNIT IV

Environmental analysis: concept of carbon footprint of materials and systems, cumulative emission for renewable energy systems, environmental indicators of RE systems.

UNIT V

Data quality of embodied energy, and specific emission of materials.

Text Books

1. Life Cycle Analysis of Renewable Energy Systems ISBN 978-1-4471-5363-**Authors** Eduardo Martínez, Emilio Jiménez, Julio Blanco, Mercedes Pérez. Designing Renewable Energy Systems: A Life Cycle Assessment Approach, Leda Gerber,December 23, 2014 by EPFL Press Reference - 224 Pages - 160 B/W Illustrations ISBN 9781498711272 - CAT# N11224

Recommended Books

1. Life Cycle Analysis of Renewable Energy Systems Due: July 7, 2020, ISBN 978-1-4471-6247-6, Authors: **Martínez**, E., **Jiménez**, E., **Blanco**, J., **Pérez**, M.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTRE222		Industrial and Commercial Applications of Renewable Energy Sources	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs):
There is vast potential of usage of renewable energy in industries and commercial sector. With the study of this course one can quantify the energy saved and carbon dioxide mitigation impact. Related latest technologies and economics of renewable energies would also be studied.

Course Outcomes (COs): Upon completion of this course students will be able to:

1. Evaluation of commercial and industrial energy demand.
2. Study of different energy systems for heating.
3. Use of renewable in commercial and industrial buildings.
4. Economics of renewable energy based commercial and industrial installations.

Syllabus

UNIT I

Commercial and industrial energy demand; Qualitative and quantitative features and characteristics, Renewables & electricity for a growing economy

UNIT II

Water heating, process heating and drying applications, Solar, Biomass and geothermal energy based systems.

UNIT III

Combined space and building service hot water systems, Electricity generation from renewable to meet commercial and industrial power requirement, Stand alone and grid connected systems, Ethanol and methanol from cellulosic biomass

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UNIT IV

Use of renewable in commercial and industrial buildings for load leveling, lighting and space heating and cooling

UNIT V

Economics of renewable energy based commercial and industrial installations case studies, Thermal low and medium energy requirements of different industries

Text Books

1. A. V. Da Rosa, Fundamentals of Renewable Energy Processes, Academic Press, 2 nd edition, 2009.

Recommended Books

1. J. D. Myers, Solar Applications in Industry and Commerce, Prentice-Hall, 1st edition, 1984.

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			Theory			Practical		L	T	P	Credits
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers				
MTRE223		Energy Policy and Planning	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

Course Educational Objectives (CEOs):
This course provides a framework for understanding the subject energy policy and planning, and for acting. First, we want students to understand the strategic role that policies play in the formation of energy systems. Secondly, we want to increase awareness among energy professionals about how encompassing the challenges are that they have to face as they enter professional life.

Course Outcomes (COs): Upon completion of this course students will be able to:

1. Understand how energy policy is designed and implemented
2. Identify policy processes.
3. Identify the role of different stakeholders; and.
4. Assess outcomes. They will also be able to understand how energy policy instruments affect energy system investment decisions and public behavior.

Syllabus

UNIT I
Energy and Environment Basic Issues: Criteria for Economic Growth; Energy-Economy Environment Linkages; Emissions Inventories: Assessment and Policy Relevance.

UNIT II
Issues for Developing Countries: Energy and Environment Policies from Urban and Rural perspectives.

UNIT III
Analysis Methodologies: Scenarios and Models, Global and Local Environmental Issues:

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UNIT IV

Climate Change Negotiations Technological Options:

UNIT V

Energy-Efficiency and New Energy Technologies; Renewable Energy: Issues, Prospects and Policies.

Text Books

1. Energy Economic by Parag Diwan
2. Renewable Energy Policy and Politics: A Handbook for Decision-Making . Mallon, K. (Editor). Earthscan Publications. 2006

Recommended Books

1. Energy Sources & Policies in India by Rishi Muni Dwivedi

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