ECON 7012	Techno economics of energy system	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	- Graduation				
Co-requisites					

OBJECTIVE:

To familiarize students with various energy generation options and their economics.

Course Outcomes

CO1: To demonstrate conceptual knowledge about technical know-how of various energy sources.

CO2: To apply various technologies available for energy generation

CO3: To evaluate economy of energy generated from various energy sources

CO4: To Integrate the understanding of techno economics of energy systems

Catalog Description

Understanding of Techno Economics of Energy Systems will help managers anlyse fundamentals of energy systems. It will also consolidate the understanding of all different kinds of technology requirements of oil, gas, coal and renewables and their relevant energy systems with cost and management implication. This course aims to provide an understanding of fundamental aspects of the energy systems and issues relevant to different types of energy.

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Course Content

Unit I: **6 lecture hours**

Fundamentals of Energy Systems

Engineering Economics, Units and Unit Conversions, Thermodynamic Cycles, Fundamentals of Heat Transfer

Unit II: **6 lecture hours**

Coal, Natural Gas, Petroleum, Nuclear, Coal, Natural Gas, Petroleum, Nuclear, Hubbert Peak Theory,

Unit III: **8 lecture hours**

Harvesting Energy from Wind, Energy and Power from Wind, Energy Production, Turbine, Type and Comparison, Cost of Electricity from Wind Energy, Payback Time for Wind Energy Systems, Cost Reduction Efforts, Effect of Capacity Factor, Basic Principles of Wind Resource Evaluation,

Unit IV 6 **lecture hours**

Trough Systems- Power Tower Systems, Dish/Engine Systems, Solar Thermal Molten Salt Technology, Photovolta, ics- PV Theory, The Efficiency of Photovoltaic Cells, The "Sun" Value, Effect of Thickness of the Cell, The Effect of Temperature, Effect of Dopant Concentration, From Cells to Arrays, Solar Cell Materials- Semiconducting Materials for Solar Cell, Multijunction Cells, Hybrid Power Systems, Solar Lighting

Unit V **6 lecture hours**

Hydropower Systems, Hydropower System Construction Methods-Impoundment, Hydro turbine - Impulse Turbine, Reaction Turbine; Selection of Turbines, Run-of-the-River Hydropower Systems, Small Hydroelectric Power System-Components of a Small Hydro Power System, Micro-Head Hydropower Systems- Selection of Turbine for Small or Micro Head Systems, Pumped Storage Hydropower System, Calculation of Power from Water Flow: Local Head Losses, Head Losses in Open Channels,
Micro-Head Hydropower Systems- Selection of Turbine for Small or Micro Head Systems, Hydropower System Efficiency, Fish Ladder and Fish, Passage in Hydropower Systems

Unit VI **1-lecture hours**

Geothermal Energy

Resource Identification, Geothermal Systems, Applications-Electricity Generation, Direct Use of Geothermal Energy, Ambient Ground Heat/Geothermal Heat Pump.

Unit VII **3 lecture hours**

Bioenergy

Energy Source of Biomass, Composition of Biomass, Types of Biomass, Biomass Resources, Land Requirement, and Production, Wood Fuel: Unit of Wood, Wood Burning, Use of Biomass: Process Heat and Steam Generation, Electric Power Generation, Biomethane, BioFuels.

Text Books

1. Tushar K. Ghosh and Mark A. Prelas, Energy Resourcesand Systems, Volume 1: Fundamentals and Non-Renewable Resources, Springer Dordrecht Heidelberg London New York, 2011

2. Tushar K. Ghosh and Mark A. Prelas, Energy Resources and Systems, Volume 2: Renewable Resources, Springer Dordrecht Heidelberg London New York, 2011

REFERENCE

a) Regular updates about energy scenario & sources - Monthly/ daily magazines

b) Ferdous, S. M., Ovy, E. G., Hasan, M. R., Khaled, W. B., & Hasan, M. N. (2011). An Overview of Technical and Economic Feasibility of Retrofitted MHD Power Plants from the Perspective of Bangladesh. Journal of Selected Areas in Renewable and Sustainable Energy, 1-5.

c) Kothari, D. P., Singal, K. C., & Ranjan, R. (2011). Renewable energy sources and emerging technologies. PHI Learning Pvt. Ltd.

WEB SOURCES:

1. http://www.iea.org/
2. http://www.cea.nic.in/
3. http://www.mnre.gov.in
4. http://www.powermin.gov.in

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Test	Assignment	Presentation	ESE
Weightage (%)	20	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Programme Outcomes**
CO1	Have skills about technical know-how of various energy sources	**PO2, PO3, PO10, PO11, PO14**
CO2	Understanding about technologies available for energy generation	**PO1, PO2, PO3, PO8, PO8, PO10, PO11, PO14**
CO3	Able to evaluate economy of energy generated from various energy sources	**PO2, PO3, PO10, PO13, PO14**
CO4	To extend the understanding of techno economics of energy systems	**PO1, PO2, PO3, PO8, PO9, PO 11, PO12, PO13, PO14**

Program Outcome / Course Outcome mapping

Course Outcomes	CO 1	CO 2	CO 3	CO4
PO 1		3		3
PO 2	3	3	3	3
PO 3	3	3	3	3
PO 4				
PO 5				
PO 6				
PO 7				
PO 8		3		3
PSO 9				2
PSO 10	3	3	3	
PSO 11	3	3		3
PSO 12				3
PSO 13			3	3
PSO 14	2	3	3	3

		Students will be able to develop and evaluate alternate managerial choices and identify optimal solutions.	Students will demonstrate application capabilities of their conceptual understanding of analytics to real world business issues.	Students will be able to exhibit effective decision-making skills, employing analytical and critical thinking ability	Students will demonstrate oral and written communication skills to present outcomes of business analytics algorithms	Students will be able to work effectively in teams and demonstrate team-working capabilities *domains for the*	Students will exhibit leadership and networking skills *perspective towards regulatory mechanism with respect to*	Students will demonstrate sensitivity towards ethical and moral issues and have ability to address them in dealing with data and	Students will demonstrate employability traits in line with the needs of changing dynamics of the analytics industry.	Students will demonstrate strong conceptual knowledge of economic theory in the context of renewable and non-	Students will demonstrate effective understanding of economics as it is applicable to energy markets, energy	Students will demonstrate analytical skills in designing solutions for energy efficiency.	Students will exhibit the ability to evaluate working of energy policies.	Students will have domestic and global perspective towards legal frameworks and environmental regulations with respect	Students will exhibit deployable skills pertinent to the renewable and non-renewable energy sectors.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO 9	PO 10	PO11	PO 12	PO 13	PO 14
ECON 7012	TEES	1	3	3					1	1	2	2	1	1	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

Name: **Enrolment No:**	UPES

End Semester Examination-March 2017
Program/course: MA – Economics **Semester : IV**
Subject: Techno economics of Energy System **Max. Marks : 100**
Code : MEDE 811 **Duration : 3 Hrs**

Section A (attempt all)			
1.	Efficiency of a typical large hydroelectric plant is generally very less.	**[2]**	**CO1**
2.	Geo thermal energy is a popular & common energy source in India	**[2]**	**CO1**
3.	Wind plant production is highly predictable & forecasting is easy.	**[2]**	**CO2**
4.	The efficiency of a solar PV is generally greater than 50%	**[2]**	**CO2**
5.	Biomass energy sources are readily available in cities	**[2]**	**CO3**
6.	Biomass fuels are zero emission fuels	**[2]**	**CO1**
7.	Solar PV plant generates AC voltage	**[2]**	**CO1**
8.	Capacity factor depends on height of wind turbine	**[2]**	**CO1**
9.	High density of air makes more production from wind turbine	**[2]**	**CO10**
10.	Net metering is very common in India.	**[2]**	**CO1**
	SECTION B (Answer all the questions)		
1.	What are the macro economic factors considered for checking viability of a wind form?	**[4]**	**CO1**
2.	What are the advantage of Mini hydroelectric plants?	**[4]**	**CO1, CO14**
3.	Draw an schematic diagram for Net metering enabled roof top PV plant	**[4]**	**CO1, CO5**
4.	How the performance of PV Cell varies with rise in temperature?	**[4]**	**CO13, CO14**
5	Why HAWT is more popular than VAWT?	**[4]**	**CO12, CO11**
	SECTION C (Answer all)		
7.	What is capacity factor of a wind turbine and How is it related with location & height?	**[10]**	**CO1, CO2**
8.	What are the various active & passive solar thermal devices?	**[10]**	
9.	What are the components of wind turbines used in wind farms?	**[10]**	**CO1, CO2**
10.	What kind of biomass fuels are available in India and write advantage / disadvantage?	**[10]**	
	Section D (Answer all)	**[10]**	
1.	What are the various type of PV cell technologies and their comparison?	**[15]**	**CO13, CO14**
2.	What are the impacts & issues of Wind power plant?	**[15]**	**CO2, CO11**

3.	What are the highlights & benefits passed on under JNNSM?	**[15]**	**CO12, CO3**