PIPM 8002	Wind and Alternative Sources of Energy	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Graduate in Engineering/Science discipline				
Co-requisites	Basic understanding about power sector				

Course Objectives

1. To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Wind and Alternative Sources of Energy.
2. To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Wind and Alternative Sources of Energy.

Course Outcomes

On completion of this course, the students will be able to exhibit

CO1. Conceptual knowledge of the technology, economics and regulation related issues associated with wind and alternative sources of energy

CO2. Ability to analyse the viability of wind and alternative energy projects

CO3. Capability to integrate various options and assess the business and policy environment regarding wind and alternative energy projects

CO4. Advocacy of strategic and policy recommendations on usage of wind and alternative energy

Catalog Description

Worldwide, increased focus on sustainable development has led to sharp rise in development of projects based on solar, wind and other alternative energy resources. As these are clean and renewable energy options, countries are promoting its large-scale usage wherever possible. Technology improvements, mass manufacturing and innovative financing mechanisms have made these projects achieve grid parity in many countries. Thus, with reduced power prices and dependable electricity storage options, large-scale integration of wind and other alternative energy projects to the grid has been planned. This has opened up numerous job opportunities worldwide. In this course, students will be engaged to help them acquire technical and commercial knowledge and skills associated with wind and alternative energy projects (non-solar renewable energy projects). Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as group discussions, cooperative group solving problems, quizzes, presentations, etc. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities and to give an oral group presentation. Students will be expected to interact with media resources, such as, web sites, YouTube videos, blogs, and newspapers articles.

Course Content

Unit I: 6.0 lecture hours

Introduction; Global trend in wind and alternative sources of energy; wind, biomass and other alternatives sources of energy for power generation in India – opportunities and challenges

Unit II: 12.0 lecture hours

Global trend in wind power; Wind energy – source of energy, variations with location and height; Wind power and wind power density; Wind atlas of India; Wind power in India – opportunities and challenges; Wind power – Layout and working principle, classification (onshore, near shore and offshore wind farms), economics, regulation; Policy regarding wind power – World and India

Unit III: 9.0 lecture hours

Biomass based power generation – technology (gasification and anaerobic digestion), economics, regulation; Opportunities and challenges regarding biomass power; Policy regarding biomass power – World and India

Unit IV: 9.0 lecture hours

Other alternative sources of energy (Tidal, Geothermal, OTEC); Issues of intermittency, storage and grid integration; Wind Parks; Financing wind and alternative sources of energy projects

Text Books

1. Twidell J., Weir T. (2015). Renewable Energy Resources (3rd Edition). Routledge. ISBN: 0415584388.
2. Kandpal T.C., Garg H.P. (2003). Financial Evaluation of Renewable Energy Technologies. Macmillan Publishers India Limited. ISBN: 1403909520.

Reference Books

1. Gasch R., Twele J. (2011). Wind Power Plants: Fundamentals, Design, Construction and Operation (2nd Edition). Springer Science & Business Media. ISBN: 3642229387.
2. van Swaaij W.P.M., Kersten S.R.A., Palz W. (2015). Biomass Power for the World. CRC Press. ISBN: 9814613894.

Modes of Evaluation

Quiz/Assignment/Presentation/Extempore/ Written Exam

Modes of Evaluation (100 Marks)

Quiz: 20 marks
Assignment/Presentation: 30 marks
Written Exam (End-semester): 50 marks

Examination Scheme

Components	Internal Assessment (Quiz/Assignment/Presentation/Extempore)	End-Semester Exam (Written Exam)
Weightage (%)	50%	50%

Program Outcomes

PO1: Students will be able to develop and evaluate alternate managerial choices and identify optimal solutions.

PO2: Students will demonstrate effective application capabilities of their conceptual understanding of power generation, transmission, distribution, trading along with sustainability practices.

PO3: Students will be able to exhibit effective decision-making skills, employing analytical and critical thinking ability.

PO4: Students will demonstrate effective oral and written communication skills in the professional context.

PO5: Students will be able to work effectively in teams and demonstrate team-working capabilities.

PO6: Students will exhibit leadership and networking skills.

PO7: Students will demonstrate sensitivity towards ethical and moral issues and have ability to address them in the context of power management.

PO8: Students will demonstrate employability traits in line with the needs of changing dynamics of the industry**.**

PSO1: Students will demonstrate strong conceptual knowledge in fuel management, power generation, transmission, distribution, trading, energy management, financing and regulation, and sustainable development.

PSO2: Students will demonstrate effective understanding of functioning of power sector.

PSO3: Students will demonstrate analytical skills in identification and resolution of issues pertaining to fuel management, power generation, transmission, distribution, trading, energy management, financing and regulation, and sustainable development.

PSO4: Students will exhibit the ability to integrate technical, economic, social and regulatory frameworks for power sector planning and resource management.

PSO5: Students will exhibit deployable skills pertinent to the power sector.

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

Mapping between COs and POs		
	Course Outcomes	**Mapped Programme Outcomes**
CO1	Conceptual knowledge of the technology, economics and regulation related issues associated with wind and alternative sources of energy	**PO1, PO8, PSO1, PSO2**
CO2	Ability to analyse the viability of wind and alternative energy projects	**PO2, PSO3, PSO5**

CO3	Capability to integrate various options and assess the business and policy environment regarding wind and alternative energy projects	**PO3, PSO4, PSO5**
CO4	Advocacy of strategic and policy recommendations on usage of wind and alternative energy	**PO4, PO6, PO8 , PSO4, PSO5**

Program Outcome / Course Outcome Mapping

Course Outcomes	**CO 1**	**CO 2**	**CO 3**	**CO 4**
PO 1	3	2	2	2
PO 2	2	3	2	2
PO 3	2	2	3	2
PO 4	1	1	3	3
PO 5	1	1	1	2
PO 6	2	1	2	3
PO 7	1	1	2	1
PO 8	3	2	2	3
PSO 1	3	2	2	2
PSO 2	3	2	2	2
PSO 3	2	3	2	2
PSO 4	2	2	2	3
PSO 5	2	3	3	3

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
PIPM 8002	Wind and Alternative Sources of Energy	3	3	3	2	1	2	1	3	3	3	3	3	3

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

Model Question Paper

Name: **Enrolment No:**	UPES

Course: PIPM 8002 – Wind and Alternative Sources of Energy

Programme: MBA (Power Management) **Semester: ODD-2017-18**

Time: 03 hrs. **Max. Marks: 100**

Section – A (5 marks * 6 = 30 Marks)

Discuss the following in brief:

1.	Offshore Wind Turbine	**[5]**	**CO1**
2.	Onshore Wind Turbine	**[5]**	**CO1**
3.	Wind Park Effect	**[5]**	**CO1**
4.	Biomass Gasification	**[5]**	**CO1**
5.	Residue to Product Ratio (RPR) of a Crop	**[5]**	**CO1**
6.	Betz Law	**[5]**	**CO1**
	Section – B (10 marks * 5 = 50 Marks)		
7.	Draw a hypothetical power curve for a 1 MW wind turbine indicating cut-in speed, rated speed and cut-out speed parameters.	**[10]**	**CO2**
8.	Discuss the various options to increase wind power at a particular location.	**[10]**	**CO2**
9.	Explain the factors that need to be considered for accurate biomass resource assessment from agriculture residue.	**[10]**	**CO2**
10.	Discuss Sweden's waste management practices that make it a world leader in this area.	**[10]**	**CO3, CO4**
11.	Assuming yourself as a policymaker, discuss policy measures that can help create a market for biogas run vehicles.	**[10]**	**CO3, CO4**
	Section – C (20 marks * 1 = 20 Marks) Answer any one question from this section:		
12.	Municipal solid waste has immense potential to address energy and non-energy issues of the cities in India. Justify.	**[20]**	**CO1, CO2, CO3, CO4**
13.	Considering India's renewable energy target of 1,75,000 MW capacity by 2022, comment on the various options and their chances of achieving individual targets. Considering low cost power and grid stability as important factors, discuss the roles that wind and biomass power technologies can play in achieving the cumulative target of 1,75,000 MW by 2022.	**[20]**	**CO1, CO2, CO3, CO4**