

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Wind and Solar Energy System (Professional Elective-III)
Course Code:	2ET1090705T
Pre-requisite Course:	--

Course Objectives:

1. Understand the fundamentals of renewable energy sources, with emphasis on wind and solar energy, and their role in sustainable power generation.
2. Understand power conditioning and grid integration of wind and solar systems.
3. To acquire knowledge about solar photovoltaic and solar thermal power generation.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Physics of Wind Power: History of wind power, Indian and global statistics, Introduction of wind park, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	06	15
2	Wind Generator Topologies: Review of modern wind turbine technologies, Fixed and variable speed wind turbines, Induction Generators, Doubly-Fed induction generators and their characteristics, Mathematical modeling of wind generators, Permanent-Magnet Synchronous generators, Power electronics converters. Generator-Converter configurations, Converter control.	10	20
3	The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability, Introduction of solar park.	04	10
4	Solar Photovoltaic: Technologies, Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control.	08	18
5	Network Integration Issues and Hybrid Renewable Energy Systems in Micro-grids: Overview of grid code technical requirements, Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances, Power quality issues, Requirement of hybrid systems, Types of hybrid systems (PV-diesel-battery, wind-PV, fuel cell-PV), limitations of hybrid systems, Analysis of integrated wind-solar hybrid energy systems, Operation of hybrid systems.	12	25

6	Solar thermal power generation: Technologies, Parabolic trough, Central receivers, Parabolic dish, Fresnel, Solar Pond and Elementary analysis.	05	12
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Text Books:

1. Wind Power in Power Systems- T. Ackermann, John Wiley and Sons Ltd.-2012.
2. Solar Energy: Principles of Thermal Collection and Storage- S. P. Sukhatme, McGraw Hill, 3rd edition, 2009.
3. Hybrid-Renewable Energy Systems in Microgrids: Integration, Developments and Control- Hina Fathima, Prabakaran N, Palanisamy K, Woodhead Publishing Series in Energy, 1st Edition- 2018.

Reference Books:

1. Renewable and Efficient Electric Power Systems- G. M. Masters, John Wiley and Sons, 3rd Edition, 2023.
2. Grid integration of wind energy conversion systems- H. Siegfried and R. Waddington, John Wiley and Sons Ltd, 3rd Edition, 2014.
3. Renewable Energy Applications- G. N. Tiwari and M. K. Ghosal, Narosa Publications, 2004.
4. Solar Engineering of Thermal Processes- J. A. Duffie and W. A. Beckman, John Wiley & Sons, 5th Edition, 2020.
5. Solar Photovoltaics: Fundamental, Technologies and Applications- Chetan Singh Solanki, 2nd Edition, PHI Learning Pvt. Limited, New Delhi, 2011.
6. Modeling and Stability Analysis of Inverter-Based Resources- Lingling Fan and Zhixin Miao, CRC Press, 2024.

ICT/ MOOCS:

1. <https://nptel.ac.in/courses/121/106/121106014/>
2. <https://nptel.ac.in/courses/108105058/>
3. <https://nptel.ac.in/courses/108108078/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Interpret solar photovoltaic and solar thermal generation.	3 Applying
CLO2	Acquire the knowledge of basic physics of wind and solar power generation.	1 Remembering
CLO3	Differentiate the power electronic interfaces for wind and solar generation.	4 Analyzing
CLO4	Understand the issues related to the grid-integration of solar and wind energy systems.	2 Understanding

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO2	PSO 3	PSO4
CLO1	H	M				M	H	M	M			M	L			L
CLO2	M	L		L		L	H		L		M	L	L			H
CLO3	M	M	L	M	H	H			L		L		M	M	M	
CLO4	H	H	M		L	H	M	M	L	M		L	M	M	M	L

H: High, M: Medium, L: Low