B.Tech III Year II Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA 19AME64d - SOLAR AND WIND ENERGY SYSTEMS

(Professional Elective-II)

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Course Objectives: The objectives of the course are to make the students learn about

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

UNIT - I: Solar radiation and collectors

12 Hrs

Solar radiation and collectors: Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats performance of the collectors.

Solar thermal technologies: Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems - Solar Desalination - Solar cooker: domestic, community – Solar pond – Solar drying.

Learning Outcomes:

At the end of this unit, the student will be able to

	Explain the basic concepts of solar radiation and solar collectors	L2
•	Develop sun path diagrams	L3
•	Explain the concepts of tracking systems	L2
•	Discuss the working principles of solar thermal technologies	L6
•	Develop design and operation of solar heating and cooling systems	L3
•	Explain the principles of thermal storage systems	L2
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UNIT – II: Solar PV fundamentals

L2

L3

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Solar PV fundamentals: Semiconductor - properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metalsemiconductor interface - dark and illumination characteristics - figure of merits of solar cell efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements high efficiency cells – Solar thermo-photovoltaics.

SPV system design and applications: Solar cell array system analysis and performance prediction-Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system -System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the properties of a semiconductor
- Apply the principles of solar thermo photo voltaics • Outline the applications of SPV system

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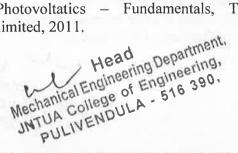
Department of Mechanical Engineering	R19		
Analyze the performance of a solar cell array system	L4		
Utilize centralized and decentralized SPV systems	L3		
UNIT – III: Introduction to wind energy	10Hrs		
Introduction: Historical Perspectives on Wind Turbines- Indian Energy Scenario - G	lobal Energy		
Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and	Global Wind		
Installations.			
Basics of Wind Resource Assessment: Power in the wind -Wind Characteristics - Me	asurement of		
wind using anemometers (cup anemometer, propeller anemometer, pressure plate	anemometer,		
pressure tube anemometer, sonic anemometer and other remote wind speed sensing t			
Turbulence-Wind Power Density –Average wind speed calculation - Statistical models			
analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes –			
Wind Monitoring Station Siting and Instrumentation.	wind Rose,		
Learning Outcomes:			
At the end of this unit, the student will be able to			
Recall historical perspective of wind turbines	L1		
Relate Indian and global energy requirements.	L1		
Interpret power in the wind	L2		
 Classify different wind speed measuring instruments 	L2		
 Apply different statistical models for wind data analysis 	L3		
UNIT – IV: Wind Energy Conversion Systems	8 Hrs		
Wind Energy Conversion Systems: Types - Components of Modern Wind Turbine			
VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive			
pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.			
Learning Outcomes:	1		
At the end of this unit, the student will be able to			
Utilize different wind parameters for design of rotor	L3		
Make use of power curve for energy estimation	L3		
List different components of modern wind turbine Final in house a control the money of a wind turbine.	L1		
 Explain how to control the power of a wind turbine Name different safety measures of wind turbine 	L2 L1		
UNIT – V: Wind Farm Design and Health (Condition) Monitoring	8 Hrs		
Wind Farm Design and Health (Condition) Monitoring: Planning of wind farm, S			
Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, P			
DPR, Environmental Benefits and Impacts.	reparation of		
Small Wind Turbines: Water pumping wind mills, offshore wind energy, Wind tu	rhina tectina		
future developments.	rome testing,		
A			
Learning Outcomes: At the end of this unit, the student will be able to			
Plan the wind farm	L3		
Analyze the feasibility of wind farm	L4		
List the environmental benefits and impacts	L1		
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Text Books:

• Explain about small wind turbines

1. Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.

2. Chetan Singh Solanki, "Solar Photovoltatics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.



L2

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L2

Reference Books:

- 1. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
- 2. Sukhatme S.P., Nayak.J.P, 'Solar Energy Principle of Thermal Storage and collection', Tata McGraw Hill, 2008.
- 3. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, (2010).
- 4. Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, 2004, Chelsea Green Publishing.
- 5. R. Jha, Wind Turbine Technology, CRC Press, (2010).

Course Outcomes:

At the end of this Course the student will be able to

- Understand with basics of solar radiation, available solar energy and its measurement
- Illustrate the solar collectors, construction and operation of solar collectors.

