

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Department Elective-II: Renewable Energy Sources
Course Code:	1ET1090705
Pre-requisite Course:	Fundamental Knowledge of Electrical Machine is required.

Course Objectives:

1. The students will acquire the knowledge regarding the fundamentals of solar system and wind energy system.
2. It will help the students to develop the skill required in field of renewable energy.
3. The student will get knowledge about the different type of the wind generator.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)								
Lecture	Tutorial	Practical	Credit	Theory				Practical				Total
				University Assessment		Continuous Assessment		University Assessment		Continuous Assessment		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	-	-	3	28	70	12	30	-	-	-	-	100

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Classification of Solar Cell: Solar cell, Parameters of solar cell, solar cell technologies, Monocrystalline Silicon Solar Cell, Polycrystalline Silicon Solar Cell, Gallium-Arsenide Cell, Copper Indium Diselenide Cell, Amorphous Solar Cell, Solar PV Module, Solar PV Panel, Solar PV Array, P-V and I-V characteristic of solar module, Effect of temperature and radiation on P-V and I-V characteristic. Solar thermal principle and its comparison with PV.	09	20
2	Solar PV System: Classification, Stand-Alone Solar PV System, Grid Interactive Solar PV System, Hybrid Solar PV System, Battery technology, Basic Concepts, Components of Battery, Operation of Battery, Battery Characteristics, Classification of Batteries, Classical batteries : Lead Acid, Nickel Cadmium, Zinc Manganese dioxide, Classification of Inverter, String Inverter and Central Inverter.	09	20
3	Wind Power Control strategies: Introduction, integrated aerodynamic and electric control strategies, power electronic converter (PEC), constant and variable speed operation of wind power plant, back to back PEC in WPP.	06	15

4	Constant speed wind power plant: Introduction, type-A WPP (Squirrel cage induction generator)- working principle, equivalent circuit, Type-B WPP (Wound rotor induction generator)- working principle, equivalent circuit, Reactive power compensation, Advantage and disadvantages of constant speed WPPs.	05	15
5	Variable speed wind power plant: Introduction, type-C WPP (Double fed induction generator)- working principle, equivalent circuit, positive and negative features of Type-C WPP, type-D WPP- working principle, equivalent circuit, Advantage and disadvantages of Type-D WPPs.	08	20
6	Captive power plant and other renewable energy sources Ocean energy electrical conversion systems, Geothermal electrical energy conversion systems Wave energy electrical conversion systems Tidal energy electrical conversion systems.	05	10

Reference Books:

1. Solar Photovoltaic Technology and Systems – Chetan singh Solanki , PHI 2017.
2. Wind Power Technology – Joshua Earnest, 2nd edition PHI, 2015.
3. Solar Photovoltaics, Fundamentals, Technologies and applications - Chetan singh Solanki , PHI 2011.
4. Solar Energy, Fundamentals, and applications- Garg, Prakash, Tata McGraw Hill, 2012.
5. Non- Conventional Energy Resources, B.H.Khan, Tata McGraw Hill, 2008.

List of Open Source Software/learning website:

- <http://www.electrical-engineering-portal.com/>
- <http://nptel.iitm.ac.in/courses.php>

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Acquire knowledge of different types of conventional and non-conventional energy sources.	1 Remembering
CLO2	Know the need of renewable energy resources, historical and latest developments.	1 Remembering
CLO3	Describe the use of solar energy and the various components used in the energy production.	2 Understanding
CLO4	Know the different type of wind generator and their operation for fix and variable speed.	1 Remembering
CLO5	Prepare economic analysis for Commercial/ Industrial/ Residential PV energy conservation systems	2 Understanding 3 Applying
CLO6	Acquire knowledge about captive power plants and other renewable energy sources.	1 Remembering

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1				L	M			L		L				L		
CLO2		M	L				H		M							L
CLO3	L			M		L				M	L		M		L	
CLO4	H	M				M		H	L			L				
CLO5				M			L					M		M	H	
CLO6		L	L		L					H	M		L			M

H: High, M: Medium, L: Low