

Program : Diploma in Electrical and Electronics Engineering	
Course Code: 6039C	Course Title: Advanced Solar Photovoltaic Lab
Semester: 6	Credits: 1.5
Course Category: Programme Elective	
Periods per week: 3 (L:0 T:0 P:3)	Periods per semester: 45

Course Objectives:

- To Identify the components of solar panel power system installations
- To know about sizing of solar systems
- To familiarize with design of solar PV system for electrical energy requirements, sizing of PV modules, battery, electronics, etc
- To get acquainted with solar simulation software.

Course Pre-requisites:

Topic	Course code	Course name	Semester
Nil			

Course Outcomes:

On completion of the course, the students will be able to:

CO _n	Description	Duration (Hours)	Cognitive level
CO1	Identify the operation of major components in a solar PV system.	15	Applying
CO2	Apply standard testing procedures to obtain the best operating conditions of a solar cell.	9	Applying
CO3	Identify the procedures to size an Off Grid Solar PV System for the given load and backup time	6	Applying
CO4	Experiment with simulation softwares for the analysis of solar PV systems	9	Applying

	Lab Exam	6	
--	----------	---	--

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				3			
CO2				3			
CO3				3			
CO4				3			

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline

Module Outcomes	Name of Experiment	Duration (Hours)	Cognitive Level
CO1	Identify the operation of major components in a solar PV system.		
M1.01	Identify the electrical components associated with a PV system. (a)DC Combiner box (b)DC Energy meters (c)Array junction Boxes(AC & DC Distribution Boxes) (d)Battery (e)Inverter (f)AC disconnect switch (g)AC combiner box	3	Applying
M1.02	Study the colour conventions and ratings for AC and DC cables used in a PV module.	1	Applying
M1.03	Practice various protection schemes employed against surges (a) Running positive and negative cables close to each other	2	Applying

	(b) Earthing connections (c) Surge Protection Devices(both in dc and ac sides) (d) Lightning arrester		
M1.04	Familiarize the operation of different solar energy charge controllers and compare the output power with and without following charge controllers . (a)Pulse Width Modulated (PWM) Controller (b)Maximum Power Point Tracking (MPPT) Controller	6	
M1.05	Familiarize the operation of solar inverters	3	
CO2	Apply standard testing procedures to obtain the best operating conditions of a solar cell.		
M2.01	Develop a circuit to plot the V-I characteristics of a single solar panel and draw the equivalent circuit of a solar cell.	3	
M2.02	Measurement of V-I characteristics of a single solar panel at various levels of insolation	3	
M2.03	Identify the best operating conditions of a single solar panel by observing the following effects on cell current (a)Effect of Color (Wavelength) (b)Effect of Shading (c)Effect of Tilt Angle (d)Effect of Distance	3	
	Lab Exam-I	3	
CO3	Identify the procedures to size an Off Grid Solar PV System for the given load and backup time		
M3.01	Apply suitable methods to calculate the energy demand of a given electrical installation and compare it with the electricity bill	3	Applying

M3.02	Apply suitable methods for finding the ratings of a given off grid PV system (a) Converter and Charge Controller Sizing (b) Inverter Sizing (c) Sizing of the Batteries (d) Sizing of the PV Array (e) Sizing of the Cables	2	Applying
M3.04	Prepare Bill Of Materials for solar installations	1	Applying
CO4	Experiment with simulation software for the analysis of solar PV systems		
M4.01	Familiarize with any solar simulation software and design a solar system PV syst PVSOL or similar	9	Applying
	Lab Exam -II	3	

Text / Reference:

T/R	Book Title/Author
T1	C. S. Solanki, Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Prentice Hall of India, 2013
R1	The Complete Lab Manual For Renewable Energy - Cutter , Ammond - Delmar Cengage Learning
R2	Christopher Kitcher ,A Practical Guide to Renewable Energy: Power Systems and their Installation: Microgeneration systems and their Installation
R3	Solanki, Chetan Singh, Renewable Energy Technologies: A Practical Guide for Beginners , PHI Learning

R4	Michael Boxwell, Solar Electricity Handbook - 2021 Edition: A simple, practical guide to solar energy - designing and installing solar photovoltaic systems.
----	--

Online Resources

Sl.No	Website Link
1	https://www.electricaltechnology.org/2020/07/design-and-installation-of-solar-pv-system.html
2	https://www.electricalengineeringtoolbox.com/2021/10/how-to-size-off-grid-solar-pv-system.html
3	https://vlab.amrita.edu/index.php?sub=77&brch=298
4	https://renewablelab.niu.edu/experiments/seriesParallelSolarCells
5	https://web.iitd.ac.in/~pmvs/courses/mcl241/laboratory-manual-RES.pdf
6	https://www.coursera.org/lecture/photovoltaic-systems/module-components-skzP1
7	https://electrical-engineering-portal.com/photovoltaic-module-interconnections
8	https://www.bbau.ac.in/dept/Physics/TM/LabExperiments%20_SOLAR%20CELL%20CHARACTERISTICS-2-6.pdf
9	http://solardat.uoregon.edu/download/Lessons/Experiments_with_PV_Cells.pdf
10	https://www.old.iitr.ac.in/departments/PH/uploads/Teaching%20Laboratory/Thermal/2.%20solar%20cell.pdf
11	https://naturalscience.ku.edu.tr/wp-content/uploads/Efficiency-of-a-Solar-Cell.pdf
12	PV system design Software https://www.pvsyst.com/ https://www.homerenergy.com/homer/software 30 Page Minor Degree in Sustainable Energy Engineering (SEE) https://solargis.com/

13	Solar radiation data of any place across the world https://globalsolaratlas.info/map
14	Knowledge Centre, Ministry of New & Renewable Energy - Government of India https://mnre.gov.in/
15	http://www.nitttrchd.ac.in/sitenew1/app_sc/list/Solar%20Cell%20Characteristics.pdf
16	solar cell experiment : https://youtu.be/pYIDJ3a8x6E
17	http://www.ee.iitkgp.ac.in/assets/file/es1.pdf
18	https://youtu.be/xQopheOsIpc
19	https://youtu.be/w8Tw2BYSER0
20	http://www.nabcep.org/wp-content/uploads/2016/10/NABCEP-PV-Resource-Guide-10-4-16-W.pdf

Student Activity

Suggested Open-ended Experiments:

Students can do open ended experiments as a group of 3-5. There is no duplication in experiments in between groups. This is mainly for the purpose of continuous internal evaluation. Students should prepare a separate report on an open ended experiment of their choice.

Example 1: Visit a solar pv field and prepare a report on it

Example 2: Design an ongrid solar PV plant for a real site

Example 3 : Based on the monthly electricity requirement of your home, design a solar PV system to fulfill your monthly electricity needs, write a design report on the same