Enrolment No:

Name:

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, June 2021

Course: Solar PV Technologies **Semester: I**
Program: M. Tech. (Renewable Energy Engineering) **Time 03 hrs**
Course Code: EPEC 7024 **Max. Marks: 100**
Total Number of Pages: 2

SECTION A

Each Question carries 5 Marks.

S. No.	Questions	CO
Q.1	Define the stratification and gassing related to the lead acid batteries .	**CO1**
Q.2	Name the main sources of electrical and optical losses in a solar cell.	**CO1**
Q.3	How bypass diode protects the PV module from shading.	**CO1**
Q.4	Define the optical efficiency of a solar cell.	**CO1**
Q.5	A single crystal PV module ordinarily has 36 cells, what configuration are these cells normally connected and why?	**CO2**
Q.6	List the IEEE 1547 key requirements of the inverter to be met for the grid-connected PV system.	**CO2**

SECTION B

Each Question carries 5 Marks.

Q.1	If the dark saturation current of a solar cell is 1.7×10^{-8} A/m^2, the cell temperature is 27^0 C and J_{SC} is 250 A/m^2, calculate V_{OC}, V_{mp}, I_{mp}, P_{max}, and η_{max}. What cell area is required to get an output of 20W when the available solar radiation is 820 W/m^2.	**CO3**
Q.2	Discuss the different phases of battery charging. What is the necessity for different charge control phases for stand-alone PV system? How they can be implemented with series switch controllers?	**CO2**
Q.3	The Sieman's process is used to purify MG-Si. Describe the process and give values for Si purity before and after the process.	**CO2**
Q.4	Describe the function of a buck type DC to DC converter. How it can be implemented to track the maximum power point in case of variable load. Explain with the help of neat diagram.	**CO3**
Q.5	The most popular algorithm belonging to the class of the direct MPPT techniques is the Perturb and Observe approach (P & O). By making the flow chart of P & O algorithm, discuss the basic schemes for implementing it.	**CO3**

Section C

Question in this section carries 20 Marks. There is an internal choice in this section.

Q.1 A remote cottage has the following loads. Estimate the daily load and peak power to be satisfied by a 24 V PV system. **CO4**

Appliance	Type	Power(W)	Daytime run (h)	Nighttime run (h)
5 lamps	DC	11 W each	0	5

Television	AC	75W	2	4
Computer	AC	160 W	4	3
Radio	DC	25 W	3	1
Water pump	AC	60 W (6 A start current)	1	1
Stove	AC	1200 W	2	1

Based on the above daily load estimation and using the simple design method, design a PV system using 60 W, 12 V panels and 145 Ah, 6 V batteries. The PV system is required to offer 3 days of storage, the battery efficiency is 75%, and the depth of discharge is 70%. The location where the system is located has 6 h of daylight during wintertime.

OR

You want to design a large rooftop solar PV system array in Dehradun (30.32N, 78.03E) facing due south. Because of the space limitations, the system is designed to have various rows of modules behind each other. The lower end of the module is resting on the ground and each module length is 2m from top to bottom. You want to space them so far apart that front row will not shadow the back row at solar noon on the shortest day of the year.

(a) Which day is the shortest day of the year at the Dehradun site? [2]

(b) What is the Sun's elevation angle at the Dehradun site at the solar noon on the shortest day of the year? [6]

(c) What distance should the modules rows be spaced apart to satisfying the shading requirements (include a sketch in your answer)? [6]

(d) At what time is the Sunrise and Sunset on the shortest day and how long would this shortest day be. [6]