

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, Dec 2019

Programme Name: M. Tech-Renewable Energy Engineering

Semester : I

Course Name : Solar PV Technologies

Time : 03 Hrs.

Course Code : EPEC- 7024

Max. Marks: 100

Nos. of page(s) : 3

Instructions: Attempt all the sections.

SECTION A (20 Marks)

S. No.	Attempt all the questions. Assume data, if not given.	Marks	CO
Q 1	Analyze the effect of earth atmosphere on solar irradiation level on earth.	5	CO1
Q 2	A Si sample is doped with 1×10^{16} P atoms/cm ³ . What will be the electron concentration (n_o) at room temperature?	5	CO2
Q 3	Differentiate the polycrystalline and Monocrystalline solar cells.	5	CO3
Q 4	Explain the use of bypass diode and method to prevent the hotspot condition in PV module.	5	CO4

SECTION B (40 Marks)

Attempt all the questions.			
Q 5	Analyze the operation of stand-alone PV system assisted applications for (i) Electric vehicles (ii) solar water pumping system. Draw the schematic diagram for both the applications.	10	CO1
Q 6	A SPV high power module is having an area of 1.62m ² gives a current at maximum power point of 7.83 A and voltage at maximum power point of 29.4V. The short circuit current of the module is 8.52A and open circuit voltage is 36.7 V. What is the fill factor (FF), maximum power point and efficiency of solar cell? Consider Standard test conditions.	10	CO2
Q 7	Analyze the operation of grid connected and stand-alone PV systems. Sketch the layout and discuss each required components in details.	10	CO3
Q 8	A house has the following AC loads rated at 230V. (i) three 60W lights (ii) two 90 W fans (iii) A 60 W radio All the loads are powered simultaneously. A 12 V battery is available. Choose the appropriate inverter? Assume that inverter efficiency is 90%.	10	CO4

SECTION-C (40 Marks)

Q 9	Attempt both the parts: (A) A solar PV module is rated for $V_{oc}= 40V$, $V_{mp}= 32V$, $I_{sc}= 5.5A$ and $I_{mp}=5A$. Design a solar PV strings to produce DC current output of 200A. What will be the DC voltage output of the string? What will be the DC power output of parallel connected string?	10+15	CO3, CO4
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	<p>(B) A customer has requirement to install a 2kW power capacity of stand-alone solar power plant for household applications. The available roof-top area for installation is available as 500 m². The installation company has 200W ($I_m=4A$, $V_m= 5V$) single PV module specifications. Calculate PV array size as,</p> <ol style="list-style-type: none"> 1) total number of solar PV module (if connected in series) 2) total number of solar PV module (if connected in parallel) 3) total number of solar PV module (if connected in series-parallel) <p>Design the electrical connections layouts for all the connections 1), 2) and 3).</p>		
Q 10	<p>Design a PV water pumping system, Which is required to draw 25,000l of water every day from a depth of 10m.</p> <p>The data required for calculations is as follows:</p> <ul style="list-style-type: none"> • Amount of water to be pumped per day= 25,000l = 25 m³ • Total vertical lift = 12 m(5 m- elevation, 5 m- standing water level, 2 m- drawdown) • Water density= 1000 kg/m³ • Acceleration due to gravity = $g= 9.8 \text{ m/s}^2$ • Solar PV module used= 75Wp • Operating factor =0.75(PV panels, in general, do not operate at their rated peak power) • Pump efficiency = 30% or 0.30 (it is typically between 0.25 and 0.40) • Mismatch factor= 0.85 (PV panels usually do not operate at max. power point, should be 1 if MPPT circuit is used). 	15	CO4