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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021**

COURSE NAME : SOLAR PV INSTALLATION AND
MAINTENANCE
COURSE CODE : BBJ10405
PROGRAMME CODE : BBJ
EXAMINATION DATE : JULY 2021
DURATION : 2 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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SECTION A

- Q1.** Maximum power output of a solar panel depends on _____.
- I. dirt
 - II. time of the year
 - III. direction and angle of a roof
 - IV. temperature
- A. I only
 - B. I and II only
 - C. I, II and III only
 - D. I, II, III and IV
- Q2.** The efficiency of a solar cell may be in the range of _____.
- A. 2 to 5%
 - B. 15 to 20%
 - C. 40 to 50%
 - D. 70 to 80%
- Q3.** Which of these statements is correct?
- A. Monocrystalline solar has better efficiency but expensive
 - B. Thin-film silicon based solar has a low lifespan but expensive
 - C. Concentrated PV cell (CPV) relatively low cost and low efficiency
 - D. Polycrystalline solar relatively low cost but has the lowest efficiency
- Q4.** The power from the sun intercepted by the earth is approximately
- A. 1.8×10^8 MW
 - B. 1.8×10^{11} MW
 - C. 1.8×10^{14} MW
 - D. 1.8×10^{17} MW
- Q5.** Maximum efficiency is obtained in _____.
- A. flat plate collector
 - B. evacuated tube collector
 - C. line focusing collector
 - D. paraboloid dish collector

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- Q6. When the source of light is not sun light then the photo voltaic cell is used as _____.
- A. photo diode
 - B. photo voltaic cell
 - C. photo detector
 - D. photo transmitter
- Q7. The typical type of inverter for residential purpose is _____.
- A. central inverter
 - B. string inverter
 - C. micro-inverter
 - D. hybrid inverter
- Q8. A DC load is connected to 24 V and the current is 2 A. What is the power of the load?
- A. 24 W
 - B. 48 W
 - C. 12 W
 - D. 26 W
- Q9. The system you are installing includes an MPPT and the solar array will comprise five (5) 60 cell solar modules in series. Each solar module has an open circuit voltage of 35V and short circuit current of 7A. What is the electrical danger with this system?
- A. The MPPT must be wired correctly.
 - B. The MPPT must be connected to a battery bank
 - C. There are 5 modules that must be lifted onto the roof.
 - D. The solar array is rated at 175V DC open circuit and hence LV
- Q10. The energy received at the site for a photovoltaic installation is 22.14 MJ/m^2 . What is the number of peak sun hours at the site?
- A. 79.7
 - B. 6.15
 - C. 25.74
 - D. 4.94

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Q11. As the temperature of a solar cell decreases how do the current and the voltage change?

- A. Current decreases and voltage increases
- B. Current increases and voltage increases
- C. Current decreases and voltage decreases
- D. Current increases and voltage decreases

Q12. The following is the hourly irradiation readings for a site where a solar array will be installed.

Time	Irradiation recorded for Wh/m ²
7.00 am - 8.00 am	150
8.00 am - 9.00 am	300
9.00 am - 10.00 am	400
10.00 am - 11.00 am	600
11.00 am - 12.00 noon	800
12.00 noon - 1.00 pm	800
1.00 pm - 2.00 pm	600
2.00 pm - 3.00 pm	400
3.00 pm - 4.00 pm	300
4.00 pm - 5.00 pm	150
Total Irradiation (kWh/m²)	4.5 kWh/m²

Figure Q12

If the site is shaded from 11 AM to 2.00 PM what is the total available daily irradiation for the site?

- A. 3.00 kWh/m²
- B. 2.30 kWh/m²
- C. 4.50 kWh/m²
- D. 3.30 kWh/m²

Q13. Which one out of the following is a potential safety hazard?

- A. The roof is rusted.
- B. A car parked underneath
- C. A small tree shading the roof
- D. A flat roof with a sound structure

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- Q14.** When lifting a tall wet lead acid battery to the site how should the battery be handled?
- A. In an upright position.
 - B. Carried on the shoulder
 - C. Using hooks through the battery terminals.
 - D. With two installers at each end when it is on its side then tipped up.
- Q15.** Cables terminated on the flooded lead acid battery banks should be _____
- A. bare wire wrapped around the terminals and covered in grease.
 - B. run via the shortest route over the filler/inspection caps.
 - C. connected with crocodile /alligator clips for easy disconnection.
 - D. bolted to the battery terminals using suitable lugs with insulation covers over the terminals.

Questions Q16 to Q20 based on the following situation:

If a house has the following electrical appliance usage:

- One 18 watt fluorescent lamp with electronic ballast used for 4 hours per day
- One 60 watt fan used for 2 hours per day
- One 75 watt refrigerator that runs 24 hours per day with compressor run for 12 hours and off for 12 hours.

The system will be powered by 12 Vdc, 110 Wp PV Module, and solar generation factor is 3.43, with 25-35% of inverter rating.

- Q16.** Determine power consumption demands
- A. 1130 kW
 - B. 1.4 kW
 - C. 1.6 kW
 - D. 400 W
- Q17.** Determine the number of the PV panel
- A. 2 Modules
 - B. 4 Modules
 - C. 6 Modules
 - D. 8 Modules
- Q18.** Determine the inverter sizing
- A. 60 W
 - B. 190 W
 - C. 500 W
 - D. 1 KW

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Q19. Determine the battery sizing

- A. 12 V 400 Ah
- B. 12 V 600 Ah
- C. 12 V 800 Ah
- D. 12 V 1.2 kAh

Q20. Determine solar charge controller sizing

- A. 15 A at 12 V
- B. 20 A at 12 V
- C. 30 A at 12 V
- D. 40 A at 12 V

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SECTION B

- Q1.** (a) Define these terminologies;
- (i) Solar cell (1 mark)
 - (ii) Solar panel (1 mark)
 - (iii) Solar array (1 mark)
- (b) Explain in detail the principle of solar cell operation from sun light into electricity generation. (10 marks)
- (c) Define short-circuit current (I_{sc}), open-circuit voltage (V_{oc}) and maximum power point (MPP). (5 marks)
- (d) Draw Voltage – Current (V-I) Characteristics of a photovoltaic cell, clearly locate short-circuit current (I_{sc}), open-circuit voltage (V_{oc}) and maximum power point (MPP). (7 marks)
- Q2.** (a) Design and sketch a smart-eco PV boat where a solar scheme is applied on a fisherman's boat to reduce the usage of diesel hence reducing the cost. Suggest rating of solar PV that is suitable for this application. (10 marks)
- (b) How do you maintain solar PV? (2 marks)
- (c) With the evolution of solar PV technology, it is clear that this approach can solve electricity problem especially to those living in villages far inside the jungle where transmission line from utility e.g. TNB is impossible to reach. However, it can be seen nowadays that the usage of solar PV is still low and the application of solar from SEDA mostly come from those living in urban. Explain briefly why this happen? Justify your answer. (8 marks)
- (d) Give your suggestion on how to solve the problem in Q2(c) so that all the residents especially those living in villages inside the jungle can benefit from this solar technology. (5 marks)