MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

CERTIFICATE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EED 1605: SOLAR TECHNOLGY SYSTEMS

DATE: 24/4/2019 **TIME: 2.30-5.30 PM**

INSTRUCTIONS:

Question ALL the questions.

Show all your workings clearly

QUESTION ONE (30 MARKS)

a) State the Standard Test Conditions of PV modules (3 marks)

b) Explain why dissimilar PV modules should not be connected in series (2 marks)

c) The following details are given,

$P_{mp} = 20W$, $V_{mp} = 18V$, Imp = 1.11A, $V_{oc} = 21.6A$, $I_{sc} = 1.28A$, Irradiance = $1000w/m^2$ and area A of the PV module = $0.68m^2$.

Calculate the (i) Efficiency of the PV module and (ii) the fill factor. (5 marks)

d) State any four major steps involved in final inspection and commissioning of a stand alone PV system.. (4 marks)

e) After a comprehensive site survey, the following details were collected;

Load description	Quantity	Wattage (W)	Total Wattage	Daily use in hours
LED lights (Bed room)	3	6		3
LED lights (Bath room)	1	6		1
LED lights (living room)	2	6		5
LED lights (kitchen)	2	6		2
Radio (AC)	1	30		5
Television (AC)	1	60		5
Laptop charger (AC)	1	40		3
Mobile phone charger (AC)	3	2		3

i. Determine the total watt-hours for each category. (2 marks)

ii. Determine the total load. (2 marks)

Given that,

Days of autonomy	= 5
Depth of discharge	= 75%
Derating factor	= 0.8
Peak sun hours (PSH)	= 4.5 hours
Safety factor	= 1.25
DC losses	= 5%
Inverter efficiency	= 90%
Buffer for growth	= 10%
Battery equalization factor	= 1.1
System voltage	= 12 V

Design a suitable system to serve the customer adequately (12 marks)

QUESTION TWO (20 MARKS)

a) With an aid of a diagram, explain the following terms;

i. Solar constant

ii. Direct radiation

iii. Diffuse radiation (5 marks)

b) The following details are given,

i. Peak sun hours = 5 hours/day

ii. Rating of a given PV module = 150W

iii. Efficiency of the given PV module = 80%

Calculate the total energy given out by the PV module in a week. (5 marks)

c) Explain the different types of PV modules, stating their efficiencies, and compare their physical sizes (10 marks)

QUESTION FOUR (20 MARKS)

a) A battery with a capacity of 160Ah is discharged by 120Ah, calculate the

i. State of charge (SOC)

ii. Depth of discharge (5 marks)

b) Figure 1 is given below,

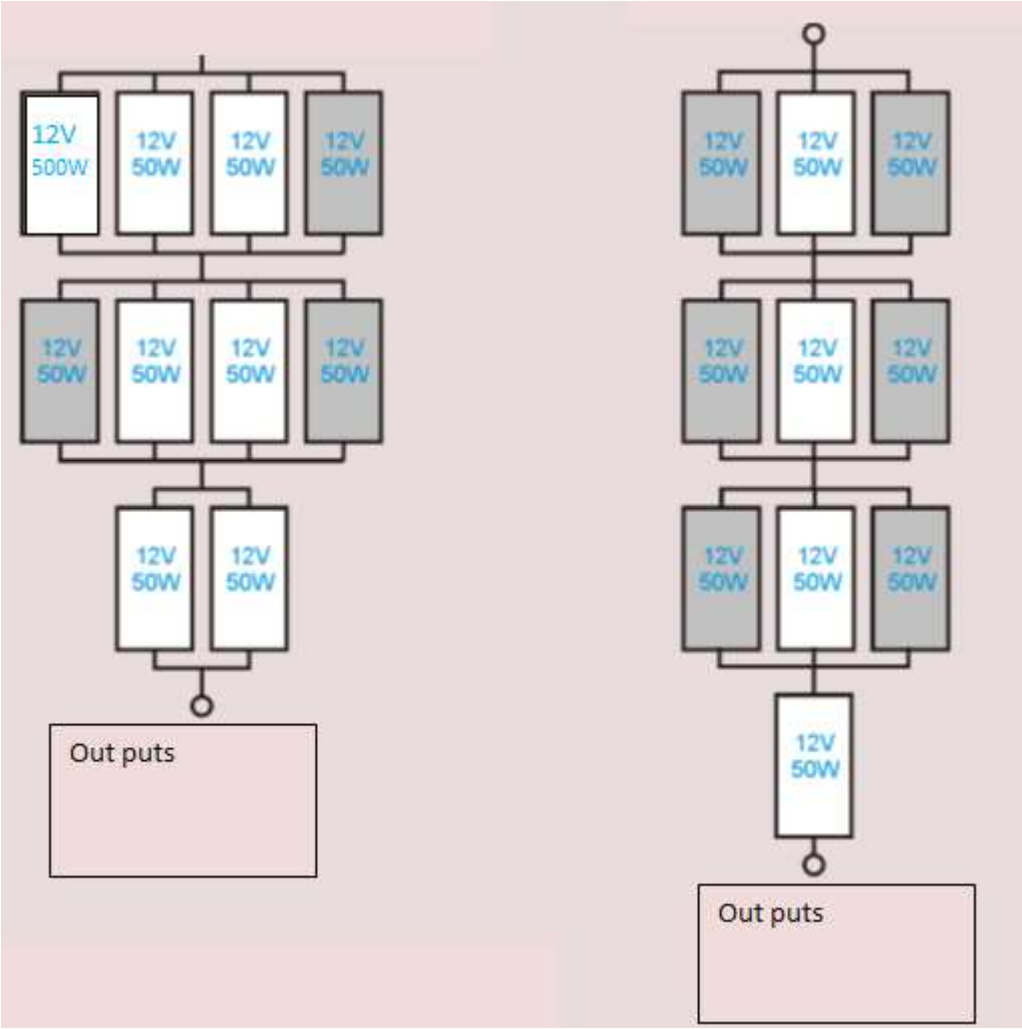

Figure 1

For each case, calculate the output voltage and power. (6 marks)

c) Calculate the approximate power conversion efficiency of a poly-crystalline PV module at an ambient temperature if the solar irradiance is 950w/m^2, Imp is 5.00A, Vmp is 17.8V and the size of the module 0.68m^2 . (4 marks)

d) Figure 2 is given below

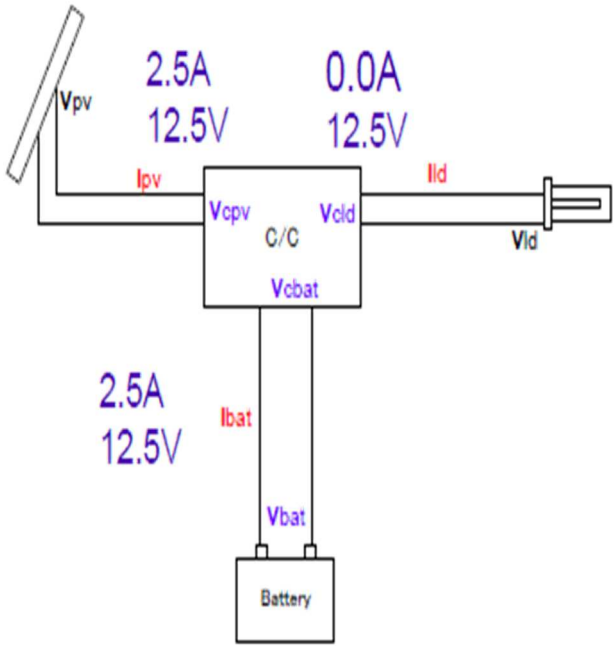

Figure 2

i. State whether the readings were taken during the day or night.

ii. Calculate the load power

iii. Calculate the PV module power output (5 marks)

QUESTION FOUR (20 MARKS)

a) Define the following terms with reference to solar PV systems.

i. irradiance

ii. Insolation

iii. Days of autonomy

iv. Peak sun hours (8 marks)

b) Explain how sulfation and stratification are prevented. (4 marks)

c) Table 1 shows loads supplied by a 12V solar battery with a 60% depth of discharge. If the number of days of autonomy is 4, determine the battery capacity. (8 marks)

Table 1

Loads	Quantity	Rating	Usage hours/day
Lights	4	10W	4 ours
T.V.	2	20W	2 hours

QUESTION FIVE (20 MARKS)

a) Explain the importance of the following

i. Low voltage disconnect in a charge controller

ii. Blocking diodes (4 marks)

b) Explain Any three types of inverters (6 marks)

c) A 12 dc home solar system supplies a load which consists of four 10 watt lamps and an 80 watt televion set. If the daily use for each appliance is 2 hours, determine the,

i. Total daily energy demand

ii. Daily system charge requirement (10 marks)