MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

BUILDING AND CIVIL ENGINEERING DEPARTMENT

FIRST YEAR FIRST TERM EXAMINATION FOR

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONIC ENGINEERING

1601/105/SIT: SOLAR INSTALLATION TECHNOLOGY

DATE: **TIME:**

INSTRUCTIONS: ANSWER ALL THE FIVE QUESTIONS

1. (a) State four advantages of solar energy over other sources of energy (4 marks

   (b) State any four applications of solar energy (4 marks)

   (c) With the aid of a block diagram, describe the elements of a photo voltaic system. (12 marks)

2. (a) With the aid of a circuit diagram, explain the construction of series charge controller. (10 marks)

   (b) The **table 1** below shows loads supplied by a 12V solar battery. Determine the average daily energy requirements (5 marks)

Loads	Quantity	Rating	Daily usage	Weekly use
Lights	4	10W	4 hours	6 Days
T.V	2	40W	2 hours	5 Days

Table 1

(c) Given P_{mp} = 20W, V_{mp}= 18V, I_{mp}= 1.11A, V_{oc}= 21.6V, I_{sc}= 1.28A for module- 1

And P_{mp}= 260W, V_{mp}= 7V, I_{mp}= 8.75A, V_{oc}= 35.6V and I_{sc}=9.63A for module- 2.

Determine the fill factor for each and recommend the better module (5 marks)

3. (a) Explain the cause of the following battery problems and how they are prevented

(i) Stratification

(ii) Sulfation

(iii) Unequal cell voltage (12 marks)

(b) A battery is rated 6V,200AH. If three of the rated battery are connected in

i. Series

ii. Parallel

Sketch the arrangement and determine the voltage, capacity and power in each case.

(8marks)

4. (a) Explain why dissimilar PV modules should not be connected in series (2marks)

(b) A solar module rated 150W receives daily insolation for 7 hours per day. If the system losses are 20%. Determine the module output for,

(i) one day

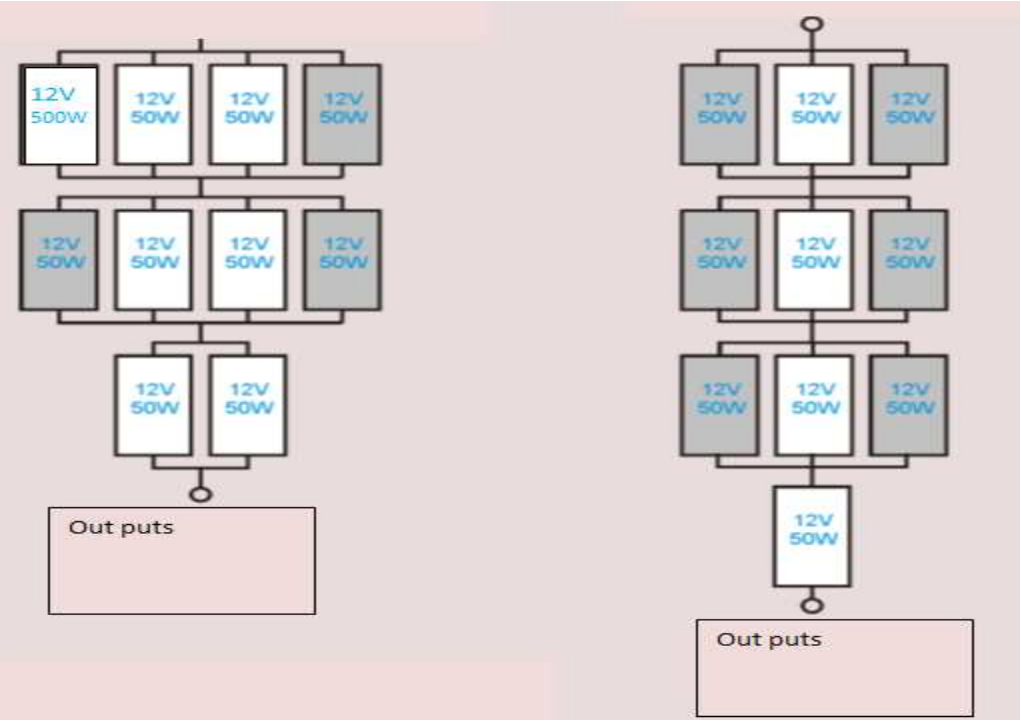
(ii) one week

(iii) One month (6 marks)

(c) The figures below show strings of PV modules, for each case, calculate the:

(i) Output voltage

(ii) Output Power. (8 marks)



d) A battery with a capacity of 160Ah is discharged by 120Ah, calculate the
(i) State of charge (SOC)

(ii)Depth of discharge (4 marks)

5. a) Define the following terms associated with solar PV installations,

(i) Insolation

(ii) Peak sun hours (PSH)

(iii) Solar window

(iv) Solar constant

(v) Air mass (10 marks)

b) Explain with the aid of I-V curve the main factors that affect the performance of a PV module. (10 marks)

6. (a) Explain any Four charge controller voltage levels. (8 marks)

(b) State Four tests carried out on a completed solar electric installation. (4 marks)

(c) (i) Draw a labelled diagram showing the earthing of a PV module (6 marks)

(ii) State Two reasons for earthing the module in (c) (i) (2 marks