



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR CERTIFICATE IN
ELECTRICAL AND ELECTRONICS ENGINEERING

SUPPLEMENTARY EXAMINATION

EPC 119: SOLAR TECHNOLOGY SYSTEMS

DATE: 1/9/2017

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

Question one is compulsory, answer any other two

1.
 - (a) A battery is supplying electrical energy to an appliance. If the percentage voltage drop is 5.56% and the battery voltage at the terminals is 12.6V, calculate the voltage at the appliance. (5 marks)
 - (b) The solar irradiance is 1000w/m and the ambient temperature is 30 C. Calculate the approximate cell temperature. (5 marks)
 - (c) Explain the steps involved in sizing a solar PV installation system. (6 marks)
 - (d) Details of a solar PV installation are given as follows;

Category A

Quantity of fluorescent lights = 1

Required voltage = 12V DC

Required current = 1.67A DC

Daily use = 4hrs/Day

Weekly use = 6days /week

Category B

Quantity of incandescent lamps = 3

Rated voltage = 12V DC

Rated current = 0.97A DC

Daily use = 5hrs/day

Weekly use = 5days/week

- i) Determine the average daily use of each category. (3 marks)
- ii) Determine the average daily load. (3 marks)

Given that, days of autonomy = 3

Depth of discharge = 0.3

Battery efficiency = 0.8

Peak sun hours(PSH) = 4.5hours

Safety factor = 1.25

Size the system appropriately (9marks)

- 2. a) With an aid of a diagram, explain the following terms;
 - Solar constant
 - Direct radiation
 - Diffuse radiation (6 marks)
 - b) Calculate the direct irradiance if the total measured irradiance is 950w/m and the measured diffuse irradiance is 65w/m. (4 marks)
 - c) Explain the different types of PV modules, stating their efficiencies. (10 marks)
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- 3. a) Explain any five technical specifications of a PV module. (10 marks)
 - b) With an aid of a diagram, explain the I – V curve and the important points. (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, I_{mp} is 5.00A, V_{mp} is 17.8V and the size of the module is 0.68m. (4 marks)

4. a) Define the following terms;
- i. Tilt angle
 - ii. Azimuth angle
 - iii. Days of autonomy
 - iv. Depth of discharge (8 marks)
- b) Explain how sulfation and stratification are prevented. (4 marks)
- c) A battery is rated 6,200AH. If three of the rated battery are connected in
- i. Series
 - ii. Parallel

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

- (8 marks)
5. (a) With the aid of a well labeled diagram, explain the construction of a lead acid battery. (8 marks)
- (b) Explain the function of a charge controller. (2 marks)
- (c) Explain the function of an inverter. (2 marks)
- (d) The table below shows loads supplied by a 12V solar battery with a 60% depth of discharge. If the number of days of autonomy is 4 and battery efficiency is 80%.

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

Size the system appropriately. (8 marks)