



MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA IN

ELECTRICAL AND ELECTRONICS ENGINEERING

EED 115: SOLAR TECHNOLOGY SYSTEMS

DATE: 30/5/2017

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

1.
 - (a) State any FOUR types of PV module mounting methods. (4 marks)
 - (b) Explain why dissimilar PV modules should not be connected in series (2 marks)
 - (c) State any four steps involved in final inspection and commissioning of a stand-alone PV project. (4 marks)
 - (d) The solar irradiance is 1000W/m^2 and the ambient temperature is 30°C . Calculate the approximate cell temperature. (4 marks)
 - (e) State the steps involved in sizing a solar PV installation system. (3 marks)
 - (f) The following details were collected after a site visit in West Pokot (15 marks)

Load description	Number of loads	Size in Watts (Per load)	Daily hourly use Hours/Day
LED lights (Bedrooms),DC	3	6	3
LED lights (Bathroom),DC	1	6	1
LED lights (Living Area),DC	2	6	5
LED lights (Kitchen),DC	2	6	2
Radio (AC)	1	30	5
Television (AC)	1	60	5
Laptop Charger (AC)	1	40	3
Mobile Phone Chargers (AC)	3	2	3

Calculate;

- (i) The total daily watt-hours for each load
- (ii) Both the the total DC and total AC Watt-hours
- (iii) The total watt-hours
- (iv) The Battery size to suit the loads
- (v) The PV array size to satisfy the battery requirements
- (vi) The Inverter and Charge controller sizes

Given the following details,

Peak sun hours (PSH)= 4.5

Depth of Discharge (DOD)= 75%

Days of Autonomy = 5

Battery efficiency = 60%

Battery charge equalization= 1.1

Use 5% as the cable losses

Use 90% as the inverter efficiency

Use 10% as the buffer growth factor

Assume the voltage system is 12V

Safety factor = 1.25

(11marks)

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^2 and the measured diffuse irradiance is 65w/m^2 . (4 marks)
 - c) Explain the different types of PV modules, stating their efficiencies. (10 marks)
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^2 , I_{mp} is 5.00A , V_{mp} is 17.8V and the size of the module is 0.68m^2 . (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 $6\text{V}, 200\text{AH}$. 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) 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 television 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)