



MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION DIPLOMA IN ELECTRICAL ENGINEERING

EED 115: SOLAR TECHNOLOGY SYSTEMS

DATE: 19/12/2017

TIME: 8.30-10.30 AM

INSTRUCTIONS

Question ONE is compulsory, answer any other two

1.
 - a) Explain briefly the main solar energy technologies (2 marks)
 - b) Explain why dissimilar PV modules should not be connected in series (2 marks)
 - c) 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. (4 marks)
 - d) The solar irradiance is 1000w/m^2 and the ambient temperature is 30^0 C . Calculate the approximate cell temperature. (4 marks)
 - e) Explain any three types of inverters (6 marks)
 - f) 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. (2 marks)
 - ii) Determine the average daily load. (2 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 (8 marks)
2. a) With an aid of a diagram, explain the following terms; (6 marks)
- Solar constant
 - Direct radiation
 - Diffuse radiation
- 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 0.68m^2 (4 marks)
4. a) Define the following terms with reference to solar PV design. (8 marks)
- i. Tilt angle
 - ii. Azimuth angle
 - iii. Days of autonomy
 - iv. Depth of discharge
- 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
- Series
 - Parallel
- Sketch the arrangement and determine the voltage and capacity in each case.
- (8 marks)
5. a) Explain the importance of the following
- (1) Low voltage disconnect in a charge controller
 - (2) Blocking diodes
- (4 marks)
- b) State the steps involved in the design of a solar pv system
- (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)