JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DEGREE OF SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGEMENT

THIRD YEAR FIRST SEMESTER 2015/2016 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3311

COURSE TITLE: PHOTOVOLTAIC TECHNOLOGY

EXAM VENUE: CR **STREAM: BSc RE TECH & MGT**

DATE: 26/04/16 **EXAM SESSION: 9.00- 11.00 AM**

TIME: 2 HOURS

Instructions to candidates

The paper contains FIVE questions.

Answer question ONE and any other TWO questions

Candidates must hand in their answer booklets to the invigilator while in the examination room.

QUESTION ONE (COMPULSORY)

a) List any two considerations that must be considered by a technician when installing an off grid solar system (2 Marks).
b) List three thin film technologies often used for outdoor photovoltaic systems (3 Marks)
c) Outline four factors that determine the size of a charge controller used in a photovoltaic system (4 Marks)
d) Explain how diffuse radiation is created (2 Marks)
e) Outline five factors that determine the short circuit current of a solar cell (5 Marks)
f) Explain how the sun generates energy and discuss the three ways that energy can be acquired for utilisation by human (4 Marks).
g) Briefly explain the following terminologies (4 Marks)
    1. Sulfation
    2. stratification
h) Discus three classifications of inverters that are commonly used in photovoltaic system (6 Marks)

QUESTION TWO

a) Define the following terms associated with battery discharging (4 marks)
    1. Depth of discharge
    2. State of charge
    3. Autonomy
    4. Self-discharge rate
b) Discuss three common instruments used to test batteries (6 Marks).
c) Discuss two types of sealed lead acid batteries used in photovoltaic technology (4 Marks)
d) Using an illustration, discuss the system configuration that can be used to connect batteries in solar system and show expected total output (6 Marks).

QUESTION THREE

a) Discuss five considerations that a P.V installer will have in mind when determining whether a proposed site will be adequate for proper operation of the system (10 Marks)
b) There are a lot of choices to be made in making a PV device, both in material properties and device designs. Outline four important design parameters that a manufacturing company in Kenya should consider (4 Marks)
c) The ministry of energy has reported that to accelerate the consumption of photo voltaic at county level, Initial cost required to install a photo voltaic system needs to be reduced. Discuss two ways in which cost can be reduced (4 Marks)
d) Discuss the two principles of doping used in the semiconductors (2 Marks)

QUESTION FOUR

a) Outline the central semiconductor parameters that determine the design and performance of a solar cell (4 Marks)
b) Outline any six characteristics of a photovoltaic system (6 Marks)
c) Discuss any five applications of solar photovoltaic technology giving two examples for each application (10 Marks)

QUESTION FIVE

a) Outline any five reasons why the university management has opted to power the street lighting using photovoltaic system (5 Marks)
b) Outline the functions of the major components of a photovoltaic system (5 Marks)
c) A farmer in Bondo wants to use solar energy for lighting his homestead and powering some domestic appliances. The following are his domestic requirements:

4 bedroom house, sitting room 6 lights, corridor 2 lights, kitchen 1 light ,bathroom and toilet 1 light, and 3 security lights. The appliances include 1 black and white television set rated at 35W, and one radio rated15W.

The farmer also gave the following information.

He lights the security lights for 12 hours, his family use an average of 1 hour in the bathroom, corridor and toilet, and watches television for 4 hours listens the radio for 8 hours, he sits in the

sitting room for an average 5 hours every evening and the average consumption for all bedrooms is 3 hours.

Assumptions made when designing the system

1. Inverter efficiency 1.9
2. Kenya receives at least 6 hours of insolation
3. Batteries should not be drained more 50%
4. There is an efficiency of 83% on the system due to wiring

Describe how you will go about sizing this system showing all the calculations for the major components of a solar system (10 Marks)