KIBABII UNIVERSITY

2017/2018 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER

SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN RENEWABLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE: IET 311

COURSE TITLE: Solar, Photovoltaics and OTEC Energy

DATE: ~~15~~/10/2018 11th **TIME:** ~~8-10AM~~ 11.00am -

INSTRUCTIONS TO CANDIDATES

Answer question ONE and any other two questions

This paper consists of 4 printed pages. Please Turn over

Question One

(a) Explain the important characteristics of the following solar cell technologies

(i) Mono-crystalline silicon **[2 Marks]**

(ii) Poly-crystalline silicon **[2 Marks]**

(iii) Amorphous silicon **[2 Marks]**

(b) With the help of sketches explain operation of the following

(i) Flat plate collector **[4 Marks]**

(ii) Evacuated tube collector **[4 Marks]**

(iii) Solar Cell **[4 Marks]**

(c) Briefly explain the use of solar energy in

(i) Cooking **[2 Marks]**

(ii) Crop drying **[2 Marks]**

(iii) Water pumping **[2 Marks]**

(d) (i) State components of solar irradiation that are incident on an inclined surface **[1 Mark]**

(ii) State the physical process through which the Sun generates energy **[1 Mark]**

(iii) State what the Sun loses through the generation of energy **[1 Mark]**

(e) A hotel installation near you wants to cover their water heating demand by solar energy. However, they want to know first if it is possible. The hotel needs 1500 L/day of warm water every day and the water has to be heated from 10 to 60 °C. The specific heat capacity of water is 4.18J/gK. Assume an irradiance of $1000 W/m^2$ for 3 equivalent sun hours and an efficiency of 70% for the installation.

(i) How much energy does the system need to produce per day to meet the warm water demand? Give your answer in kWh/day. **[3 Marks]**

(ii) If the hotel has $30m^2$ available for this application, what is the maximum percentage of the warm water demand that can be covered by solar energy? **[1 Marks]**

Question Two

(a) The figure below shows an I-V curve, with a superimposed power curve for a solar cell. Explain the following shown on the figure

(i) I_{sc} **[2 Marks]**

(ii) V_{oc} **[2 Marks]**

(iii) P_{max} **[2 Marks]**

(iv) I_{mp} **[2 Marks]**

(v) V_{mp} **[2 Marks]**

(b) State and describe the processes which are responsible for the attenuation of irradiation through the atmosphere. **[10 Marks]**

Question Three

Describe the pumping of water using solar PV system **[20 Marks]**

Question Four

(a) Explain the principle underlying the working of a solar cell **[4 Marks]**

(b) Explain the purpose of each of the following components of solar PV systems

(i) Solar cell, module, array **[3 Marks]**
(ii) Storage batteries **[2 Marks]**
(iii) Charge regulators **[2 Marks]**
(iv) Inverters **[2 Marks]**
(v) Wiring and support structures **[4 Marks]**

(c) Calculate the maximum power (in mW) of a solar cell having current and voltage values of 30mA and 0.7V respectively at the maximum power point of the solar cell **[3 Marks]**

Question Five

During the winter, the inside of an average house is

maintained at 20 ºC, while the outside temperature is 0 ºC. Assuming that the only mechanism of heat transfer is conduction, the walls are 10 cm thick and the heat conductivity of the walls is $0.5 W/Km$.

(a) Calculate the heat flux from the room to the surroundings in W/m^2. **[6 Marks]**

(b) We decide that, to reduce the heat loss through the walls, the material should be changed to an insulator material. The new overall conductivity will be $0.1 W/Km$, and the thickness of the wall is maintained.

Calculate the reduction of the heat flux throughout the walls in % compared to the initial case. **[8 Marks]**

(c) State and explain the most important heat transfer mechanism in domestic solar water heating systems **[6 Mark]**