



# **KIBABII UNIVERSITY**

**2020/2021 ACADEMIC YEAR**

**FOURTH YEAR SECOND SEMESTER**

**SPECIAL/SUPPLEMENTARY EXAMINATIONS**

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

**COURSE CODE: REN 313**

**COURSE TITLE: Bioenergy 1**

**DATE: 13/1/2022**

**TIME: 8-10AM**

## **INSTRUCTIONS TO CANDIDATES**

Answer question ONE and any other two questions

This paper consists of 4 printed pages. Please Turn over

### Question One

- (a) Describe how electrical power can be generated from biomass fuel combustion. [6 marks]
- (b) State the factors that affect the overall efficiency of combustion [6 marks]
- (c) Briefly describe the production of biogas by anaerobic digestion [6 marks]
- (d) Describe in detail the main features of the Kenya Ceramic Jiko (KCJ) and compare it with the traditional Jiko [6 marks]
- (e) Explain in detail the importance of carrying out resource assessment before setting up an energy plant based on biomass [6 marks]

### Question Two

- (a) Biomass as an energy source is described as carbon emission neutral. Explain by reference to a diagram of the carbon cycle how and why this is beneficial. [10 marks]
- (b) Briefly describe the basic principles of Bio-diesel production [10 marks]

### Question Three

Describe the process of pyrolysis of biomass materials giving information of the products produced, the effects of altering pyrolysis conditions, and the main modes of pyrolysis. 20 marks

### Question Four

- (a) With the aid of diagrams briefly describe the different stages of the combustion process and giving information on the effects of the air/fuel ratio, moisture content and fuel grade (i.e. size, density, shape etc) on the process. 8 marks
- (b) Briefly describe the gasification process and with the aid of sketches briefly describe the operating principles of the down-draught, up-draught and the bubbling fluidized bed gasifiers giving details of feed stock requirements and typical applications. 20 marks

### Question Five

- (a) Calculate the heating value of wood chip (GJ/t) with a moisture content of 48.5%, hydrogen content of 6.1% and a combustion heat of dry matter 17.7 GJ/t **8 marks**
- (b) The wood is stored in a barn and after 2 months the moisture content is 23%.  
Recalculate the heating value based upon this value. **4 marks**
- (c) What problems can arise from the storage of wood chip and how can these be minimized **3 marks**
- (d) What factors need to be considered when sizing a wood heat system for a school **5 marks**