26

KENYATTA UNIVERSITY

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENERGY TECHNOLOGY

TET 303: BIOENERGY TECHNOLOGY

1ST SEMESTER 2023/2024 TIME: 2 HRS

INSTRUCTIONS

- **This paper contains FIVE questions**
- **Answer Question ONE and any other Two Questions**

SECTION A: Answer All questions in this section

Question One

a) Define the following terms

i) heat of formation

ii) Ignition time

iii) Dry ash free basis (3 marks)

b) Outline Four features of biomass (4 marks)

c) State Four sources of biomass (2 marks)

d) Describe Two environmental impacts of biomass energy (3 marks)

e) The gravimetric analysis of a sample of coal is given as 80% C, 12% H, and 8% ash. Calculate the stoichiometric A/F ratio (6 marks)

f) Describe Two factors affecting the growth, survival and metabolism of microorganisms (4 marks)

g) Using a well labeled diagram, briefly describe the Two types of alcohol fermentations (8 marks)

SECTION B: Answer any TWO questions in this section

Question Two

a) Define the following terms (2 marks)

i) Biomass conversion

ii) Heat of combustion

b) Explain how temperature, air to fuel ratio and residence time affect biomass gasification process and products. (6 marks)

c) Describe Two methods used in processing biogas (4 marks)

d) Describe the following methods of classifying and ranking fuels (8 marks)

i) Atomic ratio

ii) Ternary diagram

Question Three

a) Define the following terms (2 marks)

i) Relative molecular mass

ii) Stoichiometric mixture of air and fuel

b) A sample of fuel F gave the following ultimate analysis by mass: C 81.9%; 5.9%; O 5.1%; N 2.2% and the remaining is ash. Calculate: (18 marks)

i) The stoichiometric A/F ratio

ii) The analysis by volume of the wet and dry products of combustion when the air supplied is 35% in excess of that required for complete combustion.

Question Four

a) What is the importance of understanding physical and chemical properties of biomass (3 marks)

b) State Three benefits of anaerobic digestion (3 marks)

c) Apart from carbonization, explain Two modes of pyrolysis (6 marks)

d) Define the term alcohol fermentation and explain the four stages of alcohol fermentation process (8 marks)

Question Five

a) With an aid of well labeled diagram, describe;

i) fixed-dome digester and

ii) Floating drum digester (8 marks)

b) Define the term anaerobic digestion and explain the Four stages of anaerobic digestion process (12 marks)