



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)