22

KENYATTA UNIVERSITY

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

(ENERGY TECHNOLOGY)

TET 303: BIOENERGY TECHNOLOGY

3RD TRIMESTER 2022/2023 TIME: 2HOURS

INSTRUCTIONS: Answer question ONE and any other TWO questions

Section A: Answer all questions in this section

Question One

(a)Differentiate between:

(i) Aerobic and anaerobic organisms (2 marks)

(ii) Updraft and downdraft gasifier (6 marks)

(iii) Chemical and physical properties of biomass (4 marks)

(b) Outline FOUR features of biomass (4 marks)

(c)Outline the THREE methods used in processing biogas (6 marks)

(d) Differentiate between fixed-dome and floating drum digesters (8 marks)

Section B: Answer any TWO questions in this section

Question Two

(a)Describe the scientific principles of the following biomass conversion technologies. (12 marks)

(i) Alcohol fermentation process

(ii) Pyrolysis process

(b) A biomass feedstock A has cellulose and hemicellulose content of 0.45 and 0.51 respectively. Determine its higher heating value. (3 marks)

(c)Enumerate FIVE factors considered in selecting feedstock for alcohol fermentation (5 marks)

Question Three

(a)Describe the following types of biomass materials (3 marks)

(i) Sacchariferous materials

(ii) Amylareous materials

(b) Outline TWO process parameters affecting anaerobic digestion process (4 marks)

(c) State TWO uses of biogas (1 marks)

(d) Ethyl alcohol is burned in a petrol engine. The equation for the combustion of ethyl alcohol is as follow

$C_2H_60 + 30_2 \longrightarrow 2C0_2 + 3H_20$

Calculate (12 marks)

(i) The stoichiometric A/F ratio:

(ii) The A/F ratio and the wet and dry analysis by volume of the exhaust gas for the mixture strength 90%.

Question Four

(a) With a help of a schematic diagram, describe the anaerobic decomposition process. (10 marks)

(b) Describe the TWO key products of anaerobic digestion process (3 marks)

(c)State TWO industrial uses of fermentation (1 mark)

(d) 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)

Question Five

(a)Define the term gasification and explain the four stages of gasification process. (12 marks)

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

(i) Atomic ration

(ii) Ternary diagram