



KIBABII UNIVERSITY

2020/2021 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER

MAIN EXAMINATIONS

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

COURSE CODE: IPT 434

COURSE TITLE: **Distillery Operation & Maintenance**

DATE: 13/10/21

TIME: 8:00-10AM

INSTRUCTIONS TO CANDIDATES

Answer question ONE and any other two questions

This paper consists of 3 printed pages. Please Turn over

Question One

- (a) Operation of an industrial plant demands team work because of the wide and varied range of skills required. [6 marks]

Identify the technical skills (trade areas) that are required to operate a distillery for production of bioethanol

- (b) Coordination is a key function to ensure smooth flow of activities in a complex industrial plant. [6 marks]

Identify the activities in a sugar cane-based bioethanol plant and briefly explain the aspects of coordination that needs to be implemented

- (c) A power outage occurs in bioethanol plant that normally operates 24/7. The outage lasts six hours. [6 marks]

Explain the challenges that this will cause to the operation of the plant when it is restarted.

- (d) Critical plant equipment is sometimes operated with a high level of redundancy (multiple spare equipment is always on standby). This is clearly expensive. [6 marks]

Why is redundancy the only viable option in some situations?

- (e) Preventive maintenance is cheaper than breakdown maintenance. Explain in the context of operation of a bioethanol distillery [6 marks]

Question Two

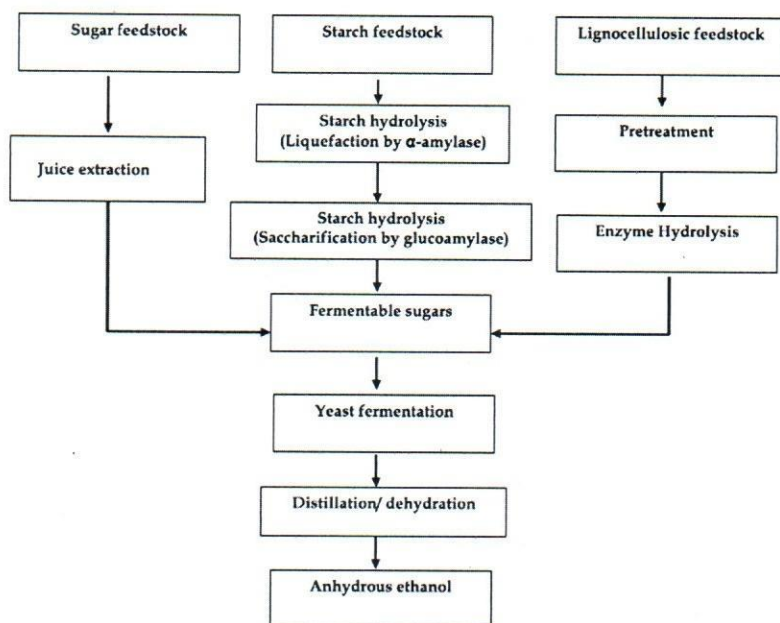
- (a) Delivery of raw materials and finished products to and from a manufacturing plant can have far reaching consequences to overall operations
- (i) With reference to storage of bioethanol, explain the consequences of a delay in delivery of the bioethanol fuel to customers [6 marks]
- (ii) What would be the effect of late delivery of raw materials [6 marks]
- (b) A concept developed in Japan that is sometimes employed to ease storage requirements is called "just in time manufacturing". In this case there is no storage of raw materials and no storage of the finished product. Can this be applied in a distillery? Explain [8 marks]

Question Four

- (a) With the help of a schematic diagram, describe the key steps involved in the production of corn (maize) bioethanol in a first-generation process and highlight the additional co-products that give value to the distillery [10 marks]
- (i) Which components have the highest cost in the process? [4 marks]
- (ii) Explain the use of the co-products of this process [3 marks]
- (b) Use of corn as a feedstock is common in the US, but is controversial. Why is this so? [3 marks]

Question Three

- (a) Bioethanol can be produced from different feedstocks as depicted in the schematic below



- (i) Identify feedstock associated with sugary, starchy and lignocellulosic materials [3 marks]
 (ii) What type of pre-treatment is the lignocellulosic feedstock subjected to and why? [4 marks]
- (b) There are fewer processing steps in the “sugar feedstock” pathway but it is not necessarily the most promising. Explain the challenges along this pathway [8 marks]
- (c) The “lignocellulosic feedstock” pathway is the most promising pathway, but has its challenges. Explain [5 marks]

Question Five

- (a) Bioethanol quality is maintained through process monitoring to ensure all reactions progress as required. Of particular interest is the fermenter. Here enzymes secreted by bacteria breakdown the sugars to ethanol and other products
- (i) What are these “other products”? [2 marks]
 (ii) How are these “other products” separated from the ethanol? [6 marks]
- (b) Distillation is a very important step in the purification of products of fermentation. Describe how it is executed and comment on the energy usage [12 marks]