



KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BSC (RENEWABLE ENERGY AND BIOFUEL
SYSTEMS)

COURSE CODE: IPT 320

COURSE TITLE: ENERGY AND MASS BALANCE
DURATION: 2 HOURS

DATE: 11/02/2021

TIME: 11:00 - 1:00 PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 4 printed pages. Please Turn Over



KIBU observes ZERO tolerance to examination cheating

QUESTION ONE (30 Marks)

- i) State the Law of conservation of mass and energy. (5mks)
- ii) A textile dryer is found to consume 4 m³ /hr of natural gas with a calorific value of 800 kJ/mole. If the throughput of the dryer is 60kg of wet cloth per hour, drying it from 55% moisture to 10% moisture, estimate the overall thermal efficiency of the dryer taking into account the latent heat of evaporation only. (5mks)
- iii) State and explain the importance of energy balance within a system (5mks)
- iv) Draw a typical input output diagram for a process and indicate the various energy inputs. (5mks)
- v) Differentiate between system and a boundary (5mks)
- vi) How much of concentrated milk of 35% total solid is required to produce 150Kg/h of milk powder of 95% total solid. (5 Marks)

QUESTION TWO (20 Marks)

- a) The dried vegetable containing 7% moisture content was conveyed to a water spraying chamber. If the moisture content of the vegetable is required to be raised to 35%. Find out the amount of water sprayed to vegetable. (10mks)
- b) A solution of common salt in water is prepared by adding 20Kg of salt to 100Kg of water, to make a liquid of density, 1323Kg/M³. Calculate the concentration of salt in this solution as a;-
 - a) Weight fraction and
 - b) Weight/Volume fraction. (10mks)

QUESTION THREE (20 Marks)

- i) Explain the meaning of the following terms as applied in mass and energy balances;-
 - a) Accumulation (2 Marks)
 - b) Steady State (2 Marks)
 - c) Unsteady State (2 Marks)
 - d) Batch Process (2 Marks)
 - e) Continuous process (2Marks)
- ii) Skim milk is prepared by the removal of some of the fat from the whole milk. The skim milk is found to contain 90.5% water, 3.5% protein, 5.1% carbohydrate, 0.1% fat and 0.8% ash. If the original

milk contained 4.5% fat, calculate its composition assuming that fat only was removed to make the skim milk and there are no losses in processing. (10 mks)

QUESTION FOUR (20 Marks)

- i) Explain recycling and by pass of process as applied in mass and energy balances. (5mks)
- ii) Dehumidified air of $0.008\text{Kg H}_2\text{O/Kg air}$ are required to be fed to a dryer. The atmospheric air has the absolute humidity of $0.02\text{Kg H}_2\text{O/Kg air}$. Therefore, the air is passed through a dehumidifying system that reduces the absolute humidity to $0.004\text{Kg H}_2\text{O/Kg air}$. So, part of the fresh atmospheric air is by passed to dehumidifying unit. Find out the mass of water removed per 100Kg of dry air feed and the percentage of bypass air. (15mks)