



Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN
FOOD TECHNOLOGY & QUALITY ASSURANCE TECHNOLOGY

BSFQ 12S

AFS 4301 : FOOD ENGINEERING III

SEMESTER EXAMINATION

DECEMBER 2013 SERIES

2 HOURS

Instructions to candidates:

This paper consist of **FIVE** questions

Answer question **ONE** (compulsory) and any other **TWO** questions

QUESTION ONE

- a) Explain the term concentration polarization and how concentration polarization caused by reverse osmosis is different from that caused by ultra-filtration **(5 marks)**
- b) The equation for determining osmotic pressure is given as follows:

$$\pi = \frac{RT}{V} \ln(a_w) = MRT$$

Identify the symbols used **(3 marks)**

- c) State the application of Ultra-filtration in the food industry **(3 marks)**
- d) Give advantages of membrane separation in the food industry **(4 marks)**

- e) State Five(5) applications of extraction in the food industry **(2.5 marks)**
- f) Explain solubility as applied to extraction of food substances **(4.5 marks)**
- g) Using illustration, discuss neutral radius including its importance in design of centrifuges be used in food industries **(8 marks)**

QUESTION TWO

- a) A solution of sucrose in water at 25°C is to be concentrated by osmosis. It is found that with a differential applied pressure of 5000kPa, the rate of movement of water molecules through the membrane is $25\text{Kg}^{-2}\text{h}^{-1}$ for a 10% solution of sucrose. Estimate the flow rate through the membrane for a differential pressure of 1000kPa with 10% sucrose solution and also estimate the flow rate of the differential pressure of 10000kPa but with a sucrose concentration of 20%.

Give that:

For sucrose, the molecular weight is 342 and for a 10% solution the molar concentration is $0.304\text{ moles m}^{-3}$ and for 20% solution the molar concentration is $0.6232\text{ moles m}^{-3}$

(10 marks)

- b) Beer with a specific gravity of 1.042 and viscosity of $1.40 \times 10^{-3}\text{NSm}^{-2}$ contains 1.5% solids which have a density of 1160kgm^{-3} . It is clarified at a rate of 240lh^{-1} in a ball centrifuge which has an operating volume of 0.09m^3 and a speed of 1000rev min^{-1} . The bowl has a diameter of 5.5cm and is fitted with a 4cm outlet. Calculate the effect on feed rate on if the ball speed is increased to $15,000\text{rev min}^{-1}$ and determine the density of the particle **(10 marks)**

QUESTION THREE

With an aid of a clear labeled diagram explain the mode of operation of a Continuous Rotary Drum Vacuum Filter **(20 marks)**

QUESTION FOUR

A process of extracting sugar from sugarcane involves pressing the cane through a three (3) roller miller followed by shredding by the fibre residue (bagasse) and extracting the sugar with water. The cane originally contained 20% fibre, 16% sugar and 64% water. After milling the moisture content of bagasse was found to be 55%. Since the fibre is used for fuel after the extraction battery stage, the solids are squeezed to remove the absorbed solution and the squeezed solution is added to the last stage, under the following conditions:

- Sugar recovery must be not less than 99%
- The concentration of sugar in the final product must be 10%
- The bagasse carries a constant amount of the solution of 1.22Kg solution per kg fibre

Calculate the following :-

- a) The water-solid ratio needed
- b) The components lost during milling
- c) The final sugar content of the extract mixed with the juice first pressed from the cane

(20 marks)