FOST 335

CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

**EXAMINATION FOR THE AWARD OF DEGREE
OF BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY**

FOST 335: UNIT OPERATIONS IN FOOD PROCESSING

STREAMS: BSC (FOST)   **TIME: 2 HOURS**

DAY/DATE: TUESDAY 17/11/2020   **5.00 P.M. – 7.00 P.M.**

INSTRUCTIONS:
- **Answer all questions in section A and any two questions in section B**
- **Show your workings and drawings clearly**

SECTION A: ANSWER ALL QUESTIONS (30 MARKS)

1. (a) Define the term unit operation as used in food processing   (**5 Marks**)
   (b) Give five classes of unit operations based on the property transferred.   (**5 Marks**)

2. (a) A processing plant is producing minced meat, which must contain 15% of fat. If this is
   to be made up from boneless cow beef with 23% of fat and from boneless bull beef with
   5% of fat, what are the proportions inwhich these should be mixed?   (**5 Marks**)

3. An autoclave contains 1000 cans of pea soup. It is heated to an overall temperature of
   100°C. If the cans are to be cooled to 40°C before leaving the autoclave, how much
   cooling water is required if it enters at 15°C and leaves at 35°C?(The specific heats of the
   pea soup and the can metal are respectively 4.1 kJ kg^{-1} $°C^{-1}$ and 0.50 kJ $kg^{-1}°C^{-1}$.The
   weight of each can is 60 g and it contains 0.45 kg of pea soup. Assume that the heat
   content of theautoclave walls above 40°C is 1.6 x 10^4 kJ and that there is no heat loss
   through the walls.   (**9 Marks**)

4. Using sketch diagrams describe the principle of operation of a centrifugal separator.
                                                                              (**6 Marks**)

SECTION B: ANSWER ANY TWO QUESTIONS (40 MARKS)

5. (a) Distinguish between "single effect" and "multiple effect evaporator (**2 Marks**)

   (b) A single effect evaporator is being used to concentrate milk from 10% solids to 30% solids at a rate of 250 kg/h. To achieve the process, steam is available at 200kPagauge pressure. The pressure in the evaporator is 77kPa absolute, and the evaporator has anoverall heat transfer coefficient of 1700 $Jm^{-2}s^{-1}°C^{-1}$. Assume that the temperature ofthe feed is 15°C and that of the boiling solution under the pressure of 77kPa absoluteis 91°C. Assume also that the specific heat of the solution is the same as that of wateri.e. 4.186kJ/kg°C and the latent heat of vaporization of the solution is the same as thatfor water under the same conditions. Calculate:

       i) The quantity of steam required per hour (**5 Marks**)

       ii) The area of the heat transfer surface (**5 marks**)

   (c) With help of sketch diagrams write short notes on the following ways of feeding multiple effect evaporators, highlighting the merits and demerits of each

       i) Backward feeding (**4 Marks**)

       ii) Mixed feeding (**4 Marks**)

6. Describe the mechanisms of the following components of a spray drier

       i) Spray forming device (**10 Marks**)

       ii) Air heating and circulating system (**3 Marks**)

       iii) Drying chamber (**3 Marks**)

       iv) Product recovery system (**4 marks**)

7. (a) A cold store has a wall comprising 11 cm of brick on the outer side, then 7.5 cm of concrete in the middle, and then 10 cm of cork on the inner side. The thermal conductivities for brick, concrete and cork are 0.69, 0.76, and 0.043 $Jm^{-1}s^{-1}°C^{-1}$ respectively. The mean temperature within the store is maintained at -18°C and the temperature of the outside surface of the wall is 18°C. Determine;

       i) The rate of heat transfer through 1 m^2 of the wall (**4 Marks**)

       ii) The temperature at the interface between the concrete and the cork layers

       (**4 Marks**)

   b) Describe the working principle of a drum drier (**6 Marks**)

   c) Differentiate natural convection from forced convection and show examples of their applications in the food industry (**6 Marks**)

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