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**University Examinations 2015/2016**

THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN FOOD SCIENCE AND NUTRITION

**AFT 3332: FOOD ENGINEERING**

 **DATE: NOVEMBER 2015 TIME: 2 HOURS**

**INSTRUCTIONS:** *Answer question* ***one*** *and any other* ***two*** *questions*

**QUESTION ONE (30 MARKS)**

1. Using an appropriate example, explain the three part/components of a measurement. (5 Marks)
2. Explain the following terms as applied in unit operations involving food processing:
3. Sensible heat. (2 Marks)
4. Latent heat. (2 Marks)
5. Determine the following unit conversion to SI units:

Density value of 60 Ib m/ft3 to kg/m3 (11bm=0.45359 kg 1ft=0.3048m) (4 Marks)

1. State the principles on which material/mass and energy balances are based. (4 Marks)
2. Briefly explain the mode of action of at least five types of driers. (5 Marks)
3. Highlight five factors affecting plant layout and design. (5 Marks)
4. Highlight three forces used in filtration. (3 Marks)

**QUESTION TWO (20 MARKS)**

1. The Fourier equation expresses heat conduction. Explain the components of the Fourier equation. (5 Marks)
2. A cold store has a wall comprising 11 cm of brick on the outside, then 7.5 cm of concrete and then 10 cm of cork. The mean temperature within the store is maintained at -18oC and the mean temperature of the outside surface of the wall is 18oC. Calculate the rate of heat transfer through the wall. The appropriate thermal conductivities are for brick, concrete and cork, respectively 0.69, 0.76 and 0.043 J m-1 s-1 oC-1. Determine also the temperature at the interfaces between the concrete and cork layers, and the brick and concrete layers. (15 Marks)

**QUESTION THREE (20 MARKS)**

1. The Grashof number (Gr) is a dimensionless ratio that arises in the study of natural convection heat flow. If the number is given as:



whereas;

D= diameter m;

= density kg m-3

g= acceleration due to gravity m s-2

T= temperature oC or T K;

viscosity kg s-1 m-1 or Pa s, N sm-2;

Give the units and dimensions of $β$ of the coefficient of expansion of the fluid. (6 Marks)

1. Discuss the role of the following in the refrigeration cycle:
2. Evaporator. (4 Marks)
3. Refrigerant. (2 Marks)
4. Compressor. (4 Marks)
5. State four modes of operation of size reduction plants. (4 Marks)

**QUESTION FOUR (20 MARKS)**

1. An autoclave contains 1000 cans of pea soup. It is heated to an overall temperature of 100oC. If the cans are to be cooled to 40oC before leaving the autoclave, how much cooling water is required if it enters at 15oC and leaves at 35oC? The specific heats of the pea soup and the can metal are respectively 4.1 kJ kg-1 oC-1 and 0.50 kJ kg-1 oC-1. The weight of each can is 60g and it contains 0.45 kg of pea soup. Assume that the heat content of the autoclave walls above 40oC is 1.6 x 104 kJ and that there is no heat loss through the walls. (10 Marks)
2. Skim milk is prepared by the removal of some of the fat from whole milk. This 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 that there are no losses in processing. (6 Marks)
3. Discuss ionic polarization of microwaves. (4 Marks)