University Examinations 2015/2016

SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY

AFT 3200: FOOD ENGINEERING I

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

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

QUESTION ONE (30 MARKS)

a) Define or differentiate the following terms as used in food engineering:

    (i) Density and specific gravity.

    (ii) Pasteurisation.

    (iii)Laminar flow.

    (iv)D-value.

    (v) Dipolar rotation.   (5 Marks)

b) Drying causes food to lose moisture. A farmer used solar to dry 120kg of maize. After drying he weighed the maize and got 80 kg. A student took a sample (3g) of the solar dried maize and dried it further in an oven at 105^0C for 24 hours. The sample lost 30% of the weight. What was the moisture content in wet and dry basis and the dry matter of the maize grains after solar drying by the farmer?   (5 Marks)

c) A student had three samples, ice at 0^0C, water at 25^0 C and cooking fat at 25^0C. How would their specific heat capacity and thermal conductivity compare?   (3 Marks)

d) Differentiate between shear thinning and shear thickening.   (2 Marks)

e) A rectangular stainless steel plate is used in manufacture of a food heating vessel. One side of the plate is 100^0C and the other side is 25^0C. Assuming steady-state conditions. Calculate the rate of heat transfer through the plate. The thermal conductivity of steel is 17W/(m^{o}C). (3 Marks)

f) A heat resistant spore was heat treated at 112 C. At time zero, the number of survivors was 1million and after 8 minutes the number of survivors was 12,000. Determine the D-value of the spore. (3 Marks)

g) Differentiate between freeze drying and spray drying giving an example of application of each process. (4 Marks)

h) Discuss importance of evaporation in food products. (3 Marks)

i) List two advantages of counter current heat exchanger. (2 Marks)

QUESTION TWO (20 MARKS)

a) Discuss two mechanisms through which a microwave oven heats food. (10 Marks)

b) Milk was pasteurized at 120^0C for 96 seconds and obtained a 8 log reduction of the target bacteria. The producer lowered the temperature to 100^oC and obtained similar reduction of the bacteria after 8 minutes. Determine the decimal reduction time and Z-value at the two temperatures. (4 Marks)

c) A 2cm thick steel pipe (thermal conductivity 43W/[m^{o}C] with 6 cm inside diameter is being used to convey steam from a boiler to process equipment for a distance of 40 m. The inside pipe surface temperature is 115°C, and the outside pipe surface temperature is 90°C. Calculate the total heat loss to the surroundings under steady-state conditions.(6 Marks)

QUESTION THREE (20 MARKS)

a) State the law of conservation of mass. (1 Marks)

b) In preparation of ready to drink juice, streams of two concentrates were mixed. Stream A contained 20% and stream B contained 60% (by weight) of sucrose. How much of the two streams should be mixed to prepare 200 kg of juice with 30% sucrose concentration. (5 Marks)

c) Calculate the time necessary to dry a product from 90% to 25% moisture (wet basis) in an industrial dryer where 2 kg dry solid/m2 surface area exposed to the air is loaded. It is given that the critical moisture content is 5 kg water/kg dry solid, the equilibrium moisture content is 0.033 kg water/kg dry solid and the drying rate at the critical moisture content is 3 kg water/m2h under the specified conditions. (10 Marks)

d) The following equipment are used in food processing. Briefly highlight the principle they employ and their application:

   (i) Rising film evaporator.
   (ii) Plate heat exchanger. (4 Marks)

QUESTION FOUR (20 MARKS)

a) Juice was pumped into a storage tank of 5M height and 3M diameter. The inlet pipe was of 2.5 cm diameter and the mean flow rate velocity was 3m/s. As a supervisor you wanted to fill the tank to 80% the capacity. Determine how long it would take. After it was filled to 80%, the inlet was closed and the outlet valve of 3 cm diameter was open and the juice flowed at 2m/s. What was the level (height) of the juice in the tank after an hour?

(10 Marks)

b) Differentiate between laminar and turbulent flow and discuss a simple experiment that you would carry out with fluid flowing through a pipe to demonstrate a laminar and turbulent flow. (5 Marks)

c) List two non-thermal food processing techniques highlighting the working principle.

(5 Marks)