Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	FOOD ENGINEERING
COURSE CODE	:	BWD 21503
PROGRAMME CODE	:	BWD
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Tomato puree contains 85% water. After being simmered for 30 minutes, it is found that 80% of the original water has been removed. Calculate the mass of water removed per kilogram of the tomato puree, and the composition of the concentrated tomato puree.

(5 marks)

(b) Bagasse, which is the dry pulpy fibrous residue that remains after sugarcane are crushed to extract their juice is dropped from a press machine into a bin. The sugarcane juice is then heated in a pasteurizer to extend its shelf life. Energy may be in different forms during the aforementioned processing. Analyze the forms of energy involved and neglected in the aforementioned food processing system.

(10 marks)

(c) Discuss the causes and effects of outlining both material and energy balances in pineapple juice manufacturing.

(10 marks)

Q2 Orange juice concentrate, 40% raw corn starch solution, water and tomato paste have wide range of movement to resistance. They have different abilities to be poured out of a cup or upon stirring.

(a) Reynolds number of the water is 40000 in Pipe A and 2000 in Pipe B. Differentiate the flow characteristics of the water in both pipes.

(4 marks)

(b) Analyze the flow properties of orange juice concentrate, 40% raw corn starch solution, water and tomato paste.

(12 marks)

(c) Orange juice level in a holding tank should be monitored continually and any deviations are promptly addressed. Propose how to control the orange juice level in the holding tank.

(5 marks)

(d) Justify your proposal as answered in **Q2(c)**.

(4 marks)

Q3 (a) Heating and cooling of foods are conducted in an equipment called heat exchangers in a food manufacturing plant. Heat exchangers can be classified into noncontact and contact types. List **THREE (3)** types of noncontact type heat exchangers used in the food industry.

(5 marks)

(b) Differentiate **THREE (3)** comparisons between conductive heat transfer and convective heat transfer.

(6 marks)

(c) A 2 cm thick steel pipe (thermal conductivity = 43 W/[m °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 **(Figure Q3(c))**. Calculate the total heat loss to the surroundings under steady-state conditions.

(8 marks)

(d) The diffusion of gases is a process that considering the concentration of gas molecules. Briefly explain the mass transfer involved according to ideal gas law that relates to partial pressure based on the illustrated diagram **(Figure Q3(d)).**

(6 marks)

Q4 (a) Plant design refers to the overall design of a manufacturing facility. Explain **FOUR (4)** elements to be considered in designing a food plant.

(8 marks)

(b) Plant design can be divided into two general types which are long term design and short term design. Differentiate between these two types.

(5 marks)

(c) Plant layout is the most effective physical arrangement of machines, processing equipment and service departments to achieve greatest coordination and efficiency. Design an advanced layout model in a milk powder processing factory considering the food hygiene and food safety aspects.

(12 marks)

– END OF QUESTIONS –

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FORMULA

$$q_r = \frac{(T_i - T_o)}{\left[\frac{\ln(r_o/r_i)}{2\pi Lk}\right]}$$

$$R_t = \frac{\ln(r_o/r_i)}{2\pi Lk}$$

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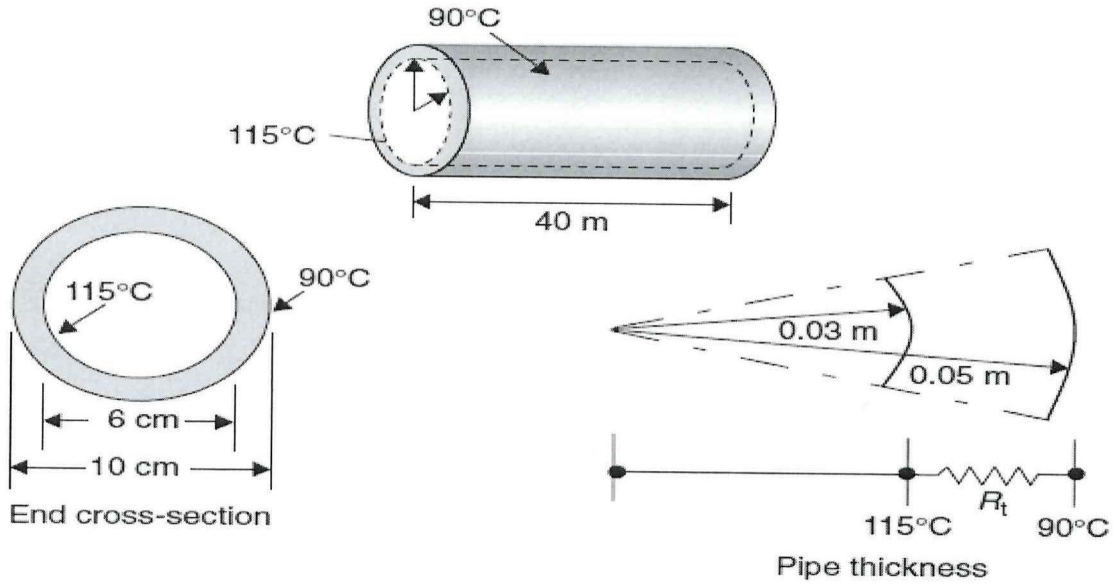

Figure Q3(c): Diffusion of gases in an enclosed chamber

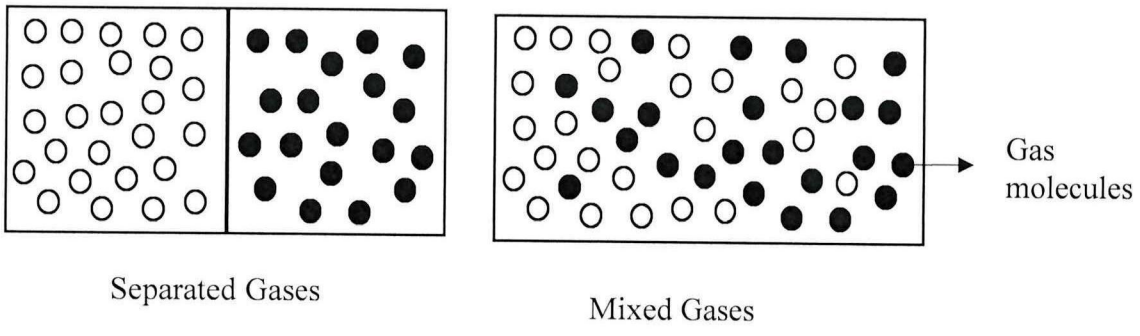

Figure Q3(d): Diffusion of gases in an enclosed chamber