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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : CHEMICAL INDUSTRY UNIT
PROCESS AND OPERATION
- COURSE CODE : BWK 20603
- PROGRAMME CODE : BWK
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 - Open book
 - Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

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TERBUKA

- Q1** The study of design of reactors and fluid mechanic behaviour is important to determine the unit process and unit operation in chemical industry.
- (a) XY Glove is an international company producing various type of gloves from different kind of materials where various type of reactors were used in their glove-making process.
- (i) List the **FIVE (5)** type of reactors in chemical industry.
(5 marks)
- (ii) If XY Glove is using continuous stirred tank reactor (CSTR) in one of the processes to produce gloves, sketch the reactor with proper diagram and label.
(5 marks)
- (iii) Describe the **FIVE (5)** advantages of CSTR.
(5 marks)
- (b) Determining type of flow in chemical industry is important to study the behaviour of the fluid in chemical industry.
- (i) State the **THREE (3)** type of flows in fluid mechanic.
(3 marks)
- (ii) Osborne Reynolds, a British engineer who discovers the variables that can be used as a criterion to distinguish between types of flow. Calculate the flow rate (Q) Ls^{-1} where the Reynold number, R_e is 2000, glass tube diameter (D) is 0.01 m, area (A) is $2 \times 10^{-4} \text{ m}^2$ and kinematics viscosity (V) for 25°C water is $0.89 \times 10^{-6} \text{ ms}^{-1}$ and determine the type of flow.
(7 marks)
- Q2** Mass and heat transfer are considered vital unit operation and unit process in chemical industry. These mechanisms can be applied in various application which involved important factor and parameter for a successful reaction.
- (a) Absorption and distillation are common separation process which involved two different mechanisms but can be used for similar application.
- (i) Describe **THREE (3)** differences of absorption and distillation.
(6 marks)
- (ii) Boiling point diagram can be used to express the vapor-liquid relations. Explain the diagram with the aid of illustration and Raoults's law.
(9 marks)

- (b) In heat transfer, the transfer of energy across mediums involve are conduction, convection and radiation and can occur in many types of chemical processes.
- (i) Define conduction process. (2 marks)
- (ii) Describe the mechanism of conduction based on Fourier's law with the aid of illustration. (5 marks)
- (iii) Calculate the heat loss per m^2 of surface area for an insulating wall composed of 20 mm-thick fibre insulating board, where the inside temperature is 350 K and the outside temperature is 280 K, thermal conductivity of fibre insulating board is 0.048 W/mK. (3 marks)
- Q3** A liquid mixture containing 45% benzene and 55% toluene by mass is being fed to a distillation column. The overhead product contains 95 moles % benzene and the bottom product leaves with 8.00% of the benzene fed into the column is 2000 Lh^{-1} and the specific gravity of the feed mixture is 0.872. (MW of C_6H_6 : 78.11g/mol; $\text{C}_6\text{H}_5\text{CH}_3$: 92.14 g/mol)
- (a) Predict the mass flow rate of the distillate. (15 marks)
- (b) Determine the composition of the bottom stream. (10 marks)
- Q4** Air at 10°C and 80 kPa enters the diffuser of a jet engine steadily with a velocity of 200 ms^{-1} . The inlet area of the diffuser is 0.4m^2 . The air leaves the diffuser with a velocity that is very small compared with the inlet velocity.
- (a) Calculate the mass flow rate of the air. (10 marks)
- (b) Find the temperature of the air leaving the diffuser. (15 marks)

- END OF QUESTIONS -