



UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL AND BIO-ENGINEERING TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : CFB31103
COURSE TITLE : FOOD PROCESS ENGINEERING
PROGRAMME NAME : BACHELOR OF CHEMICAL ENGINEERING TECHNOLOGY (FOOD)
WITH HONOURS
DATE : 24 JANUARY 2026
TIME : 2:00PM - 5:00PM
DURATION : 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of ONE sections.
4. Section A consist of five questions. Answer FOUR (4) questions only.
5. Please write your answer on the answer booklet provided.
6. Please answer all questions in English only.
7. Refer to the attached Formula/ Appendies. ☐ Tick if applicable

THERE ARE 5 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 100 marks)

Answer **FOUR (4)** questions.

Please use the answer booklet provided.

Question 1

Total solids (TS) in a liquid food can be concentrated from 10% to 30% using a membrane separation device. There are two stages in the concentration process, which the first stage releases a liquid stream with low total solids. The final concentration product is extracted from a low-total-solids stream in the second stage and fed back into the first. When there is 2% TS in the recycle system, 0.5% TS in the waste stream, and 25% TS in the stream between stages 1 and 2, calculate the total amount of the recycle stream. 100 kg/min of 30% TS should be produced by the process.

(25 marks)

Question 2

A carbon-steel pipe (thermal conductivity = 45 W/m·K) is used to transport hot syrup at 95°C, with the inner pipe wall temperature maintained at 90°C. The pipe has an inner diameter of 4 cm and a wall thickness of 0.8 cm. To limit heat loss to no more than 30 W per meter of pipe length, thermal insulation is required. Due to space limitations, the insulation thickness cannot exceed 4 cm. The temperature at the outer surface of the insulation must remain at or above 25°C to prevent moisture condensation from the surrounding air. Assume steady-state radial heat conduction, negligible contact resistance, and that heat transfer is dominated by conduction through the pipe wall and insulation.

- i. Calculate thermal conductivity of the insulation that will result minimum heat loss.

(15 marks)

- ii. Discuss the need for thermal insulation in transporting heated syrup, considering its effects on energy consumption.

(10 marks)

Question 3

Answer these questions;

- (a) Air in a processing room has a dry-bulb temperature of 20 °C and a wet-bulb temperature of 15 °C. By using a provided psychrometric chart at standard atmospheric pressure:
- i. Determine moisture content (humidity ratio), kg water vapour/kg dry air.
(5 marks)
 - ii. Determine relative humidity, %.
(5 marks)
 - iii. Determine specific enthalpy of air, kJ/kg dry air.
(5 marks)
 - iv. Determine specific volume of air, m³/kg dry air.
(5 marks)
- (b) Explain TWO (2) factors that influence the drying rate of a food material.
(5 marks)

Question 4

A food processing factory produces canned fruit cocktail and sterilizes the product in a steam retort at 118°C for 25 minutes. The target microorganism is *Clostridium botulinum* with a z-value of 10°C.

- i. Calculate the F_0 value of this thermal process using a reference temperature of 121.1°C.

(10 marks)

- ii. Given that the minimum required F_0 value for safety is 5 minutes, determine whether the process is sufficient to ensure safety.

(10 marks)

- iii. Evaluate whether this process is optimal in terms of energy efficiency. Justify your answer.

(5 marks)

Question 5

A liquid food processing plant (e.g. fruit juice, dairy beverages, or sauces) is experiencing high energy consumption. Propose an appropriate engineering improvements to enhance process efficiency, product quality, and/or energy utilization. Choose ONE (1) of the following physical operations (a–e) and answer accordingly.

- (a) Mechanical, Electrical, and Optical Properties
- (b) Rheological Properties
- (c) Mixing
- (d) Sedimentation and Centrifugation
- (e) Filtration and Membrane Processes

- i. Identify ONE (1) current limitations or inefficiencies of the selected process.

(8 marks)

- ii. Evaluate the issue using engineering principles.

(9 marks)

- iii. Propose specific and realistic engineering improvements.

(8 marks)

END OF EXAMINATION PAPER

Appendix

$$q_r = \frac{(T_i - T_o)}{R_1 + R_2}$$

$$q_r = \frac{(T_i - T_o)}{\frac{\ln r_2/r_1}{2\pi L k_a} + \frac{\ln r_3/r_2}{2\pi L k_b}}$$

$$L = 10^{\frac{T - T_{ref}}{z}}$$

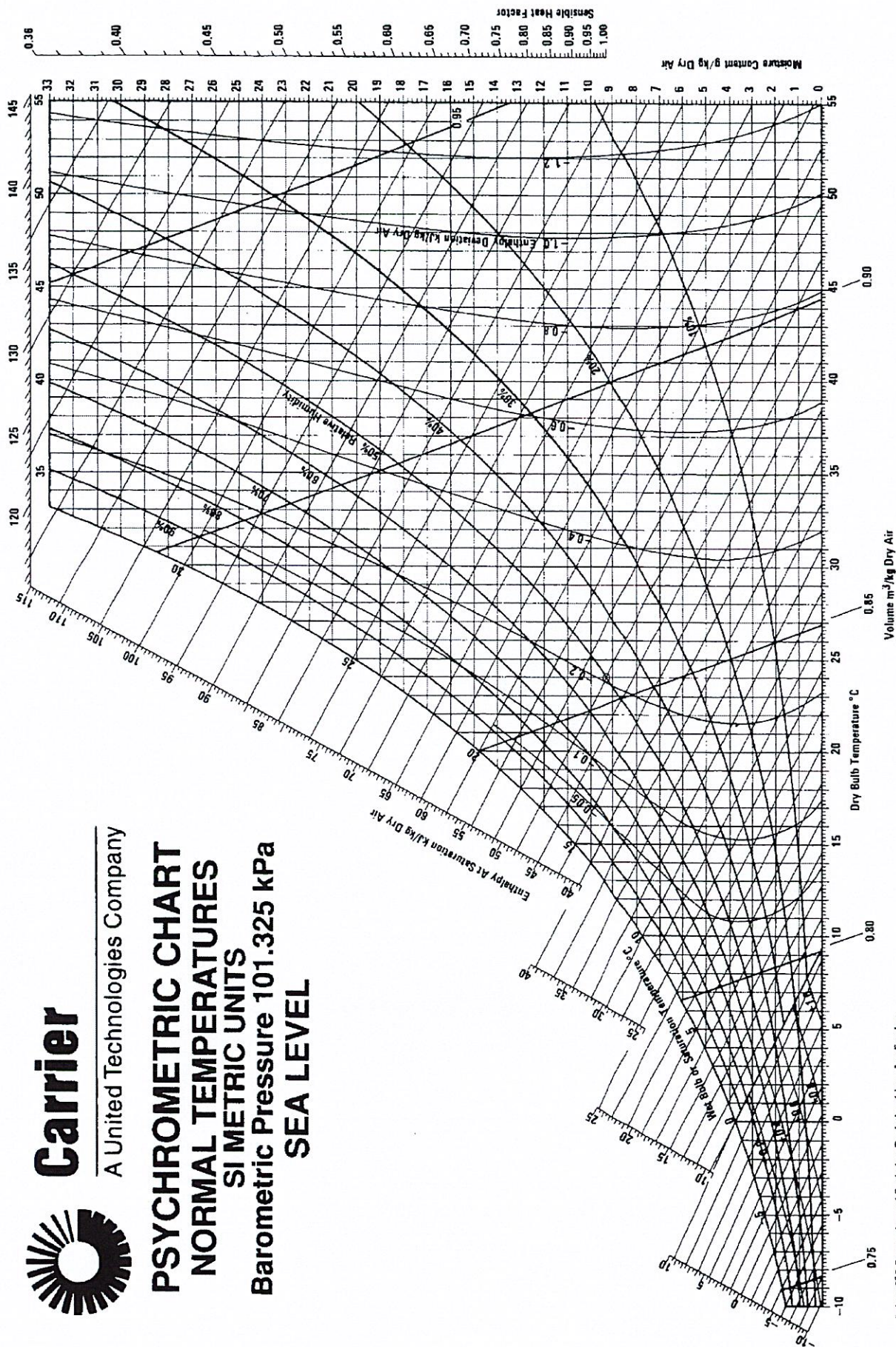
$$F_0 = L \times t$$



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PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL



Below 0°C Properties and Enthalpy Deviation Lines Are For Ice

■ Figure A.5.2 Psychrometric chart for low temperatures.

