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UNIVERSITY OF ESWATINI

FINAL EXAMINATION PAPER

PROGRAMME : BACHELOR OF SCIENCE IN FOOD SCIENCE, NUTRITION AND TECHNOLOGY YEAR II

COURSE CODE : FNS201

TITLE OF PAPER : PRINCIPLES OF FOOD ENGINEERING

TIME ALLOWED : TWO (2) HOURS

INSTRUCTIONS : ANSWER QUESTION ONE (1) AND ANY OTHER TWO (2) QUESTIONS. ILLUSTRATE YOUR ANSWERS WITH DIAGRAMS WHERE NEEDED

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QUESTION 1 (COMPULSORY)

(a) A packed food is thermally treated at 130°C to reduce the microbial load from 10,000 to 10^{-4} per package. The decimal reduction time (D) of the target microorganism at this temperature was found to be 2.5 min. **(10 Marks)**

    i. Calculate the time required to reach at this target.

    ii. If the z-value is 10°C, calculate the time required to reach at the same target at 135°C.

(b) Ambient air at 25 °C dry bulb temperature and 80% relative humidity was heated to 50°C dry bulb temperature. The heated air was used to dry a food product and the air left the dryer at 90% relative humidity. Using a psychrometric sketch, show the process and determine the properties of the heated air and the air leaving the dryer.

(10 Marks)

(c) Raw milk with 4% fat was fed into a cream separator at the rate of 200 kg/hr. The cream stream that leaves separator has 40% fat whereas the whey stream has 0.5% fat. Calculate the amount cream and whey produced per hour. Assume steady state.

(10 Marks)

(d) Calculate the rate of heat transfer through a composite wall of a cold store made of concrete lined with an insulation layer with 6 m² surface area. The insulation and concrete have thickness of 10 cm and 15 cm, respectively. The temperature on the two sides of the composite wall is 10 °C and 25 °C. The thermal conductivity of the insulator is 0.07 W/m°C and that of the concrete is 0.5 W/m°C. The system is at steady state. **(10 Marks)**

[TOTAL MARKS = 40]

QUESTION 2

(a) Write short notes on the following:
    i. F-value
    ii. Thermal death time curve
    iii. Steady state process
    iv. Sorption isotherms

(4×5 = 20 Marks)

(b) Explain the heating and cooling processes using psychometric chart and describe the changes in the specific humidity and relative humidity of the air.　　**(10 Marks)**

[TOTAL MARKS = 30]

QUESTION 3

(a) Discuss Newtonian and Bingham-plastic behavior using shear stress-shear rate graph. **(10 Marks)**

(b) Describe the evaporation and condensation processes in a refrigeration system using pressure-enthalpy chart.　　**(10 Marks)**

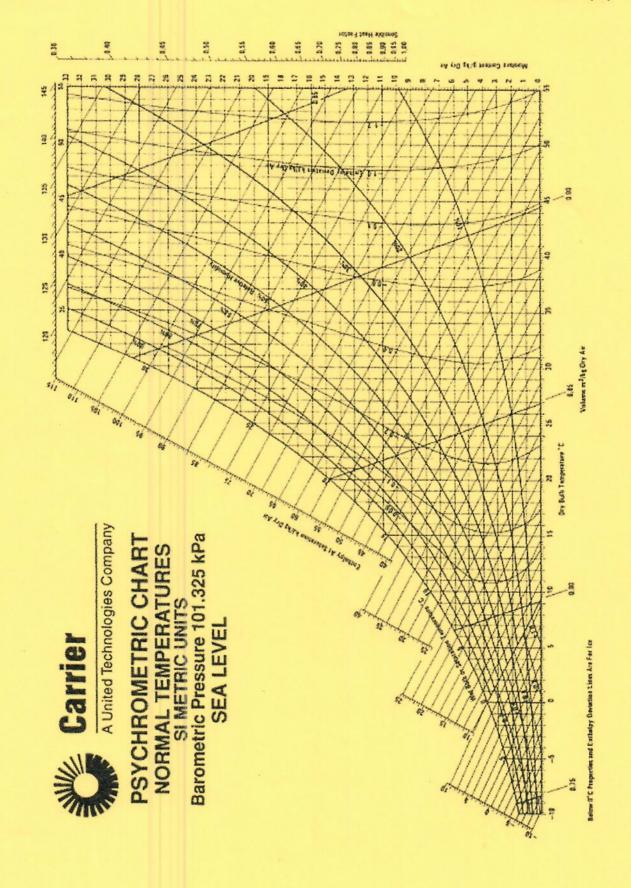(c) Describe mass transfer by molecular diffusion and convective mass transfer.

(10 Marks)

[TOTAL MARKS = 30]

QUESTION 4

(a) Describe the boiling point rise phenomena. Use graphical illustration to show the effect of solute concentration on boiling point.　　**(10 Marks)**

(b) An air–vapour mixture is at 30°C dry bulb temperature and 55% relative humidity. Using the psychrometric charts provided determine all other properties.　**(10 Marks)**

(c) Describe the *end-point* and *multiple-point* methods of measurements of thermal resistance of micro-organisms.　　**(10 Marks)**

[TOTAL MARKS = 30]

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

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