UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION PAPER

PROGRAMME	:	**BACHELOR OF SCIENCE IN HOME ECONOMICS [FOOD SCIENCE AND TECHNOLOGY OPTION] YEAR IV**
COURSE CODE	:	**FST 411**
TITLE OF PAPER	:	**PRINCIPLES OF FOOD ENGINEERING**
TIME ALLOWED	:	**TWO (2) HOURS**
INSTRUCTIONS	:	**ANSWER QUESTION ONE (1) AND ANY OTHER (3) QUESTIONS**

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QUESTION 1 [COMPULSORY]

a) Explain the following terms

i) Wet bulb temperature
ii) Constant rate period
iii) Falling rate period
iv) Critical moisture content
v) Equilibrium moisture content [15 Marks]

b) Alcohol has a density of 792 kg m^{-3} at 0°C. What will be its density at 50°C given that its coefficient of volumetric expansion is 0.0011 m^3K^{-1} [10 Marks]

[Total marks = 25]

QUESTION 2

a) Surface heat transfer coefficient is a measure of the resistance to heat flow caused by the boundary film. Explain what the boundary film is and how it can be reduced in batch processing and in plate heat exchangers. [10 Marks]

b) Calculate how much heat energy is required to produce 10kg of steam of dryness 0.5 at 7 bar, from feed water at 20 °C, given that sensible heat (h_f) = 697kJ kg^{-1}, latent heat (h_{fg}) is 2067 kJ kg^{-1} from enthalpy table at 7 bar, and the specific heat capacity of water is 4.18 kJ kg^{-1} K^{-1} [15 Marks]

[Total marks = 25]

QUESTION 3

a) Name two types of heat exchangers of your choice and explain under what conditions you would choose each type by giving an example of a food product to be processed. [10 Marks]

b) A heat exchanger is using hot water at 80°C to heat incoming milk at 20°C. The flow rate of the hot water is 140 kg s^{-1} and its outlet temperature is 45°C. The flow rate of milk is 170 kg s^{-1}. The specific heat capacity of milk is 3.9 kJ kg^{-1} K^{-1} and that of water is 4.18 kJ kg^{-1} K^{-1}

i) Calculate the outlet temperature of milk.

ii) Calculate the logarithmic mean temperature difference between channels. [15 Marks]

[Total marks = 25]

QUESTION 4

a) Describe the various sections of an evaporator with an aid of a diagram.
[10 Marks]

b) 100kg of Orange juice containing 9% total solids is evaporated to a final product containing 60% solids.

i) Calculate the yield of the final product

ii) Calculate how much water is evaporated [15 Marks]
[Total marks = 25]

QUESTION 5

a) What are the advantages of using steam in a food processing plant?
[10 Marks]

b) Two fluids, milk and rape seed oil are flowing along pipes of the same diameter (5cm) at 20°C and at the same flow velocity of $3ms^{-1}$. Determine whether the flow is streamline or turbulent in each fluid, given that the viscosity of milk is 2.10×10^{-3} Nsm^{-2} and the density is $1030kg\ m^{-3}$, and the viscosity of rape seed oil is 118×10^{-3} Nsm^{-2} and the density is $900\ kg\ m^{-3}$ [15 Marks]
[Total marks = 25]