CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

SECOND YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY

FOST 234: FOOD PLANT UTILITIES AND SERVICES

STREAMS: BSC FOST **TIME: 2 HOURS**

DAY/DATE: MONDAY 29/03/2021 **11.30 A.M. – 1.30 P.M.**

INSTRUCTIONS:

- **Answer ALL questions in section A and any TWO in section B.**
- **Show your workings clearly.**
- **No borrowing of calculators while in the exam room.**
- **Do not write anything on the question paper. All rough work to be done on the answer booklet and crossed through.**

SECTION A: ANSWER ALL QUESTIONS (30 MARKS)

QUESTION ONE

In the processing of yogurt, milk with a specific heat capacity of 3.86 kJ/kg ^{0}C is being heated from $22^{0}C$ to $90^{0}C$ at a rate of 500 kg/h using steam as the heating medium. At the point of use, the steam is available at 198 kPa gauge pressure. The heat exchanger being utilized has an efficiency of 90% and the steam quality is 85%. The system is designed to allow condensate to be released at 95^{0}C. Given that the specific heat capacity of water is 4.186 kJ/$kg^{0}C$, determine:

(i) Mass flow rate of steam required for this process. (6 marks)

(ii) Volume flow rate of steam required for this process. (2 marks)

(iii) The steam generation capacity required. (2 marks)

QUESTION TWO

A cold storage room is being maintained at 2^0C using a vapour compression refrigeration system that uses R-134a. The evaporator and condenser temperatures are -5^0C and 40^0C, respectively. The refrigeration load is 20 tons. Assuming that the unit operates under saturated conditions and the compressor efficiency is 85%,

(i) Represent this process on the pressure enthalpy chart. (3 marks)
(ii) Calculate the mass flow rate of refrigerant. (2 marks)
(iii) Calculate the compressor power requirement and the C.O.P. (2 marks)

QUESTION THREE

Using equations/diagrams, describe three ways of removing temporal water hardness. (6 marks)

QUESTION FOUR

Explain the importance of steam traps and give two examples of steam traps highlighting their principles of operation. (7 marks)

SECTION B: ANSWER ANY TWO QUESTIONS 40 MARKS

QUESTION FIVE

(a) Discuss how compressed air is generated for use in a food processing plant. (10 marks)

(b) Describe the major sources of contaminants for compressed air, their sources and discuss the various ways of their removal. (10 marks)

QUESTION SIX

(a) Water quality is extremely important for various operations in food processing. Describe the physical, chemical and biological parameters that must be monitored to assure good quality water for food processing plants. (10 marks)

(b) Discuss the merits and demerits of chlorination as a method of disinfecting water for use in food processes. (10 marks)

QUESTION SEVEN

(a) Describe the uses of electricity in the food industry and show the mechanisms through which electricity achieves those functions. (8 marks)

(b) Using examples, describe how illumination is achieved in food processes. (8 marks)
(c) Discuss how electrical safety is achieved in a food processing plant. (4 marks)
