Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2161410 **Date:13/05/2016**

Subject Name: Low Temperature Process Systems For Foods

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define and classify refrigerants. State important desirable properties of refrigerants and explain the safety criteria for their selection. **07**

(b) A 50 TR air conditioning plant is working on simple vapour compression cycle with a certain refrigerant with the following operating conditions: **07**

Evaporating temperature = -2°C
Condensing temperature = 38°C
Refrigeration efficiency = 82%.
Calculate the following:

(a) Mass flow rate of the refrigerant.
(b) Condenser heat rejection
(c) Rated compressor power if it is 95 % efficient
(d) Actual COP
(e) Carnot COP
(f) Quality of the refrigerant entering the evaporator in %
(g) Power consumption in kW/TR

Refrigerant Properties		
t (^{o}C)	h_f (kJ/kg)	h_g (kJ/kg)
-2	190	380
38	240	402

Q.2 **(a)** Explain NH_3- H_2O based vapour absorption refrigeration system with a neat flow diagram and identify the components that replace the compressor of a conventional VCR system. In a vapour absorption system, heating, cooling and refrigeration takes place at temperatures of 103 ^{0}C, 25 ^{0}C & - 17 ^{0}C respectively. Calculate the maximum COP of the system. **07**

(b) Explain simple VCR system with the help of a neat flow diagram and P-h phase diagram. Explain the effect of the following on performance of a simple VCR system: (i) Increase in condenser temperature (ii) Liquid sub-cooling. **07**

OR

(b) Explain the principle and operation of vapour compression refrigeration system with the help of P-h, T-s diagrams. Write down thermodynamic equations for cooling effect, compressor power rating, condenser heat and throttling. If the liquid refrigerant exiting the compressor is superheated, what will be its effect on refrigeration efficiency and COP of the system? **07**

Q.3 **(a)** Explain the following with neat diagrams: **07**
(i) Centrifugal dust separator
(ii) Air washer

(b) Explain fan characteristics with respect to power, operating pressure and efficiency. A blower running at 660 RPM consumes 60W power and delivers 10 m^3/m air at 160 Pa static pressure. If the fan speed is doubled, calculate **07**
(i) The power required.
(ii) Static pressure.
(iii) Air flow rate.

OR

Q.3 **(a)** State fan laws. Name different types of fans and their applications. A fan was purchased to operate on a fixed RPM. Calculate the percentage increase in air flow rate and power consumption if the fan speed is doubled. **07**

(b) Discuss the following with neat diagrams and their applications: **07**
(i) Electronic air filter
(ii) Automatic humidity controller

Q.4 **(a)** Classify different types of cold storages used in Food Industry and briefly explain the different components of a cold storage and list out different type of safety device and write their functions and location in the cold storage. **07**

(b) What do you mean by sensible heat and latent heat? One tone of lean meat is first cooled from 30 to 2 ^{0}C, thereafter it is cooled and frozen to -20 ^{0}C. Calculate the total heat load. Freezing point of meat is -1 ^{0}C and latent heat of fusion is 246.8 kJ/kg. Specific heat of meat above freezing point is 3.21 kJ/kg.^{0}C and specific heat of meat below freezing point is 1.71 kJ/kg.^{0}C. **07**

OR

Q.4 **(a)** Name different types of expansion valves and their operating principles. With help of a labeled diagram, explain the working of single-stage centrifugal compressor mentioning all components. **07**

(b) Differentiate between freezing, refrigeration and chilling with examples. What is IQF? State its applications in food industry. **07**

Q.5 **(a)** Explain with neat diagram the working of a flooded type evaporator. **07**

(b) Explain Controlled atmosphere storage and Modified atmosphere storage giving examples from food industry. **07**

OR

Q.5 **(a)** Explain the principle and working of an evaporative condenser with a labeled diagram, **07**

(b) Mention the classification of compressors. Differentiate between positive and non-positive displacement type compressors with examples. **07**

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