Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI (NEW).EXAMINATION – WINTER 2016

Subject Code: 2161406 **Date: 26/10/2016**

Subject Name: Food Refrigeration & Air - Conditioning

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)** Answer the following questions: **07**

(i) What is the thermodynamic function of compressor in simple VCR system?
(ii) Define refrigeration efficiency.
(iii) What is green house effect?
(iv) Give an example of azeotrope.
(v) How do CFC's deplete the ozone layer of stratosphere?
(vi) Give R designation of NH_3.
(vii) How is leakage of halocarbons detected?

(b) Explain the thermodynamic criteria for selection of refrigerants. A simple vapour compression refrigeration system is operating on the following conditions: **07**

Refrigeration capacity = 20 TR,
Evaporating temperature = - 5 ^oC
Condensing temperature = 40 ^oC,
Compressor discharge temperature = 45 ^oC
COP of the system = 4.5
Calculate the following:

I. Compressor power requirement in kW.
II. Heat rejection ratio.
III. Carnot COP of the system.
IV. Refrigeration efficiency in %

Q.2 **(a)** Explain the operation of simple VCR system with the help of P-h & T-s diagrams indicating various state points. Explain the effect of the following on the performance of vapour compression cycle: **07**

(i) Compressor volumetric efficiency
(ii) Reduction in suction temperature.

(b) Explain the construction and operation of simple Ammonia – Water VAR system. Justify the statement mathematically: "Ideal COP for an absorption system is equal to the product of COP for a Carnot refrigeration cycle and the efficiency of Carnot heat engine cycle". **07**

OR

(b) Explain the construction and working of simple VAR system based on LiBr – Water. State the thermodynamic and economic constraints of VAR systems. **07**

Q.3 **(a)** Explain the construction and working of "Domestic Electrolux Refrigerator". In an absorption type refrigeration system, heating, cooling and refrigeration takes place at temperatures of 100°C, 20°C and -10°C respectively. **07**

(i) Find the theoretical COP of the system.

(ii) If the heating temperature is increased to 227°C and the refrigeration temperature is decreased to -30°C, find the percent change in the COP.

(b) Classify different types of compressors and briefly explain the construction, working principle and advantages of Hermetic compressors. **07**

OR

Q.3 **(a)** Explain the operation of reciprocating compressor with the help of a P-v diagram. Prove that the volumetric efficiency of a single acting reciprocating compressor is given by $\eta_{vol} = 1 + c - c\left(\frac{P_d}{P_e}\right)^{1/n}$. The symbols have their usual meanings. **07**

(b) Explain the operation of a simple cascade refrigeration system with the help of a schematic diagram and draw its P-h diagram. Write expression for COP of a 2-stage cascade system. **07**

Q.4 **(a)** Classify refrigerant condensers. What are the selection criteria of condensers for refrigeration application? Explain the construction and operation of a shell and tube condenser. **07**

(b) Explain the principle and operation of thermostatic expansion valve with a neat diagram. **07**

OR

Q.4 **(a)** What are cooling towers? With the help of a neat diagram explain the construction and working of an induced draft cooling tower. **07**

(b) What is the thermodynamic function of refrigerant evaporators? Classify refrigerant evaporators and explain the construction and working of flooded evaporator. **07**

Q.5 **(a)** Write short notes on the following: **07**

(i) Types of fans (ii) Capillary tubes (iii) HP/LP cut outs

(iv) HEPA filter (v) AHU's (vi) Humidistat (vii) Aspect ratio

(b) What is IQF? Calculate the refrigeration load expressed in TR which balances the heat loss from the four side walls of a small cold room 2.5 m × 3.0 m × 2.0 m. The walls are made of 20 cm brickwork, 20 cm hard board and 1.25 cm cement. The inside wall temperature is -25°C and outside wall temperature is 27°C. Consider a safety factor of '2.5' for losses through joints etc. The thermal conductivities of brick, board and cement plaster are 0.62 W/m°C, 0.05 W/m°C and 0.82 W/m°C respectively. **07**

OR

Q.5 **(a)** Discuss in detail the design considerations of a cold room suitable for long term storage of perishable Agri-produce. **07**

(b) Write brief notes on the following: **07**

(i) Laws of air movement (ii) Radial flow fans (iii)Thermostats

(iv) Draft (v) Modified atmosphere storage (vi) Cold chain

(vii) Solenoid valves

****