NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR (HP) DEPARTMENT OF MECHANICAL ENGINEERING **END TERM EXAMINATION NOV-DEC 2022** Refrigeration and Air Conditioning (ME-314)

Do-Lax mikant A PROI No:

Time: 3:00 hrs, M.M.: 50

**Note:** Attempt all the questions. Make necessary assumptions wherever required. Psychrometric chart and Refrigeration Table are allowed in the examination.

- Q.1 Setup following expression for the COP of a Bell-Coleman refrigeration cycle: 2  $COP = \frac{T_4}{T_3 - T_4}$ , where  $T_3$  is the temperature of air entering the expander and  $T_4$  is the temperature of air leaving the expander.
- Q.2 (a) Why liquid-suction heat exchanger is incorporated in vapour compression 3 refrigeration system? Explain with pressure enthalpy diagram.

(b) In an ammonia system one evaporator is to provide 180 kW of refrigeration at -30°C and another evaporator is to provide 200 kW at 5°C. The system uses two 7 stage compression with intercooling and is arranged as shown in Figure below. The condensing temperature is 40°C. Calculate the power required by the compressor and compare this work with two evaporator one compressor sytem.



Roll No:

5

5

8

- Q. 3 What are the refrigerant number of refrigerants whose chemical formulae are: CBrClF<sub>2</sub>, CH<sub>2</sub>FCF<sub>3</sub>, CH<sub>3</sub>CH=CH<sub>2</sub>, CO<sub>2</sub>, CH<sub>3</sub>CH<sub>2</sub>CH<sub>3</sub>
- Q.4 (a) Draw the schematic diagram of actual ammonia water vapour absorption 5 refrigeration system and represents processes of each compenent in enthalpy concentration diagram.

(b) Illustrate two facts (i) the position in the LiBr-H<sub>2</sub>O vapour absorption 4 refrigeration system where crystallization is most likely to occur, (ii) Under what conditions this crystallization problem occurs in LiBr-H<sub>2</sub>O system, explain with temperature-pressure-concentration diagram.

(c) Compare the Vapour absorption refrigerantion system and vapour 4 compression refrigeration system based on following:

(i) Decresae in evaporator pressure, (ii) Ideal and actual COP

(iii) Capacity, cost and space (iv) Quality of evaporator vapour

- Q. 5 What is Joule -Kelvin effect? Explain with T-p diagram.
- Q. 6 (a) what are the conditions of cooling and humidification Processes (1-2a, 1-2b, 4 1-2c and 1-2d) shown in below figure. Explain with T-s diagram.



(b) A building has the following calculated cooling loads:

RSH gain=300 kW, RLH gain =90 kW

The space is maintained at the following conditions:

Room DBT=25°C, Room RH=50%

The outdoor air is at 30°C and 50% RH. And 9% by mass of air supplied to the building is outdoor air. If the air supplied to the space is not to be at a temperature lower than 15°C, find:

- (i) Amount of air supplied to space in  $m^3/s$ .
- (ii) Volume flow rates of return air and outdoor air
- (iii) State and volume flow rate of air entering the cooling coil
- (iv) Capacity, ADP, BPF, and SHF of cooling coil.

(c) Write down the heat balance equation of human body and explain the different 3 terms included in it.