Printed Page:- 05 **Subject Code**:- **AME0602**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI - THEORY EXAMINATION (2022-2023 **)**

Subject: Refrigeration and Air-Conditioning

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* **three Sections -A, B, & C.** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION A **20**

1. Attempt all parts:-

1-a. A refrigerator working on a reversed Carnot cycle has a C.O.P. of 4. If it works as a heat pump and consumes 1 kW, the heating effect will be: (CO1) 1

(a) 1 kW

(b) 5 kW

(c) 6 kW

(d) 8 kW

1-b. The COP of a Carnot refrigeration cycle decreases on (CO1) 1

(a) Decreasing the difference in operating temperatures

(b) Keeping the upper temperature constant and increasing the lower temperature

(c) Increasing the upper temperature and keeping the lower temperature constant

(d) Increasing the upper temperature and decreasing the lower temperature

1-c. In a vapour compression cycle, the refrigerant immediately after expansion value is: (CO2) 1

(a) Saturated liquid

(b) Subcooled liquid

(c) Dry vapour

(d) Wet vapour

1-d. Environment friendly refrigerant R134a is used in the new generation domestic refrigerators. Its chemical formula is: (CO2) 1

(a) CH ClF2

(b) C2 Cl3 F3

(c) C2 Cl2 F4

(d) C2 H2 F4

1-e. Waste heat can be effectively used in which one of the following refrigeration systems? (CO3) 1

(a) Vapour compression cycle

(b) Vapour absorption cycle

(c) Air refrigeration cycle

(d) Vortex refrigeration system

1-f. Why nozzle is used in a steam jet refrigeration system? (CO3) 1

(a) To convert the high pressure motive steam into high velocity steam

(b) To reduce energy consumption

(c) To improve safety aspects

(d) To improve thermal conductivity

1-g. During chemical dehumidification process of air (CO4) 1

(a) Dry bulb temperature and specific humidity decrease

(b) Dry bulb temperature increases and specific humidity decreases

(c) Dry bulb temperature decreases and specific humidity increases

(d) Dry bulb temperature and specific humidity increase

1-h. During the adiabatic cooling of moist air (CO4) 1

(a) DBT remains constant

(b) Specific humidity remains constant

(c) Relative humidity remains constant

(d) WBT remains constant

1-i. The commonly used refrigerant in ice plant is (CO5) 1

(a) NH3

(b) CO_2

(c) R-12

(d) None of these

1-j. The room air conditioner controls the (CO5) 1

(a) Temperature of the air

(b) Temperature and humidity of the air

(c) Temperature and dust of air

(d) None of these

2. Attempt all parts:-

2.a. Draw the T-S diagram for reverse Brayton cycle. (CO1) 2

2.b. What is refrigerant? Can water be used as refrigerant? (CO2) 2

2.c. In Amonia-water system list the absorbent and refrigerant. (CO3) 2

2.d. What is wet bulb depression? (CO4) 2

2.e. What is the function of a fan in an air-conditioning system? (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. Differentiate between heat engine, refrigerator and heat pump with help of neat sketch. (CO1) 6

3-b. 2.5 kW per tonne of refrigeration is required to maintain the temperature of -45°C in the refrigerator. The refrigeration cycle works on Carnot cycle, determine the following: 1. C.O.P. of the cycle; 2. Temperature of the sink; 3. Heat rejected to the sink per tonne of refrigeration, and 4. Heat supplied and E.P.R., if the cycle is used as a heat pump. (CO1) 6

3-c. What are the methods of improving COP of VCR system? (CO2) 6

3-d. Explain the effect of i) sub cooling of liquid and ii) superheat of vapor on the system performance. (CO2) 6

3.e. Explain the working of Electrolux Refrigerator with neat sketch, and also explain the significance of Hydrogen used in system. (CO3) 6

3.f. The air enters a duct at 10°C and 80% RH at the rate of 150 m^3/min and is heated to 30°C without adding or removing any moisture. The pressure remains constant at 1 atmosphere. Determine the relative humidity of air at exit from the duct and the rate of heat transfer. (CO4) 6

3.g. Write about processes of food preservation in detail. (CO5) 6

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a. A simple air refrigeration system is used for an aircraft to take a load of 20 TR. The ambient pressure and temperature are 0.9 bar and 22°C respectively. The pressure of air is increased to 1 bar due to isentropic ramming action. The air is further compressed in a compressor to 3.5 bar and then cooled in a heat exchanger to 72°C. Finally, the air is passed through the cooling turbine and then it is supplied to the cabin at a pressure of 1.03 bar. The air leaves the cabin at a temperature of 25°C. Assuming the isentropic efficiencies of the compressor and turbine as 80 per cent and 75 percent respectively, find : 1. Power required to take the load in the cooling cabin; and 2. C.O.P. of the system. Take Cp = 1.005 kJ/ kg K; and index = 1.4. (CO1) 10

4-b. Explain, with a neat sketch, the working principle of boot-strap type of air refrigeration system. Draw T-S diagram for the system. (CO1) 10

5. Answer any <u>one</u> of the following:-

5-a. A two stage compression ammonia refrigeration system operates between overall pressure limits of 14 bar and 2 bar. The temperature of the desuperheated vapour and subcooled liquid refrigerant are limited to 30°C. The flash tank separates dry vapour at 5 bar pressure and the liquid refrigerant then expands to 2 bar. Estimate the C.O.P. of the machine and power required to drive the compressor, if the mechanical efficiency of the drive is 80% and load on the evaporator is 10 TR. (CO2) 10

5-b. Five hundred kg of fruits are supplied to a cold storage at 20°C. The cold storage is maintained at -5°C and the fruits get cooled to the storage temperature in 10 hours. The latent heat of freezing is 105 kJ/kg and specific heat of fruit is 1.256 kJ/kg k. Find the refrigeration capacity of the plant. (CO2) 10

6. Answer any <u>one</u> of the following:-

6-a. Explain the working of NH_3-H_2O vapour absorption refrigeration system with neat sketch. (CO3) 10

6-b. Explain in brief working of vortex tube refrigeration system. (CO3) 10

7. Answer any <u>one</u> of the following:-

7-a. Air at 40°C dry bulb temperature and 15% relative humidity is passed through the adiabatic humidifier at the rate of 200 m^3/min. The outlet conditions of air are 25°C dry bulb temperature and 20°C wet bulb temperature. Find. 1. dew point temperature; 2. relative humidity of exit air; and 3. amount of water vapour added to the air per minute. (CO4) 10

7-b. Atmospheric air at a dry bulb temperature of 16°C and 25% relative humidity 10

passes through a furnace and then through a humidifier, in such a way that the final dry bulb temperature is 30°C and 50% relative humidity. Find the heat and moisture added to the air. Also determine the sensible heat factor of the process. (CO4)

8. Answer any <u>one</u> of the following:-

8-a. Write short notes on :(a) Room air conditioner; (b) Refrigerated trucks; and (c) Marine air-conditioning. (CO5) 10

8-b. Explain the working of cold storages with constructional details. (CO5) 10