Printed Page:- 04 **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 (2023 - 2024)

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. In aircraft, air refrigeration cycle is used because of (CO1) 1

(a) Low unit weight per tonne of refrigeration

(b) High heat transfer rate

(c) Lower temperature at high-altitudes

(d) Higher coefficient of performance

1-c. A single-stage vapour compression refrigeration system cannot be used to produce ultralow temperatures because. (CO2) 1

(a) Refrigerants for ultra-low temperatures are not available

(b) Lubricants for ultra-low temperatures are not available

(c) Volumetric efficiency will decrease considerably

(d) Heat leakage into the system will be excessive

1-d. The desirable combination of properties for a refrigerant include (CO2) 1

(a) High specific heat and low specific volume

(b) High heat transfer coefficient and low latent heat

(c) High thermal conductivity and low freezing point

(d) High specific heat and high bailing point

1-e. Which one of the following statements regarding ammonia absorption system is correct? The solubility of ammonia in water is: (CO3) 1

(a) A function of the temperature and pressure of the solution

(b) A function of the pressure of the solution irrespective of the temperature

(c) A function of the temperature of the solution alone

(d) Independent of the temperature and pressure of the solution

1-f. The compressor from VCRS is replaced by which of the following in the VARS? (CO3) 1

(a) Absorber, Pump

(b) Generator, Pressure reducing valve

(c) Absorber, Pump, Generator, and Pressure reducing valve

(d) Absorber, Rectifier, Generator, and Pressure reducing valve

1-g. When atmospheric air is heated at constant pressure, then which one is not correct. (CO4) 1

(a) humidity ratio does not change

(b) relative humidity increases

(c) dew point temperature does not change

(d) wet bulb temperature increases

1-h. During adiabatic saturation process of air, wet bulb temperature (CO4)

(a) increases and dry bulb temperature remains constant 1

(b) remains constant and dry bulb temperature increases

(c) remains constant and dry bulb temperature decreases

(d) decreases and dry bulb temperature remains constant

1-i. The natural convection air-cooled condensers are used in (CO5)

(a) domestic refrigerators 1

(b) water coolers

(c) room air conditioners

(d) all of these

1-j. The heat rejection factor (HRF) is given by (CO5)

(a) 1+COP

(b) 1-COP 1

(c) 1+1/COP

(d) 1-1/COP

2. Attempt all parts:-

2.a.	Define Mach number. (CO1)	2
2.b.	Derive the chemical formula for R-114,R-717. (CO2)	2
2.c.	What is the role of analyzer in practical amonia-water system? (CO3)	2
2.d.	State the factors that determine human comfort. (CO4)	2
2.e.	Which material is commonly used for making ducts in the air conditioning systems? (CO5)	2

3. Answer any <u>five</u> of the following:- **SECTION B** **30**

3-a.	A machine working on a Carnot cycle operates between 350 K and 250 K. Determine the C.O.P. when it is operand as: 1. a refrigerating machine; 2. a Heat pump; and 3. a heat engine. (CO1)	6
3-b.	Draw block diagram of bell-colleman cycle with T-S diagram. (CO1)	6
3-c.	What are the advantages of compound compression with intercooler over single stage compression ? (CO2)	6
3-d.	Distinguish between dry and wet compression. What are the advantages of one over the other? (CO2)	6
3.e.	What is an absorption refrigeration system? How does it differ from vapour compression system? (CO3)	6
3.f.	The atmospheric air has 35°C dry bulb temperature and 50% relative humidity. Using psychrometric chart, find (i) wet bulb temperature, (ii) humidity ratio, (iii) dew point temperature, and (iv) enthalpy of air per kg of dry air. (CO4)	6
3.g.	Explain with neat sketch of desert water cooler. (CO5)	6

SECTION C **50**

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

4-a.	A boot strap air refrigeration system is used for an aeroplane to take 10 tonnes of refrigeration load. The ambient air conditions are 15°C and 0.9 bar. This air is rammed isentropically to a pressure of 1.1 bar. The pressure of the air bled off the main compressor is 3.5 bar and this is further compressed in secondary compressor to a pressure of 4.5 bar. The isentropic efficiency of both the compressors is 90% and that of cooling turbine is 85%. The effectiveness of both the beat exchangers is 0.6. If the cabin is to be maintained at 25°C and the pressure in the cabin is 1 bar, find : 1. mass of air passing through the cabin ; 2. power used for the refrigeration system ; and 3. C.O.P. of the system. (CO1)	10
4-b.	Explain with neat sketch the working of a simple air cooling system used for aircraft. (CO1)	10

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

5-a. An ammonia refrigerating machine fitted with an expansion valve between the temperature limits of- l0°C and 30°C. The vapour is 95% dry at the end isentropic compression and the fluid leaving the condenser is at 30°C. Assuming actual C.O.P. 60% of the theoretical, calculate the kilograms of ice produced per kW hour at 0°C from water 10°C. Latent heat of ice is 335 kJ/kg.Use Ammonia refrigeration chart. (CO2) 10

5-b. A vapour compression works on a simple saturation cycle with R-12 as the refrigerant which operates between the condenser temperature of 40°C and an evaporator temperature of -5°C. For the modified cycle. the evaporator temperature is changed to -10°C and other operating conditions are the same as the original cycle. Compare the power requirement for both cycles. Both system develops 15 tonnes of refrigeration. (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 working of Li - Br vapour absorption refrigeration system with neat sketch. (CO3) 10

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

7-a. The atmospheric air at 760 mm of Hg, dry bulb temperature 15° C and wet bulb temperature 11° C enters a heating coil whose temperature is 41°C. Assuming by-pass factor of heating coil as 0.5, determine dry bulb temperature; wet bulb temperature and relative humidity of the air leaving the coil. Also determine the sensible heat added to the air per kg of dry air. (CO4) 10

7-b. An air conditioning plant is required to supply 60 m^3 of air per minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. (CO4) 10

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

8-a. Explain with neat sketch of evaporative condenser. (CO5) 10

8-b. Explain with neat sketch of shell and tube evaporator. (CO5) 10