TE Sem VI Mechanical C Scheme NOV-2025 Date 05/12/2025
Q.P. 00218 (1/2)

Duration: 3 Hrs **[Max Marks:80]**

N.B.: 1. Question No.1 is compulsory
2. Attempt any three questions from the remaining questions.
3. All questions carry equal marks.
4. Assume suitable data if necessary and state it clearly.
5. Use of Refrigerant tables, Friction Charts, Psychrometric Charts, and Steam Tables are permitted.

1. **Answer ANY FOUR from the following.** **[20]**
   a. Define human comfort. Explain the factors affecting human comfort.
   b. Define the term 'effective temperature' and explain its significance in the design of air conditioning systems.
   c. Define: i) Ton of Refrigeration ii) Bypass Factor iii) Dry bulb temperature iv) Wet bulb temperature v) Humidity ratio
   d. Explain the working of a simple air cycle cooling system used for aircrafts.
   e. Write a short note on the factors affecting comfort air conditioning.
   f. Which material is commonly used for making ducts in the air conditioning systems?

2. a. A Vapour Compression Refrigeration System using Ammonia works between -25 °C and 40 °C as evaporator & condenser temperature respectively. Using P-h chart, Determine; **[12]**
   1. COP.
   2. Mass of Refrigerant per TR.
   3. Piston Displacement per TR using Volumetric Efficiency of 83 %.
   4. Heat Rejected in the Condenser per TR.
   5. Ideal COP.
   b. Explain construction and working of simple vapour absorption refrigeration system with neat sketch. **[08]**

3. a. Sketch the T-s and p-h diagrams for the vapour compression cycles when the vapour after compression is i) Dry Saturated ii) Wet **[08]**
   b. An air-cooling system for a jet plane cockpit operates on the simple cycle. The cockpit is to be maintained at 25 °C. The ambient air pressure and temperature are 0.35 bar and -15 °C, respectively. The pressure ratio of the jet compressor is 3. The plane speed is 1000 kilometres per hour. The pressure drop through the cooler coil is 0.1 bar. The pressure of the air leaving the cooling turbine is 1.06 bar and that in the cockpit is 1.0325 bar. The cockpit cooling load is 58.05 TR. The temperature of air leaving the coder is 50 °C. **[12]**
   1. Temperature and pressure at all the points.
   2. Mass of air circulated per minute
   3. COP

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4 a. Explain the working principle of thermostatic expansion valve with the help of a neat diagram. [08]

b. A sample of moist air has Dry Bulb Temperature is 22 °C and Relative Humidity is 30 %. Barometric Pressure is 760 mm of Hg. Determine the following properties by using steam table and Verify your results with Psychrometric chart. [12]

1. Vapour Pressure.
2. Dew Point Temperature.
3. Specific Humidity.
4. Enthalpy of the mixture.

5 a. A rectangular duct section of 500 mm x 350 mm size carries 75 m^3/min of air having density of 1.15 Kg/m^3. Determine the equivalent diameter of a circular duct if (a) the quantity of air carried in both the cases is same, and (b) the velocity of air for both the cases is same. If f = 0.01 for sheet metal, find the pressure loss per 100 m length of duct. [08]

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. [08]

c. What are the desirable properties of an ideal refrigerants? [04]

6 **Write a note on following (any Four).** [20]

a. Dairy and food processing plant

b. What is the function of the following components in an absorption system:
(i) Absorber (ii) Rectifier (iii) Analyzer (iv) Heat exchangers.

c. What are the factors affecting the comfort air conditioning.

d. Explain the working of Heat Pump and state the applications.

e. Show the following processes on the skeleton psychrometric chart:
(a) Dehumidification of moist air by cooling; and
(b) Adiabatic mixing of two air streams.

f. Prove that the performance factor of a Bell-Coleman Cycle refrigeration systems is given by $C.O.P. = \frac{T_2}{T_3 - T_2}$

Where T_2 and T_3 are the temperatures of air at the inlet and discharge of compressor resp.

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