

10/12/2024 MECHANICAL SEM-VI C SCHEME HVACR QP CODE: 10066252

**Duration: 3 Hours**

**[Max Marks: 80]**

- N.B. : (1) Question No 1 is Compulsory.  
(2) Attempt any three questions out of the remaining five.  
(3) All questions carry equal marks.  
(4) Assume suitable data, if required and state it clearly.  
(5) Use of Refrigerant tables, Friction charts, Psychometrics chart, and Steam table are permitted.

**Q.1 Attempt any Five of the following [20]**

- Explain numbering system of refrigerants
- Draw T-s Diagram of vapor compression Refrigeration cycle and show various process.
- Write a note on heat pump.
- State the various applications of HVACR.
- State and explain the types of expansion devices.
- Write a note on food preservation.
- Explain with neat sketches the simple air refrigeration system.

**Q.2 a) Explain the difference between vapor compression refrigeration system and vapor absorption refrigeration system with neat schematic diagram. [08]**

**b) An air cooling system for a jet plane cockpit operates on the simple cycle. [12]**

The cockpit is to be maintained at  $15^{\circ}\text{C}$ . The ambient air pressure and temperature are 0.16 bar and  $-7^{\circ}\text{C}$  respectively. The pressure ratio of the jet compressor is 2.5. The plane speed is 1000 kilometres per hour. The pressure drop through the cooler coil is 0.15 bar. The pressure of the air leaving the cooling turbine is 1.07 bar and that in the cockpit is 1.0325 bar. The cockpit cooling load is 65 TR. Determine

- Temperature and pressure at all the points.
- Mass of air circulated per minute
- COP

Q.3 a) Define refrigerants and its ideal properties. [08]

b) R-12 refrigeration system operates between  $-10^{\circ}\text{C}$  and  $35^{\circ}\text{C}$ . The flow rate of refrigerant through the system is  $0.2 \text{ kg/s}$ . At the entry of the compressor the refrigerant is dry and saturated. Use P-h Chart [12]

1. Actual COP

2. Ideal COP

Take  $C_p$  at  $40^{\circ}\text{C} = 0.82 \text{ kJ/kg K}$  and  $C_p$  at  $-15^{\circ}\text{C} = 0.64 \text{ kJ/kg K}$ .

Q.4 a) Explain various psychrometric process [08]

b) For a sample of air leaving  $25^{\circ}\text{C}$  DBT, Humidity ratio  $0.010 \text{ kg/kg}$  of dry air at barometric pressure of  $750 \text{ mm of Hg}$ . Determine following properties by using psychrometric relations and Verify your result with psychrometric chart [12]

1. Partial pressure of water vapour

2. Relative humidity

3. Dew point temperature

4. Vapour density,

5. Enthalpy

Q.5 a) Define the effective temperature. Discuss various duct design methods [08]

b) In a conference room for seating of 50 persons, [12]

Application : Summer Air Conditioning

Inside condition :  $20^{\circ}\text{C}$ , DBT, 60% RH

Outside condition :  $30^{\circ}\text{C}$  DBT,  $27^{\circ}\text{C}$  WBT

Sensible load per person :  $80 \text{ W}$

Latent load per person :  $50 \text{ W}$

Light and fans :  $20000 \text{ W}$

Glass and walls :  $20000 \text{ W}$

Air infiltration :  $20 \text{ m}^3/\text{min}$

Assuming 30 % fresh air and 70% of recirculated air are mixed before passing through the Cooling coil.

1. Identify and Show psychrometric process required for above application on psychrometric chart
2. Estimate Total load.
3. Calculate RSHF

Q.6

Write a notes on following (**any Four**)

[20]

1. Air handling Unit
  2. Psychrometry properties
  3. Type of Insulation Material used in HVACR
  4. Cooling tower performance
  5. Ice Manufacturing plant
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