

Total Pages : 5

V/SEM/MECH/2014(W)

REFRIGERATION AND AIR CONDITIONING

[Theory-3]

Full Marks : 80

Time : 3 hours

Answer any five questions

The figures in the right-hand margin indicate marks

Refrigeration table, psychrometric chart and calculator are allowed.

- 1. (a) Define 1 tonne of refrigeration. 2
- (b) An ammonia refrigerator is used to produce 2 tonnes of ice per day at -4 °C from water at 20 °C. The temperature limits of the working refrigerator are -6 °C and 20 °C. Determine the power required to drive the compressor if the actual C.O.P is 60% of Carnot C.O.P. Take latent heat of ice as 336 kJ/kg and s.p. heat of ice as 2.1 kJ/kg-K. 6
- (c) Describe reverse Bryton cycle. Derive the C.O.P of the cycle. 8
- 2. (a) Write the chemical formula of R11 and R113. 2

(b) What are properties of ideal refrigerant ? 6

(c) An open air cycle operated by air-refrigeration system is required to produce 6 tonnes of refrigerating effect with a cooler pressure of 11 bar absolute and a refrigerated space region at a pressure of 1.05 bar. The temperature of air leaving the cooler is 38 °C and the air leaving the room is 16 °C. Calculate

- (i) mass of air circulated per minute.
- (ii) compressor displacement required per minute.
- (iii) expander displacement required per minute.
- (iv) C.O.P

Assume that theoretical cycle is operating with isentropic compression and expansion with no compressor clearance and no losses.

For air take $\gamma = 1.41$, $C_p = 1.003$ kJ/kgK. 8

- 3. (a) Define specific humidity. 2
- (b) Describe cooling and dehumidification process of air and show the ADP (Apparatus Dew Point) in psychrometric chart. 6

(Turn Over)

(c) 150 m³ of air per minute is passed through the adiabatic humidifier. The condition of air at inlet is 35 °C DBT (Dry Bulb Temperature) and 20% relative humidity and the outlet condition is 20 °C DBT and 15 °C WBT (Wet Bulb Temperature). Determine the following :

- (i) Dew point temperature
- (ii) Relative humidity to the air per minute
- (iii) Amount of water vapour added to the air per minute. 8

4. (a) What is effective temperature ? 2

(b) Describe comfort chart. 6

(c) With neat sketch explain the working of simple vapour absorption refrigeration system. <http://www.sctevtonline.com> 8

5. (a) What is the function of solenoid valve in refrigeration system ? 2

(b) Derive an expression for volumetric efficiency of compressor. 6

(c) A F₁₂ vapour compression refrigeration system has a condensing temperature of 50 °C and evaporating temperature of 0 °C. The

refrigeration capacity is 7 tons. The liquid leaving the condenser is saturated liquid and compression is isentropic. Determine

- (i) The refrigerant flow rate.
- (ii) The power required to run the compressor.
- (iii) The heat rejected in the plant.
- (iv) C.O.P of the system.

Use the properties of F₁₂ as listed in the table

Temp (°C)	Pressure (bar)	h_f (kJ/kg)	h_g (kJ/kg)	s_f (kJ/kgK)	s_g (kJ/kgK)
50	12.199	84.868	206.298	0.3034	0.6792
0	3.086	36.022	187.397	0.1418	0.6960

Take Enthalpy at the end of isentropic compression = 210 kJ/kg. 8

6. (a) What is sensible heat factor ? 2

(b) Explain working principle of Desert cooler. 6

(c) What is the purpose of air conditioner ? Describe commercial air conditioning system. 8

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7. (a) What is secondary refrigerant ? 2
- (b) What are the factor affecting the performance of simple vapour compression refrigeration system ? Describe any *one* factor. 6
- (c) Describe actual vapour compression cycle with p-h and T-s diagram. 8

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