[This question paper contains 5 printed pages.]

Your Roll No. .....

3202 **J**

MEM

Paper—ME.662

REFRIGERATION AND AIR-CONDITIONING

Time : 3 *Hours* *Maximum Marks* : 100

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any **five** *questions.*

Use of refrigeration tables and charts and psychrometric chart is permitted.

Assume missing data, if any.

1. (a) What are the factors which lead to change in evaporator and condenser pressures ? Discuss the effect of variation in condenser pressure on the various performance parameters in a vapour compression system. 10

(b) A simple saturated vapour compression system R12 operates at following conditions :

Refrigeration capacity = 12 TR

Condensing temperature = 35°C

Evaporation temperature = – 5°C

[P. T. O.

Degree of superheat setting of thermostatic expansion valve = 6°C.

Calculate (i) mass flow rate of refrigerant in kg/hr, (ii) percentage change in COP and compressor power if evaporation temperature changes to 0°C. 10

2. (a) Describe the snow chamber method of producing dry ice using T-s and P-h diagrams. 15

(b) Explain why hydrocarbon refrigerants are better than hydrofluorocarbon refrigerants ? 5

3. In a single effect water-lithium bromide vapour absorption refrigeration system of 50 kW capacity, the condenser and evaporator saturation temperatures are 32°C and 5°C. The generator is maintained at 80°C using waste heat from hot gases and the absorber is at 25°C. Assume that the solution leaving the absorber is saturated at evaporator pressure and the solutions entering and leaving the generator are saturated at generator pressure. There is no under cooling in the condenser and dry saturated vapour leaves the evaporator. The effectiveness of solution heat exchanger may be assumed as 0.7. Assuming that the enthalpy of superheated steam at low pressures may be taken as approximately equal to the saturated value at the same temperature, calculate :

(i) Heat interactions in generator and absorber.

(ii) COP refrigeration.

Neglect pump work and heat losses. 20

4. (a) Prove that the optimum coupling temperature in two cascade circuit refrigeration system is given by

$$T_{c_2} = \frac{b_1 + b_2}{\frac{b_2}{T_{c_2}} + \frac{b_1}{T_{e_1}}} = T_{c_1}$$

where T_{c_2} = condenser temperature of high temperature circuit.

T_{e_1} and T_{c_1} = Evaporation and condenser temperatures of low temperature circuit.

b_1 and b_2 are constants. 10

(b) Discuss the various methods of capacity control of a reciprocating compressors. 10

5. (a) Explain the procedure of designing a capillary tube for a vapour compression system. 15

(b) Derive an expression, showing a relationship between degree of saturation and relative humidity. 5

6. (a) Describe the Linde Hampson process of liquifaction of gases. Determine the yield and minimum work of compression per unit mass of liquid air at pressure P_1 = 1 bar, pressure P_2 = 200 bar, Temperature T_1 = 300 K. Use the properties of air given below :

P	T (K)		Specific volume (v) (m^3/kg)		Specific enthalpy (h) kJ/kg		Specific entropy kJ/kg K	
(bar)	Bubble	Dew	v_j	v_g	h_j	h_g	s_j	s_g
1.	78.7	81.7	0.00114	0.224	0	205.3	0	2.559

P (bar)	T (K)	h kJ/kg	s kJ/kg K
150	300	400.5	2.369
200	300	394.3	2.265
250	300	389.8	2.182

15

(b) Give the applications of multistage, cascade and cryogenic systems. 5

7. (a) Explain the process of cooling and dehumidification. 5

(b) The following data refers to air-conditioning system :

(i) Room conditions : 26°C D.B.T., 19°C W.B.T.

(ii) Outside conditions : 35°C D.B.T., 27°C W.B.T.

Room heat gains :

Sensible heat = 11 kW

Latent heat = 4 kW

The conditioned air supplied to the room is 50 cmm and contains 25% fresh air and 75% recirculated air.

Determine :

(i) The DBT and WBT of supply air

(ii) The ADP and BPF of the coil

(iii) The refrigeration load on the cooling coil. 15

8. Write short notes on any *two* of the following : 2×10

(i) Air duct design

(ii) Refrigeration controls

(iii) Applied psychrometry.