

Total No. of Questions : 12]

SEAT No. :

P6069

[Total No. of Pages : 6

[5560]-2

T.E. (Mechanical)

REFRIGERATION AND AIR CONDITIONING

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 100

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) Answer any three questions from each section.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right side indicate full marks.
- 5) Use of Calculator is allowed.
- 6) Use of psychrometric chart is allowed.
- 7) Assume Suitable data if necessary, state clearly the assumption made.

SECTION - I

- Q1)** a) Explain vortex tube refrigeration with neat diagram. List its advantages and disadvantages. [8]
- b) In a refrigerator working on Bell-Coleman cycle, air is drawn into the compressor from the cold chamber at a pressure of 0.95 bar & temperature of -5°C . After compression to 5 bar it is cooled at constant pressure to temperature of 15°C . The compression and expansion follows $PV^{1.3} = C$. If air is expanded to 1 bar calculate COP & capacity if mass circulation of air is 1.5 kg/min. [8]

OR

- Q2)** a) What is Peltier effect? With neat diagram explain thermoelectric refrigeration system. [8]
- b) Explain various processes in Bell-Coleman cycle. Derive the expression for COP of Bell Coleman cycle. [8]
- Q3)** a) A refrigeration plant operates between the temperature limits of -15°C and 30°C . The machine circulates 4.5 kg/min. There is no undercooling. Compressor discharge is at 75°C . Determine: COP, refrigerant quantity entering compressor, and ice produces at 0°C in kg/h from water at 25°C . Assume: $C_{pg} = 2.82 \text{ kJ/kgK}$, $C_{pi} = 2.1 \text{ kJ/kgK}$, $C_{pl} = 4.18 \text{ kJ/kgK}$, & $H_{fs} = 336 \text{ kJ/kg}$.

P.T.O.

Use following properties :

[8]

| Sat. temp. °C | h_f kJ/kg | h_g kJ/kg | s_f kJ/kg K | s_g kJ/kg K | V_f m ³ /kg | V_g m ³ /kg |
|---------------|-------------|-------------|---------------|---------------|--------------------------|--------------------------|
| -15 | 112.3 | 1426 | 0.457 | 5.549 | 0.00152 | 0.509 |
| +30 | 323.1 | 1469 | 1.204 | 4.968 | 0.00158 | 0.111 |

- b) Draw neat diagram of double effect Li-Br refrigeration system. Explain its working. [8]

OR

- Q4) a)** Draw practical VCC on T-s and p-h diagram. Explain the various losses/gains in practical VCC. [8]

- b) Discuss the effect of suction superheat, subcooling and liquid-liquid heat exchanger on performance of VCC with the help of p-h or T-s diagram. [8]

- Q5) a)** A two evaporator, single compressor and individual expansion valve arrangement is used in multistage vapour compression system using R134a. Sketch schematic arrangement and also cycle on p-h chart. [10]

Determine overall COP, mass flow rate of refrigerant & cooling load on condenser.

The exchanger details of system are as follows :

- Evaporator, E1 : -30°C & 20TR capacity
 - Evaporator, E2 : -10°C & 10TR capacity
 - Condenser, C : 40°C with no subcooling
- b) Explain the desirable properties of refrigerant. List some eco-friendly refrigerant for air conditioners. [8]

OR

- Q6) a)** Explain: ODP and GWP. [6]

- b) What is flash and water inter-cooling? Draw its p-h and T-s diagram for two stage VCC with flash intercooling and water intercooling. [6]

- c) Explain alternative refrigerants for refrigeration. [6]

SECTION - II

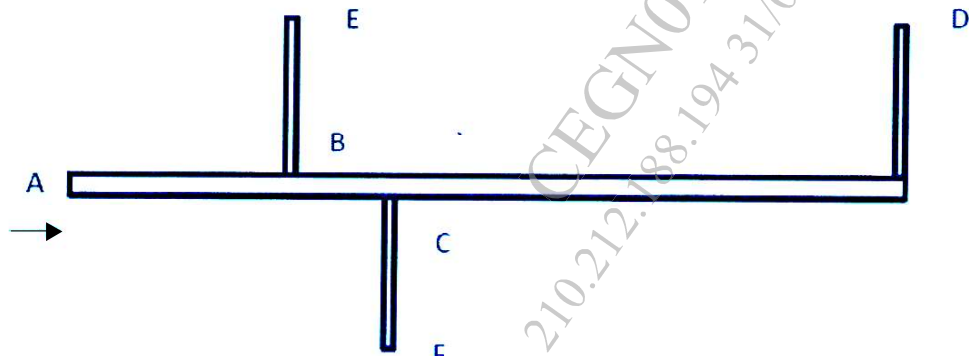
- Q7)** a) Explain: relative humidity and specific humidity. [4]
b) Explain the heat balance of human body. What are the various factors affecting human comfort. [6]
c) A psychrometer records 35°C & 25°C WBT. Calculate- vapour pressure, relative humidity, specific humidity, DPT & degree of saturation. Barometer reads 100 kPa. Calculate all properties when barometer reads 101.325 kPa. [8]

OR

- Q8)** a) Explain difference between thermodynamic wet bulb temperature and wet bulb temperature. [8]
b) What is selection criterion of evaporator coil in an air conditioning system? Explain with suitable example. [10]
- Q9)** a) Draw schematic of VAV air conditioning systems. Compare VAV with other types of air conditioning systems. [8]
b) Explain: SHR, RSHF, GSHF and ESHF. [8]

OR

- Q10)** a) Explain the various types of condensers used in refrigeration systems. Discuss the working of any two of them. [8]
b) Discuss the procedure to calculate cooling load? [8]
- Q11)** a) Write short note on : duct materials. [6]
b) Use equal friction method to find duct dimensions for the following air duct system. [10]



Length of ducts are :

$AB = 30 \text{ m}$, $BC = 15 \text{ m}$, $CD = 60 + 15 \text{ m}$ after elbow, $CF = 22.5 \text{ m}$, $BE = 30 \text{ m}$.

Air delivery

At E = 60 cmm, At F = 180 cmm, at D = 240 cmm

Assume free exit at each outlets (E, F, D).

OR

- Q12)** a) What are friction and dynamic losses in duct? Explain. [8]
b) Explain equal friction method for duct design. [8]

