302051

Seat No.	

T.E. (Mechanical) (Semester – II) Examination, 2014
REFRIGERATION AND AIR CONDITIONING
(2008 Course)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **3** questions from Section **I** and **3** questions from Section **II**.*
*2) Answers to the **two** Sections should be written in **separate** answer books.*
*3) Draw **neat** diagrams **wherever** necessary.*
*4) **Use** of Steam tables, p-h chart, Psychrometric chart and scientific calculator is **allowed**.*
*5) Assume suitable data **wherever** necessary.*
*6) Figures to the **right** indicate **full** marks.*

SECTION – I

1. a) Define 1 Ton of Refrigeration. Prove 1 TR = 3.517 kW. **4**

   b) The capacity of refrigerator is 450 TR when working between – 15 °C and 30 °C. Find mass of ice produced at 0 °C within 24 hours when water is supplied at 20 °C. Also find out the minimum power required and heat rejected in condenser in kW. Assume the machine to be working on Reversed Carnot cycle.

   Take Cp for water = 4.18 kJ/kg °C and latent heat of ice as 335 kJ/kg. **6**

   c) Write a note on Thermoelectric Refrigeration. **6**

OR

2. a) Compare Vapour Compression Refrigeration with Air Refrigeration system. **4**

   b) An air refrigeration system operating on Bell Coleman cycle takes in air from cold room at – 6 °C and compresses it from 1.04 bar to 6.2 bar. The index of compression is 1.26 and the compressed air is cooled to 25 °C. Air expands in expander with index of expansion as 1.36. Determine COP of the system and Quantity of air circulated per minute for production of 1500 kg of ice per day at 0 °C from water at 15 °C. Take Cp for water as 4.18 kJ/kg °C, Cp for air as 1.005 kJ/kg°C and latent heat of ice as 335 kJ/kg, Rair = 0.287 kJ/kg °C. **6**

   c) Write a note on Magnetic Refrigeration. **6**

P.T.O.

3. a) Explain the effect of

   i) Increase in condenser pressure on the performance of VCC.

   ii) Decrease in evaporator pressure on the performance of VCC. **6**

   b) Compare Aqua – NH_3 with LiBr – H_2O Vapour Absorption system. **4**

   c) An ammonia vapour compression refrigerator has an effective swept volume of 0.298 m^3/min. Condensation and evaporation takes place at 28.9 °C and – 12.2 °C respectively. There is no subcooling of refrigerant and the refrigerant temperature after compression is 51.2 °C. Assuming Cp for superheated vapour as 2.89 kJ/kg °C determine : **8**

   i) dryness fraction of the refrigerant as it enters the compressor

   ii) rate of circulation of ammonia in kg/min

   iii) rate of extraction of heat in kW

   iv) heat rejected in condenser in kW

   The relevant properties of ammonia are

Temp. °C	h_f kJ/kg	h_{fg} kJ/kg	s_f kJ/kgK	s_{fg} kJ/kgK	v_g m^3/kg
28.9	320.53	1148.06	1.082	3.798	0.106
– 12.2	125.7	1307.28	0.506	5.00	0.406

OR

4. a) Write a note on LiBr – H_2O vapour absorption system. **8**

   b) Using p-h chart, calculate COP, mass flow rate of refrigerant and compressor input in kW for following system parameters.

   i) Refrigerant R22, Condensing temperature 40 °C and evaporating temperature is 0 °C.

   ii) Temperature of refrigerant entering the compressor is 5 °C, leaving the compressor is 60 °C and leaving the condenser is 30 °C respectively.

   iii) Heat rejection in condenser is 200 kW. **6**

   c) A vapour absorption cycle has generator temperature 120 °C, evaporator temperature – 10 °C and ambient temperature 30 °C. Estimate the maximum possible COP. The actual COP is 0.5 times the maximum COP. If the capacity of the plant is 100 TR, calculate the fuel consumption of the plant, assuming the calorific value of the fuel as 40 MJ/kg. **4**

5. a) What is the difference between Primary and Secondary refrigerants ? Why secondary refrigerants are used ? List atleast two secondary refrigerants. 6

   b) Write a note on Cascade Refrigeration system. 6

   c) Write a note on Alternative Refrigerants. 4

OR

6. a) A compound compression system uses a flash intercooler and R22 as refrigerant. The saturation temperature in the evaporator, intercooler and condenser are – 30 °C, – 10 °C and 30 °C respectively. Assume isentropic compression, dry saturated suction vapour and saturated liquid refrigerant in the cycle, calculate the following for 20 TR load in the evaporator

   i) Mass flow rate in each cylinder in kg/s

   ii) Power required to run the system

   iii) Piston displacement in m^3/s for each cylinder

   iv) COP of the system. 10

   b) Write a note on desirable properties of refrigerants. 6

SECTION – II

7. a) Define human comfort. Write a note on Indoor Air Quality (IAQ). 6

   b) 20 m^3/min of air at 30 °C DBT and 60 % RH is cooled to 22 °C DBT maintaining its specific humidity (humidity ratio) constant. Without using psychrometric chart, calculate

   i) heat removed from air and

   ii) RH of cooled air.

   Assume total air pressure as 1 bar. Take partial pressure of water vapour at 30 °C DBT as 0.04242 bar and at 22 °C as 0.02642 bar. 6

   c) Differentiate between ventilation and infiltration. 4

OR

8. a) Write a note on Evaporative cooling. **6**

b) The sensible heat gain of a room is 4.8 kW and its latent gain is 1.4 kW. A conditioned air supply of 0.5 m^3/s is to be delivered to the room. If the room is to be maintained at 25 °C DBT, find the relative humidity that will result in the conditioned room if the supply air is at 17 °C and 90 % RH. **4**

c) Outside design conditions are 40 °C DBT and 30 % RH. Room design conditions are 25 °C and 50 % RH. Room sensible heat is 50 kW and room latent heat is 10 kW. If the outside air quantity is 50 m^3/min and assuming bypass factor of cooling coil as 0.1, find GSHF and ESHF. **6**

9. a) Explain all water air conditioning system. **6**

b) Differentiate between DX and Flooded evaporators. **6**

c) List the different types of compressors with specific application of each type. **4**

OR

10. a) Compare air cooled and water cooled condensers. **6**

b) Write a note on Thermostatic Expansion valve. **6**

c) Write a note on Filters used in Air conditioning application. **4**

11. a) Explain equal friction method of duct design. List its advantages and disadvantages. **8**

b) A rectangular duct section 500 mm × 350 mm size carries 75 m^3/min of air having density of 1.15 kg/m^3. Determine the equivalent diameter of circular duct if

i) the quantity of air carried in both the cases is same and

ii) the velocity of air in both the cases is same.

If friction factor is 0.01 for sheet metal, find pressure loss per 100 m length of duct. **6**

c) Write a note on selection of Fan for air conditioning application. **4**

OR

12. a) Write note on **any two** : **12**

i) Need for cold chain

ii) IQF (Individual Quick Freezing)

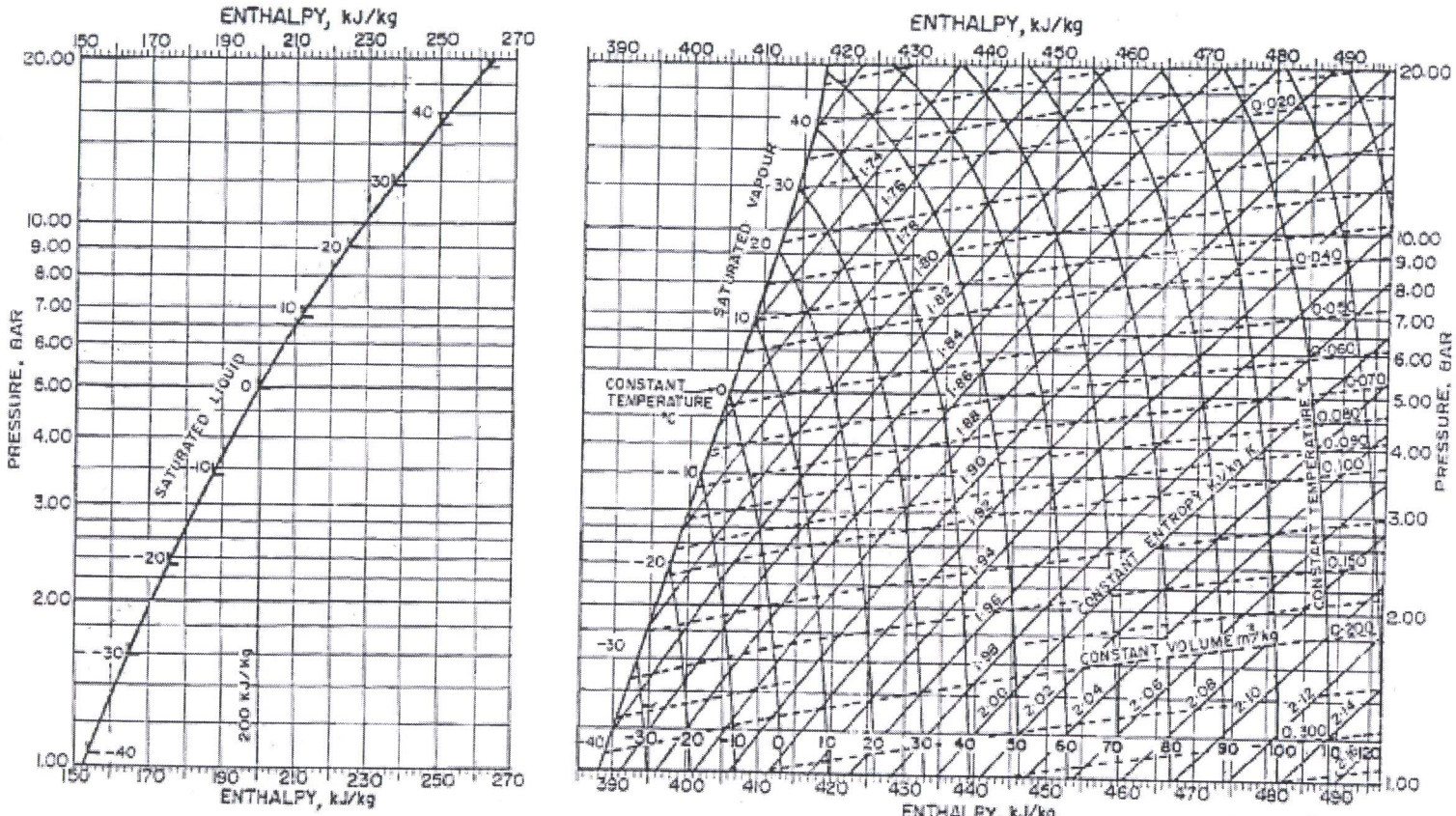
iii) CA/MA storages.

b) A duct 15 m in length passes air at a rate of 90 m^3/min. Assuming the friction factor as 0.005 calculate the pressure drop in the duct in mm of water when

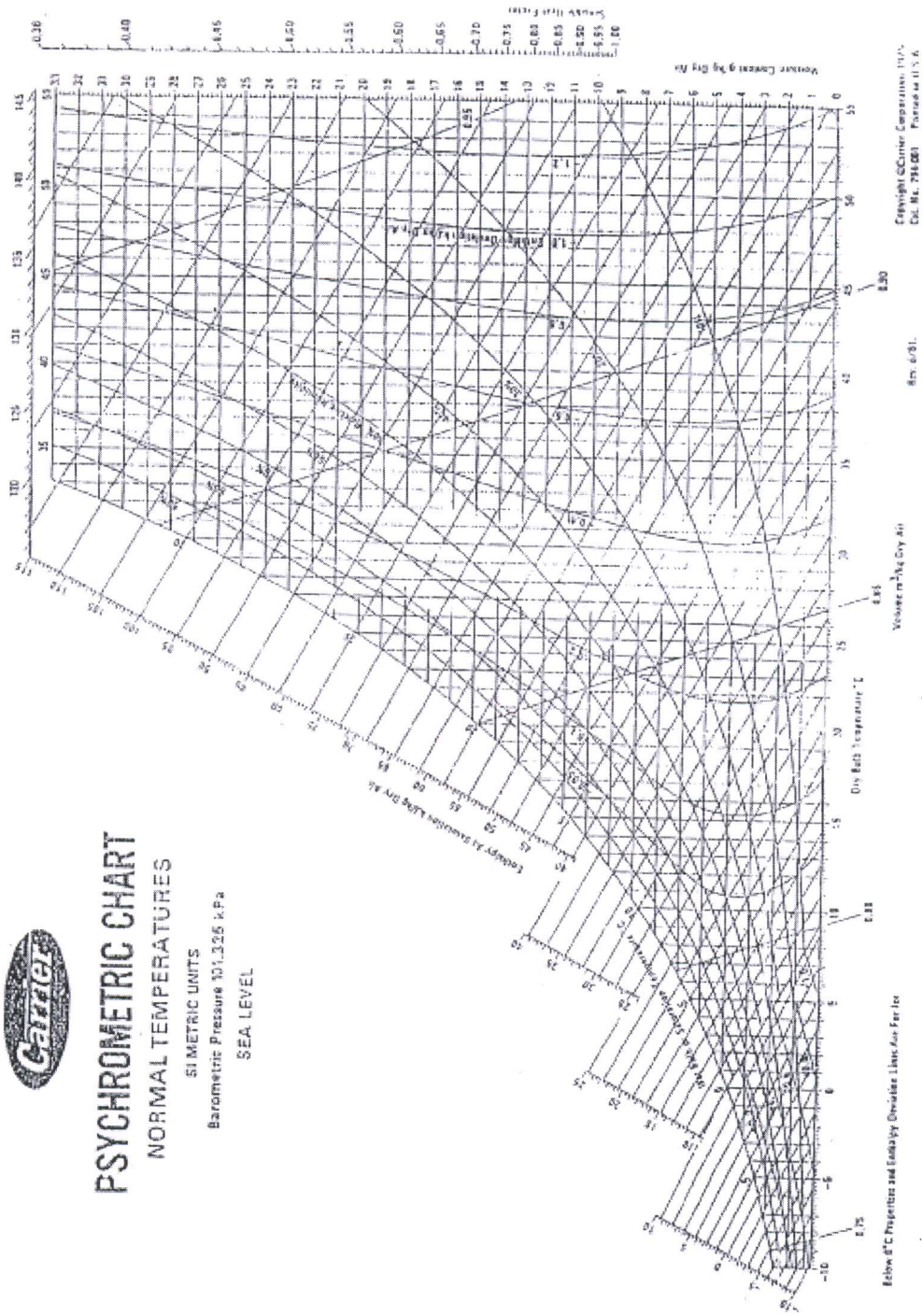
i) the duct is circular of diameter 0.3 m and

ii) the duct is of square cross section with side 0.3 m

Assume density of air as 1.2 kg/m^3. **6**



PRESSURE – ENTHALPY DIAGRAM, REFRIGERANT 22


Carrier
PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL