T.E. (Mechanical) (Semester – II) Examination, 2010
REFRIGERATION AND AIR-CONDITIONING
(2003 Course)

Time : 3 Hours   Max. Marks : 100

Instructions : *1) Answer **any three** questions from **each** Section.*
*2) Answer **three** questions from Section **I** and **three** questions from Section **II**.*
*3) Answers to the **two** Sections should be written in **separate** books.*
*4) Neat diagrams must be drawn **wherever** necessary.*
*5) Black figures to the **right** indicate **full** marks.*
*6) **Use** of logarithmic tables, slide rule, Mollier charts, elecronic pocket calculator and steam tables is **allowed**.*
*7) Assume **suitable** data, if **necessary**.*

SECTION – I

UNIT – I

1. a) What are limitations of reversed Carnot refrigeration system ?   4

   b) A businessman after feasibility study found the ice consumption in a locality to be 300 kg/hr. He wants to manufacture ice at -10°C from water available at 30°C. What should be the capacity of machine in TR if it should be 10% over capacity ?

   Take C_{pw} = 4.18 KJ/kg. C_p of ice = 2.1 kJ/kg and latent heat of fusion of ice is 335 KJ/kg.   4

   c) Explain with a neat sketch the reduced ambient air-refrigeration system.   8

                                   OR

2. a) Explain with neat sketch thermoelectric refrigeration.   6

   b) Explain the term "Dry air rated temperature" (DART).   4

P.T.O.

c) An air refrigeration system having pressure ratio of 5 takes air at 0°C. It is compressed and then cooled to 19°C at constant pressure. If the efficiency of the compressor is 95% and that of expander is 75% Determine :

   1) The refrigerating capacity of the system, if the flow of air is 75 kg/min.

   2) The power required of the compressor.

   3) COP of the system.

Assume compression and expansion processes to be isentropic. Take $\gamma = 1.4$, $C_p = 1.005$ KJ/kg.   **6**

UNIT – II

3. a) Sketch the actual vapour compression cycle on P-V and T-S diagram. How does it deviate from the theoretical vapour compression cycle ?   **8**

b) Compare the COP of an ammonia refrigeration cycle operates between -20°C and 30°C. in following two cases.

   1) Wet compression, in which vapour leaving the compressor is dry saturated.

   2) Dry Compression, in which vapour entering the compressor is dry saturated.

Assume compression to be isentropic and no sub cooling of liquid refrigerant. Take $C_{p_l} = 4.6$ kJ/kgk, $C_{pv} = 2.8$ kJ/kgk. Use following properties of refrigerant. **8**

Ts(°C)	Specific Enthalpy (KJ/kg)			Specific Entropy (kJ/kg k)	
	h_f	h_{fg}	h_g	S_f	S_g
–20	89.8	1330.2	1420.0	0.3684	5.6244
30	323.1	1145.8	1468.9	1.2037	4.9842

OR

4. a) Write short notes on :

   1) Desirable properties of ideal refrigerant for vapour compression cycle.

   2) Ozone depletion and Global warming issues.   **10**

b) Explain briefly Montreal Protocol and Kyoto protocol.   **6**

UNIT – III

5. a) Enumerate the limitations and drawbacks of a single stage vapour compression plant required to operate between high condenser temperature and low evaporator temperature.   **6**

   b) A multiload refrigeration system uses three separate evaporators E1, E2 and E3 at temperatures -10°C, 0°C and 10°C respectively. While from the condenser the refrigerant R-12 liquid is coming to the different evaporators at a temperature 40°C, the liquid from the condenser could be assumed to be saturated. The loads on evaporators E1 & E3 are 10 TR each and the load on E2 is 20TR (at 0°C). After each of the above three evaporators, separate pressure reducing valves bring the pressure to the suction pressure. Single compressor and individual expansion valves are used in the system. Make the neat flow diagram and with P-h chart find the following :

   1) Power required to run the system.

   2) COP of the system.   **9**

   c) Which components of the simple vapour-absorption system replaces the compressor of a vapour compression system ?   **3**

OR

6. a) Describe briefly, with neat schematic the operation of a Lithium-Bromide water absorption system.   **8**

   b) Find out the generator temperature for an absorption system having evaporator and absorber temperatures as 250 K and 310 K respectively. The COP is to be 1.3. If the saturated steam is supplied at a temperature 15K above the generator temperature, what is the steam pressure. (Use steam table).   **6**

   c) What is the purpose of Heat exchanger employed in Practical vapour absorption system between :   **4**

   1) Generator and absorber

   2) Condenser and evaporator

SECTION – II

7. a) Explain the term "Thermodynamic wet bulb temperature".   4

   b) Describe various methods of humidification and dehumidification of air.   4

   c) A 2 TR cooling unit is used to dehumidify $0.2 \ m^3/s$ from 28°C DBT and 25°C WBT to specific humidity level of $w_2 = 0.08$ kg of w.v./kg of d.a. Determine :
      i) DBT and DPT of air at exit condition, and
      ii) amount of dehumidification. The barometric pressure is 1.01325 bar.   8

                              OR

8. a) Explain thermodynamics of human body.   4

   b) State factors governing optimum effective temperature.   4

   c) A drying room is to be maintained at 32°C and 30% RH. The sensible heat gain to the room is 150000 kJ/h. The moisture to be evaporated from the objects during drying is 18 kg/h. If there is no direct heat source to provide for evaporation in the room. Calculate the state and rate of supply air at 15°C DBT.   8

9. a) Describe the procedure to estimate load on central air-conditioning system with the help of psychometric chart and block diagram. The 60% recirculated air mixes with 40 % fresh air in AHU befor cooling coil.   10

   b) Explain air-water conditioning systems with schematic diagram.   6

                              OR

10. a) Enumerate main types of compressors used in refrigeration system. Explain working of screw compressor.   8

    b) Explain installation and charging procedure of refrigeration system.   8

11. a) Explain "pressure losses" in duct. 6

   b) State and explain factors involving principles of air distribution. 6

   c) State disadvantages of equal friction method and advantages of static regain method. 6

OR

12. a) What are the major causes of food spoilage ? 6

   b) Explain the different methods of food preservation. 9

   c) Define "food preservation", what are the advantages of food preservation ? 3

Pressure - Enthalpy (p-h) Chart for Dichlorodifluoromethane (CCl₂F₂) (Refrigerant - 12)
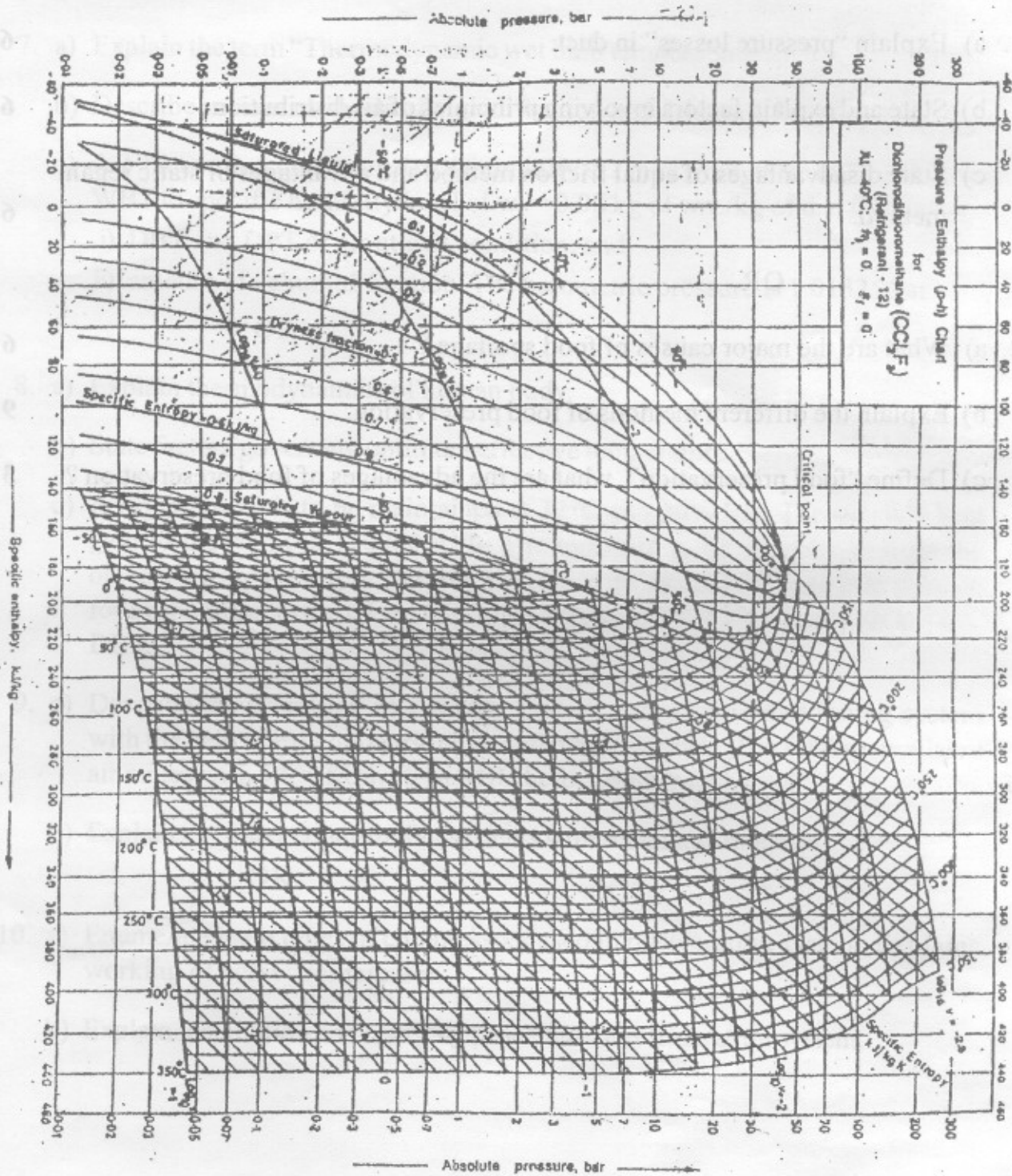
PSYCHROMETRIC CHART

Normal Temperature
SI Units

SEA LEVEL
BAROMETRIC PRESSURE: 101.325 kPa

DRY BULB TEMPERATURE - °C

Chart by: HANDS DOWN SOFTWARE, www.handsdownsoftware.com