[5254] -544

B.E. (Mechanical)

REFRIGERATION AND AIR - CONDITIONING EQUIPMENT DESIGN

(2012 Pattern) (Elective - III)

Time : 2½ Hours]　　　　　　　　　　　　　　　　　　　　*[Max. Marks :70*

Instructions to the candidates:

　　1)　Answer three questions out of 6.

　　2)　Solve Q.1 or 2, Q.3 or 4, Q.5 or 6.

　　3)　All the three questions should be solved in one answer book and attach extra supplements if required.

　　4)　Draw Diagrams wherever necessary.

　　5)　Use of scientific calculator is allowed.

　　6)　Assume suitable data where ever necessary.

Q1) Explain the performance characteristic curves of reciprocating and centrifugal compressors.　　　　　　　　　　　　　　　　　　　　　　　　**[10]**

OR

Q2) A typical two - evaporator R - 134a system working with individual compressor and individual expansion valve has - 30°C(20TR) and - 5°c (30TR) evaporating temperature and 40°C condensing temperature. Calculate　　　　**[10]**

　　a)　Overall COP

　　b)　Mass flow rate of refrigerant through each compressor

　　c)　Cooling capacity on the condenser

　　d)　Displacement volume required for each compressor if their vol. eff. = 0.9

Q3) a)　List out the limitations of VCS for the production of low temperatures.**[5]**

　　b)　Explain the construction working of externally compensated regulating valve.　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**[5]**

OR

Q4) a) Write a short note on defrost method for multiple evaporator systems.**[5]**

b) Write a short note on : **[5]**

   i) Liquefaction of nitrogen

   ii) Liquefaction of hydrogen

Q5) a) Write a short note on "Baudelot Cooler'. **[4]**

b) Design R - 22 condenser to meet the following conditions; **[12]**

Refrigeration load	30TR
Condensing temperature	37.78°C
Evaporating temperature	−1.11°C
Water inlet temperature	25.55°C
Water flow rate per TR	0.00757 m³/min
Heat rejection factor	1.013
Maximum tube length & diameter	3.6576 m & 2.54 cm
Fouling factor	0.001 m²K/W
HTC inner & outer side respectively	6000 W/m².K & 1500 W/m².K

State the selection basis of condenser

<div align="center">OR</div>

Q6) a) Write a short note on 'Pump Circulation System". **[8]**

b) Explain the procedure of thermal design of shell and tube condensers.**[8]**

Q7) a) A test is performed on an induced draft counter flow cooling tower. The following observations are made : **[16]**

Water flow rate :	12.67 kg/s
Air flow rate :-	11.9 kg/s
Water entering temperature :	36.3°C
Water leaving temperature :	32.1°C

Ambient air conditions : 43.3°C DBT, 25.6°C WBT

If the dimensions of the tower are length L = 3.9624 m, width W = 2.616 m and height H = 2.438 Determine the following :

   i) Value of the performance coefficient.

   ii) The wetted area of tower if air HTC is 83 W/m²K.

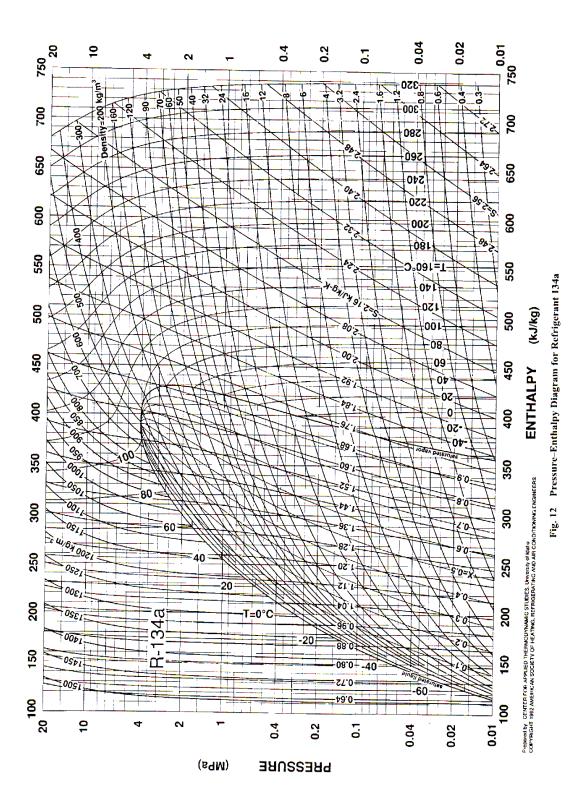   iii) Value of mass transfer coefficient

   iv) Tower efficiency

OR

Q8) a) Explain working of coil/fill type evaporative cooling tower with neat sketch. **[8]**

b) Explain the thermal analysis of cooling tower. **[8]**

Q9) a) Write a short note on : **[12]**

   i)   Vortex Tube

   ii) Thermoelectric Refrigeration

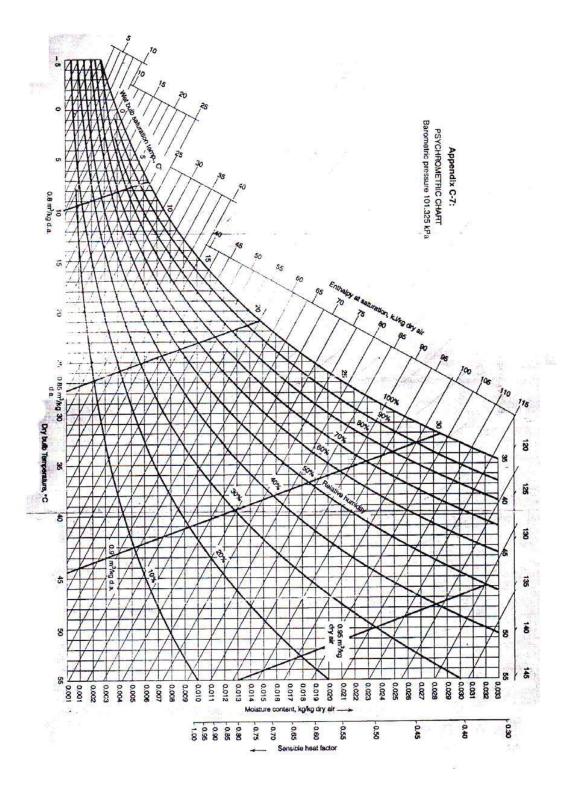b) Discuss various types of wick structures used in heat pipe. **[6]**

OR

Q10) a) In steam jet refrigeration the dry saturated motive steam is supplied at 6 bar. The amount of motive steam per unit mass of flash vapour is 2 kg/kg. The quality of vapour at the beginning of compression is 0.9. The condensing and flash vapour temperature is 40°C and 5°C respectively. The compression efficiency is 0.78. Obtain the TR of the system for 0.8 kg/s of motive steam and volume of vapour handled by the ejector.   (Use steam table for properties). **[12]**

b) Discuss various applications of heat pipe. **[6]**

Fig. 12 Pressure-Enthalpy Diagram for Refrigerant 134a

Appendix C-7:
PSYCHROMETRIC CHART
Barometric pressure 101.325 kPa

◆◆◆◆