Total No. of Questions : 12]

SEAT No. :

P4405

[Total No. of Pages : 6

[5460]-22

T.E.

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 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) With neat schematic explain the working of steam jet refrigeration system. Explain its applications. List its disadvantages. **[8]**

b) Air enters the compressor of an ideal Brayton Refrigeration Cycle at 101 kPa and 270 K with a volumetric flow rate of 2 m^3/s. If the compressor pressure ratio is 3.0 and the turbine inlet temperature is 300 K, determine, **[8]**

i) The net power input

ii) The refrigeration capacity

iii) Coefficient of performance

Take $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg.K

OR

Q2) a) Explain methods to produce low temperature. **[8]**

b) Explain various processes in Bell-Coleman cycle. Derive the expression for COP of Bell Coleman cycle. **[8]**

P.T.O.

Q3) a) i) Prove that the maximum COP of an ideal vapour absorption refrigeration system is given by

$$\text{COP}_{\max} = \left(\frac{T_L}{T_C - T_L}\right) \times \left(\frac{T_G - T_C}{T_G}\right)$$

Where T_L = Evaporator temperature, T_C = Condenser temperature and T_G = Generator temperature.

ii) Compare vapour compression with vapour absorption system. **[8]**

b) A cold storage is to be maintained at –5 °C while surrounding are at 35 °C. The heat leakage of the surrounding into the cold storage is estimated to be 29 kW. The actual COP of the refrigeration plant is 1/3rd of an ideal COP of the plant working between the same temperature. Find actual COP and power required to drive the plant.

Determine percent change in COP and power required when surrounding temperature is 55 °C keeping all other conditions same. **[8]**

OR

Q4) a) Draw neat diagram of water-ammonia refrigeration system. Explain its working. What is the use of analyzer and rectifier in this system? **[8]**

b) Discuss the effect of operating parameters on performance of VCC with the help of p-h or T-s diagram. **[8]**

Q5) a) A vapor compression system using ammonia as refrigerant works between 2 bar and 14 bar. Two flash chambers are fitted in the system at 6 bar and 10 bar and vapours are sent to the respective compressors where these compressors handle only flash gas. If the load on the evaporator is 18 TR, find the power required to run system and its COP.

What is the COP? Is it works on simple saturated VCC? **[10]**

b) Explain the desirable properties of refrigerant. List some eco-friendly refrigerant and state why eco-friendly refrigerant must be used? **[8]**

OR

Q6) a) Explain pumped circulation system with neat diagram. **[7]**

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

c) Explain in brief : Montreal Protocol and Kyoto Protocol. **[5]**

SECTION - II

Q7) a) Explain: thermodynamic wet bulb temperature. **[4]**

b) Prove that the specific humidity is given by **[6]**

$$\omega = 0.622 \frac{p_v}{p - p_v}$$

Where p = total pressure of air, and

p_v = partial pressure of moisture in air.

c) Air at 35°C and 60% RH is cooled to 24°C DBT. It is achieved by cooling and dehumidification. Air flow rate is 50 cmm. Using psychrometric chart, calculate: **[8]**

i) Dew point temperature

ii) Mass of water drained per hour

iii) Capacity of cooling coil and

iv) If by-pass factor of coil is 0.15, find ADP.

OR

Q8) a) Explain : thermodynamic wet bulb temperature. **[4]**

b) Prove that the specific humidity is given by **[6]**

$$\omega = 0.622 \frac{p_v}{p - p_v}$$

Where p = total pressure of air, and

p_v = partial pressure of moisture in air.

c) Moist air at 40°C & 80% RH passes through an air conditioning plant and attains the final condition 24°C & 60% RH. Assuming constant pressure of 100 kPa, determine capacity of cooling coil and rate of moisture removal in kg/h for mass flow rate of 2 kg/s. Show the process on psychrometric chart. **[8]**

Q9) a) Draw schematic of central air conditioning systems. Compare various types of central air conditioning systems. **[6]**

b) Explain: RSHF, GSHF and ESHF. **[6]**

c) What is selection criterion of condenser coil in an air conditioning system? Explain. **[4]**

OR

Q10)a) Explain the various types of compressors used in refrigeration systems. Discuss the working of screw compressor. **[7]**

b) Discuss the procedure to calculate ventilation load? **[4]**

c) What is variable air volume air conditioning system? **[5]**

Q11)a) What are desirable properties of duct materials? **[4]**

b) Explain the various types of food preservation techniques. **[6]**

c) A rectangular duct section 500 mm × 350 mm carries 75 cmm of air having density of 1.12 kg/m^3. Calculate the equivalent diameter of circular duct for **[6]**

i) Same quantity of air handling in both cases.

ii) Same velocity of air in both cases.

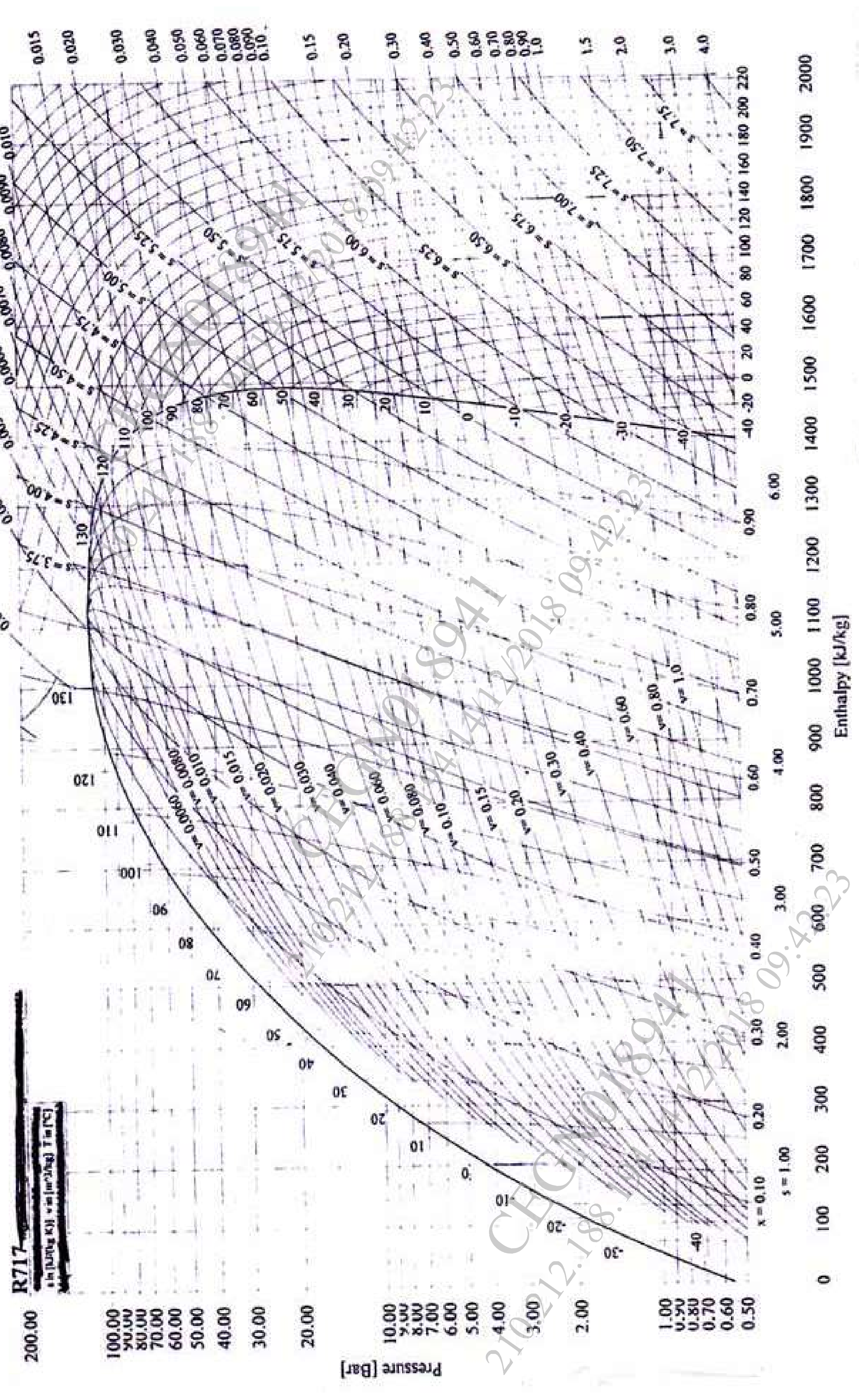
iii) If $f = 0.001$ for sheet metal, find the paper drop per 100 m length of duct.

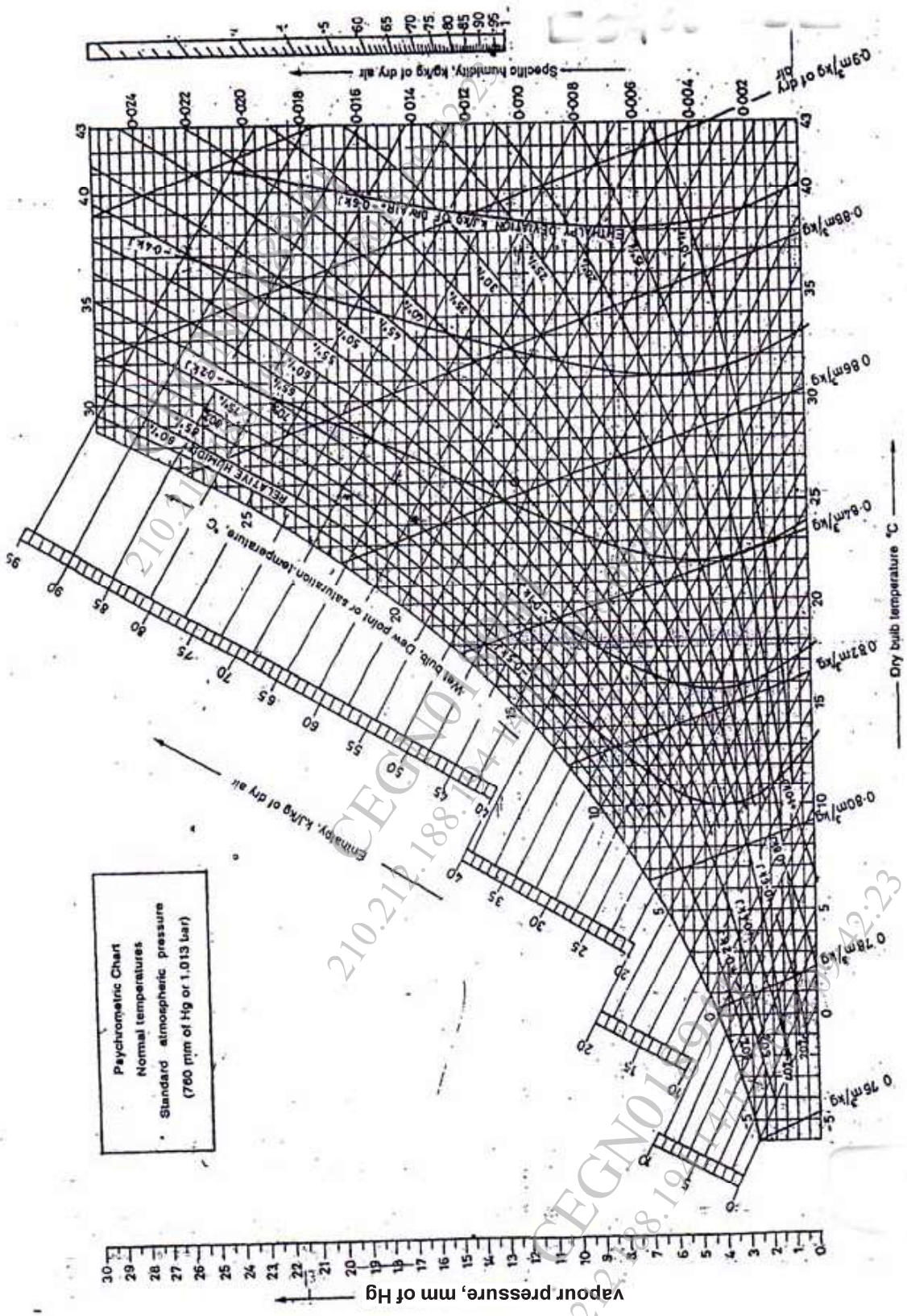
OR

Q12)a) What are dynamic losses in duct? Explain. **[4]**

b) Explain static regain method for duct design. **[6]**

c) Write short note on : cold chain. **[6]**


R717
[redacted]
Enthalpy [kJ/kg]
Pressure [Bar]


Psychrometric Chart
Normal temperatures
Standard atmospheric pressure
(760 mm of Hg or 1.013 bar)
Dry bulb temperature °C
Wet bulb, Dew point or saturation temperature, °C
Enthalpy, kJ/kg of dry air
Specific humidity, kg/kg of dry air
vapour pressure, mm of Hg