CS/B.Tech/(ME-NEW)/SEM-6/ME-604A/2013

2013

AIR CONDITIONING & REFRIGERATION

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

i) A one ton refrigerating machine means that

a) The total weight of the machine is one tonne

b) The quantity of refrigerant used is one tonne

c) The refrigerator can produce one tonne of ice at 32°F from one tonne of water at 32°F in one day

d) none of these.

ii) Where does the highest temperature of refrigerant occur in vapour compression refrigeration system ?

a) in evaporator

b) before expansion valve

c) between compressor and condenser

d) between compressor and evaporator.

iii) The refrigerant R-22 stands for

a) Ammonia

b) Carbon Dioxide

c) Methyl chloride

d) Methane.

iv) Which of the following components is common between vapour compression and vapour absorption refrigeration system. ?

a) Condenser

b) Absorber

c) Generator

d) Rectifier.

v) For one ton refrigerant plant, if C.O.P. of the plant is 5, the heat rejection ratio of the condenser will be

a) 2.2

b) 1.2

c) 2.333

d) 1.333.

vi) For saturated air

a) Wet bulb depression is positive

b) Wet bulb depression is negative

c) Wet bulb depression is zero

d) Dew point of air is zero.

vii) During adiabatic saturation process of unsaturated air which of the following remains constant ?

a) Relative humidity

b) Dry bulb temperature

c) Wet bulb temperature

d) Dew point of air.

viii) By which fo the following are dust and other impurities in air removed ?

a) Centrifugal device

b) Adhesive impregnanted filters

c) Electrostatic precipitator

d) Any one of these.

ix) In cooling towers the drift loss is around

a) 1 to 2%

b) 5 to 10%

c) 10 to 20%

d) 20 to 30%.

x) For the same frictional loss in the air conditioning duct of round cross-section and rectangular cross-section, the equivalent round duct dia. is

(a = width of duct, b = breath of duct)

a) $d_e = \frac{2ab}{a+b}$

b) $d_e = \frac{a \times b}{a+b}$

c) $d_e = \frac{a+b}{2a \times b}$

d) $d_e = \frac{a+b}{a \times b}$

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Describe the effect of cnanges in evaporation pressure and condenser pressure on the performance of a simple vapour commpression refrigeration system.

3. Show that the work of reciprocating compressor consdering the effect of clearance volume is

$$W = \frac{n}{n-1} P_1 (V_1 - V_4) \left[\left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} - 1 \right]$$

Where all terms of the expression have their usual meaning.

4. Draw a neat diagram of practical vapour absorption system and briefly explain its operation.

5. a) State Relative humidity.

b) Prove that relative humidity. (ϕ) is given by

$\phi = \mu / 1 - (1 - \mu) (P_{vs} / P_t)$

Where, μ = Degree of saturation,

P_{vs} = Saturation pressure of vapour in moist air

P_t = Total pressure of moist air. 1 + 4

6. Explain a chemical dehumidification process and show it on psychometric chart.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Compare the performance of reciprocating and centrifugal refrigeration compressors.

b) Briefly describe the actual air refrigeration cycle.

c) An ammonia refrigeration plant operates between a condesing temperature of 40°C and evaporating temperature of – 10°C. The vapour is dry at the end of compression. The specific heat of ammonia vapour is 2.1897 kJ/kg K. Calculate the theoretical coefficient of performance of the cycle and the power of the compressor to remove 200 kJ/min

t	h_f	h_g	s_f
°C	kJ/kg	kJ/kg	kJ/kg K
40	371.5	1473	1.36
– 10	135.4	1433	0.544

4 + 4 + 7

8. a) State five advantages of Air cycle for aircraft refrigeration.

b) In an absorption type refrigerator, heat is supplied to NH_3 generator by condensing steam at 2 bar and 88% dry. The temperature in the refrigerator is to be maintained at – 4°C. If the refrigeration load is 18 ton and actual COP is 72% of maximum COP. Calculate :

i) The maximum COP possible and actual COP

ii) Mass of steam required per hour.

You may take the condensing temperature as 35°C.

5 + 10

9. a) Name any two methods for determination of air conditioning duct size and briefly state their respective pricniple in one or two sentences. State one advantage and one disadvantage of each method.

b) In an air conditioning system, the size of the main air supply duct is 880 mm × 660 mm in cross-section and carries 330 m ^{3} per minute of standard air. The main duct branches into two ducts of cross-section 660 mm × 550 mm and 660 mm × 440 mm. The mean velocity in larger branch is 420 meter per minute. Determine the mean velocity in the main duct and the smaller branch. 8 + 7

10. a) Define 'Air conditioning'. Name the six basic elements of an air conditioning system.

b) Air flowing at rate of 20 m ^{3}/min at 40°C DBT and 50% RH is mixed with another stream flowing at the rate of 100 m ^{3}/min at 26°C DBT and 50% RH. The mixture flows over a cooling coil whose ADP temperature is 10°C and bypass factor is 0.2. Find DBT and RH of the air leavng the coil. The air is supplied to an air condidtioned room to be maintained at 26°C DBT and 50% RH. Estimate room sensible heat factor and cooling load capacity of the coil in ton of refrigeration.

7 + 8

11. a) Define a fan. What type of fan is particularly suitable for an air conditioning system with elaborate ducting ? Describe briefly the following types of centrifugal fan and compare their performance.

i) Forward curved blade fans

ii) Backward curved blade fans.

b) An air conditioned auditorium is to be maintained at 25°C DBT and 55% RH. The ambient conditioned is 39°C DBT and 28°C WBT. The total sensible heat load is 120000 KJ per hour and the total latent heat load is 48000 KJ per hour. 80% of the air from the auditorium is re-circulated and mixed with 20% of make up air before the cooling coil. The condition of air leaving the coil is 15°C.

Determine :

i) Room sensible heat factor

ii) Amount of make up air

iii) ADP of coil

iv) By pass factor of cooling coil. 7 + 8