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Refrigeration & Air Conditioning
(New) (1210)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt **any two** from a, b, c of each question from each unit.
5. Draw neat sketches wherever necessary.
6. Assume suitable data, if necessary.
7. Black figures to the right indicate full marks.
8. Use of refrigerant property tables, steam table, charts and non programmable calculator is allowed.

UNIT – I

1. a) Derive an expression for COP of air refrigerator working on reversed carnot cycle. **10**

b) The following data refer to a boot strap air cycle evaporative refrigeration system used for an aeroplane to take 20 tonnes of refrigeration load. **10**

Ambient air temperature = 15ºC
Ambient air pressure = 0.8 bar
Mach no. of flight = 1.2
Ram efficiency = 90%
Pressure of air bled off the main compressor = 4 bar
Pressure of air in the secondary compressor = 5 bar
Isentropic efficiency of main compressor = 90%
Isentropic efficiency of secondary compressor = 80%
Isentropic efficiency of cooling turbine = 80%
Temperature of air leaving the first heat exchanger = 170ºC
Temperature of air leaving second heat exchanger = 155ºC
Temperature of air leaving the evaporator = 100ºC
Cabin pressure = 1 bar
Cabin temperature = 25ºC

Find :

1) Mass of air required to take cabin load.
2) Power required for the refrigeration system.
3) COP of the system.

c) i) Give the methods for finding leak detection of refrigerants. **6**

ii) What do you mean by antifreeze solutions ? Give examples. **4**

UNIT – II

2. a) What are the advantages of compound vapour compression with intercooler ? Give the necessity of multiple evaporative system. **10**

b) Saturated ammonia at 2.5 bar enters a 160mm x 150 mm, twin cylinder, single acting compressor whose volumetric efficiency is 79% and speed is 250 rpm. The head pressure is 12 bar. The subcooled liquid ammonia at 22ºC enters the expansion valve. For a std. refrigeration cycle, find **10**

1) The ammonia circulated in kg/min.
2) The refrigeration in TR.
3) COP of the refrigeration cycle.

Refer the following table for the properties of ammonia.

Pressure (bar)	Saturation Temp ^oC	Specific Volume (m^3/kg)	Specific enthalpy		Specific entropy (kJ/kgk)	
			Liquid (kJ/kg)	Vapour (kJ/kg)	Liquid	Vapour
2.5	-15	0.5098	112.4	1426.58	0.4572	5.5497
12	30	0.1107	328.08	1468.87	1.2037	4.9842

Assume specific heat at constant pressure for liquid ammonia as 4.606 kg/kgk and for superheated ammonia vapour as 2.763 kJ/kgk.

c) Define Joule's – Thomson coefficient. How it is obtained ? Give the examples where Joule's Thomson effect is used. **10**

UNIT – III

3. a) Explain three fluids refrigeration VAS system. **10**

b) In an aqua NH_3 vapour absorption system, the following data is available. **10**

Temperature of weak solution in generator = 100ºC
Temperature of strong solution to generator = 82ºC
Temperature of condenser = Temperature of absorber = 40ºC
Temperature in the evaporator = 10ºC

Determine the following for 10 tons refrigeration capacity.

1) Heat supplied in the generator, kJ/sec ?
2) Heat rejected in the absorber, kJ/sec ?
3) Degasing value.
4) Heat rejected in condenser kJ/sec ?
5) Mass flow rate of strong solution handled by the pump ?
6) COP of the system ?

c) Give the properties of an ideal refrigerant, ideal absorbent and ideal refrigerant-absorbent combination. **10**

UNIT – IV

4. a) Define the following. **10**
i) By-pass factor.
ii) Coil efficiency.
iii) Psychrometer.
iv) Chemical dehumidification.
v) Effective temperature.

b) Moist air enters a chamber at 5ºC DBT and 2.5ºC WBT at a rate of 90 cmm. The barometric pressure is 1.01325 bar. While passing through the chamber, the air absorbs sensible heat at the rate of 40.7 kw and picks-up 40 kg/h of saturated steam at 110ºC. Determine the dry and wet bulb temperatures of the leaving air. **10**

c) Explain summer air-conditioning system. **10**

UNIT – V

5. a) Define human comfort. How comfort chart is prepared. **10**

b) The conditioning plant of a room consists of a fresh air intake, a cooling coil-followed by a mixing chamber for the cooled fresh air and recirculated room air, and a supply fan. The cooling coil handles all fresh air and has a BPF of 0.1. **10**

The ratio of fresh air to recirculated air is determined by modulating dampers. The other data is as follows :

Inside conditions : DBT = 24ºC, RH = 50%
Outside conditions : DBT = 30ºC, WBT = 23.3ºC.
Heat gains : RSH = 14.7 kw, RLH = 3 kw
Supply air quantity = 191 cmm.

Neglecting temperature changes in the fan and duct, determine :
i) DBT and moisture content of supply air.
ii) Mass flow rate of moist air supplied to room.
iii) DBT and moisture content of air leaving cooling coil.
iv) Load on the cooling coil.

c) i) Give the classification of air conditioning systems. **6**

ii) Explain infiltration heat load. **4**

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