B.E. Eighth Semester (Mechanical Engineering) (CGS)

10890 : Elective-III : Refrigeration & Air Conditioning

8 ME 02

P. Pages : 4

Time : Three Hours

AW - 3149

Max. Marks : 80

Notes :
1. Answer **1 or 2, 3 or 4, 5 or 6, 7 or 8, 9 or 10, 11 or 12** question.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and chemicals equations should be given wherever necessary.
5. Illustrate your answer necessary with the help of neat sketches.
6. Use of slide rule logarithmic tables, Steam tables, Mollier's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
7. Please answer the questions as per weightage of marks.
8. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Discuss why the effect of decreasing evaporator pressure is more server as compared to an equal increase in condenser pressure. **4**

b) A room airconditioner works between evaporator and condenser temperature of 7°C and 50°C respectively. The refrigerant R22 is superheated by 11°C to the temperature of 18°C in evaporator and subcooled by 8°C to the temperature of 42°C in condenser. It requires 1 TR capacity. Assume the following data : **10**

i) Volumetric efficiency at suction conditions = 0.8
ii) Compressor speed = 2900 RPM
iii) Stroke to bore ratio = 1.9
iv) Single acting single stage reciprocating compressor with single cylinder.
v) Isentropic efficiency = 0.9
vi) Mechanical efficiency = 0.95

Determine :

i) Power in kw ii) Actual COP
iii) Dryness fraction of refrigerant entering into the evaporator
iv) Draw flow, P-h and T-S diagram.

OR

2. a) Explain the actual vapour compression cycle with the help of P-h and T-S diagram. Discuss the effect of deviations from simple saturated cycle on the performance of system. **7**

b) A 60 litre / hr water cooler works between evaporator and condenser 0°C and 38°C respectively. It requires 0.4 TR capacity using refrigerant R134a. Determine : **7**

i) Power in kw
ii) Theoretical COP and
iii) Carnot COP

3. a) State the limitations of use of single refrigerant in vapour compression cycle for production of low temperatures. **4**

b) A two stage compression machine with water and flash intercooler is to produce 40 TR while working between -30°C evaporator temperature and 35°C condenser temperature the saturation temperature corresponding to flash intercooler pressure is 0°C. The refrigerant ammonia is dry saturated at entry to both the compressors and saturated liquid at the exit of condenser and flash intercooler. The refrigerant temperature leaving the water intercooler and entering flash intercooler is 30°C. Determine :

i) COP ii) Heat rejected in water intercooler.

OR

4. a) Explain the compound vapour compression system with flash chamber and single evaporator with the help of P-h diagram. The use of flash chamber is always desirable but the use of flash intercooling may or may not be desirable comment on the statement.

b) A R134a refrigeration plant has two evaporators of capacity 20TR at 5°C and 30 TR at -10°C with multiple expansion valve and individual compressor but one condenser at 40°C. Assuming isentropic compression and entry of dry saturated vapour in both the compressors. Determine :

i) Power consumed by each compressor and
ii) COP

5. a) Why frost formation takes place ? What is effect on performance of system. Enlist different methods of defrosting. Explain any one method. 7

b) Explain the step by step procedure for leak testing and charging of refrigeration system. 6

OR

6. a) Explain the working of hermetically sealed compressor with the help of neat sketch. What are the advantages and limitations in comparison to open type compressor. 7

b) Classify condensers and explain the working of evaporative condenser. Why it is used in ice plants. 6

SECTION - B

7. a) Define and state the significance of following terms ; 6

i) Sensible heat factor ii) Apparatus dew point
iii) Wet bulb depression and iv) Humidifying efficiency

b) Room air at 24°C DBT and 60% RH is mixed with outdoor air at 40°C DBT and 45% RH in the ratio of 3:2. The mixture is then passed through a cooling coil whose temperature is maintained at 13°C. The by pass factor of cooling coil is 0.3. Determine : 7

i) DBT, specific humidity and specific enthalpy of resulting mixture.
ii) Condition of air leaving the cooling coil.
iii) If 500 m^3/min of air is supplied to the room find the capacity of cooling coil in TR.

OR

8. a) What do you mean by pass factor and contact factor. Derive a relation for bypass factor. State the factors on which bypass factor of direct expansion coil depends. 5

b) A class room of 60 seating capacity is air conditioned the outdoor conditions are 32°C DBT and 22°C WBT and the required conditions are 22°C DBT and 50% RH. The quantity of outdoor air supplied is 0.5 cmm/student. The comfort conditions are achieved first by chemical dehumidifying at constant enthalpy and then sensible cooling. Determine : 8

i) Condition of air leaving the dehumidifier
ii) Capacity of dehumidifier in kg/hr
iii) Capacity of cooling coil in Tonnes of refrigeration and
iv) Effective coil surface temperature if its by pass factor is 0.3.

9. a) Explain the working of window air conditioner with neat sketch. Discuss its operation as heat pump in winter. 8

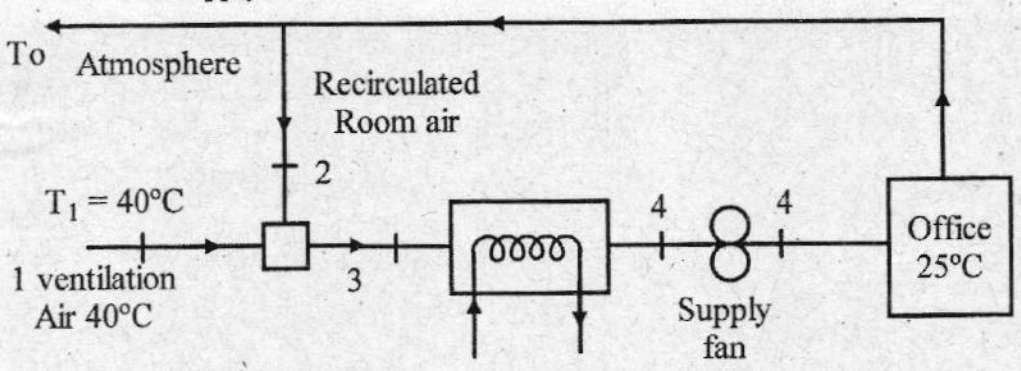
b) Why ducts are normally made of rectangular section. Enlist different methods of duct design. Explain any one of them. 5

OR

10. a) State the advantages, disadvantages and application of ALL AIR and ALL WATER system. 8

b) State which loads will be considered in calculating grand sensible heat and grand latent heat. 5

11. The air conditioning plant of an office at 20°N latitude and 78° longitude consists of ventilation air intake, a mixing chamber for ventilation air and recirculated room air. The mixture enters the cooling coil. A supply fan supplies the conditioned air to the room. Room sensible and latent heat loads are 2,09,340 kJ/hr and 52,344 kJ/hr respectively. The indoor conditions are 25°C DBT and 50% RH the outdoor conditions are 40°C DBT and 27°C WBT. 4200 m^3/hr of ventilation air is supplied. Coil by pass factor is 0.15. Neglecting sensible heat from supply fan. 14

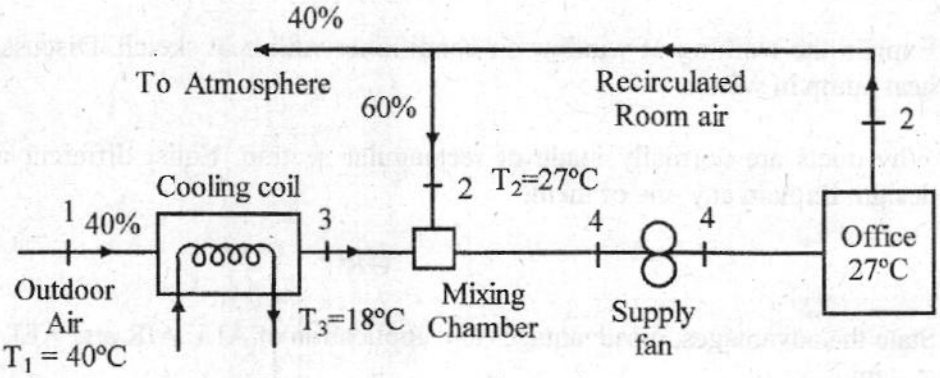


Determine :

i) Ventilation load
ii) ESHF
iii) GSHF
iv) Coil ADP and
v) Condition of air entering and leaving the cooling coil.

OR

12. The air conditioning plant of an office at 20°N latitude and 78° longitude consists of an outdoor air intake, a cooling coil followed by mixing chamber for cooled outdoor air and recirculated office air. The supply fan supplies conditioned air to the office as shown in figure. The cooling coil handles all outdoor air. The modulating damper mixes 40% of cooled outdoor air and 60% of recirculated office air. Air leaves the cooling coil at 18°C. Room sensible heat is 1,00000 kJ/hr and room latent heat is 40,000 kJ/hr. Indoor design conditions are 27°C DBT and 60% RH and outdoor conditions are 40°C DBT and 30°C WBT. Neglect sensible heat from supply fan. **14**



Determine :

i) RSHF
ii) State of air entering the room
iii) Coil ADP
iv) Bypass factor and
v) Amount of outdoor air.

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