Total No. of Questions :12]

SEAT No. :

P2397

[Total No. of Pages :4

[5153] - 20

T.E. (Mechanical)

REFRIGERATION AND AIR-CONDITIONING

(2008 Course) (Semester - II) (302051)

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 side indicate full marks.***
5) ***Use of calculator, Refrigeration tables and psychrometric chart is allowed.***
6) ***Assume suitable data if necessary.***

SECTION-I

Q1) a) Sketch the vapour compression cycle on T-s diagram and derive an expression for its COP. **[4]**

b) Prove that $(COP)_{HP} = (COP)_{R} + 1$ **[4]**

c) A simple R-12 plant is to develop 4 tonnes of refrigeration. The condenser and evaporator temperatures are 35°C and -15°C, respectively. Draw p-h diagram and determine: **[8]**

i) The mass flow rate of refrigerant in kg/s.

ii) The volume flow rate of refrigerant.

iii) Heat rejected to condenser in kW.

iv) Power required to drive the compressor.

v) COP of system.

vi) Compare this COP with COP of Carnot refrigerator operating between temperatures 35°C and - 15°C.

OR

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Q2) a) Define refrigerating effect. What is one ton of refrigeration? Derive formulation for calculating the tonnage of refrigeration? **[6]**

b) The pressure in the evaporator of an ammonia refrigerator is 1.902 bar and the pressure in the condenser is 12.37 bar. Calculate the refrigeration effect per unit mass of the refrigerant and $(COP)_R$ for following cycles:**[10]**

i) The dry saturated vapour delivered to the comprssor, where it is compressed isentropically to the condenser pressure.

ii) The dry saturated vapour delivered to the compressor and liquid after condensation is under-cooled by 10^oC.

Q3) a) Discuss the effect on performance of ideal VCC. **[8]**

i) lowering evaporator pressure, and

ii) Vapor super heat at compressor entry.

b) The refrigerant R - 12 enters the compressor of a refrigerator as a superheated vapour at 0.14 MPa and - 20^oC at a rate of 0.05 kg/s and leaves at 0.8 MPa and 50^oC. The refrigerant is cooled in the condenser to 26^oC and 0.72 MPa and is throttled to 0.15 MPa. Neglect any heat transfer and pressure drop in the connecting line between the components, determine **[8]**

i) Rate of heat removal from the refrigerated space.

ii) Power input to the compressor.

iii) The isentropic efficiency of the compressor, and

iv) Coefficient of performance of the refrigerator.

OR

Q4) a) Comparison of Vapour Absorption refrigeration system with Vapour Compression refrigeration System. **[6]**

b) Explain working of simple ammonia water vapour absorption refrigeration system with schematic. **[10]**

Q5) a) State desirable properties of refrigerants. **[4]**

b) How refrigerants are designated. Give the refrigerant number of with two refrigerants using designation formula. **[4]**

c) Draw schematic of cascade refrigeration system and explain its working. **[10]**

OR

Q6) a) Give the classification of refrigerants. **[4]**

b) Explain the selection criterion of refrigerants. **[4]**

c) Draw the schematic and p-h diagram of a vapour compression refrigeration system equipped with two evaporators at different temperature with single compressor using multi expansion valve and a back pressure valve. Explain its working mathematical formulation for calculation of performance of the system. **[10]**

SECTION-II

Q7) a) Define the following terms: **[8]**

i) Specific Humidity

ii) Degree of saturation

iii) Relative Humidity

iv) Dew point temperature

b) The humidity ratio of atmospheric air at 28°C DBT and 760 mm of Hg is 0.016 kg/kg of dry air. Determine: **[8]**

i) Partial pressure of water vapour

ii) Relative humidity

iii) Dew point temperature

iv) Specific enthalpy

OR

Q8) a) Draw Skelton of psychrometric diagram and show various properties on it. **[4]**

b) Explain heating and humidification process with the help of psychrometric chart. **[4]**

c) Air is cooled from 39°C DBT and 29% RH to 24°C at the rate of 5 m^3/s. Calculate the capacity of cooling coil if the surface of cooling coil is 20°C. Also calculate the bi pass factor. Show the process on psychrometric diagram. **[8]**

Q9) a) Explain the working principle and classification of evaporators. **[4]**

b) Explain working principle of evaporative condensers with a suitable schematic. **[4]**

c) Explain the working of summer air conditioning system. **[8]**

OR

Q10)a) What are advantages of multistage compression in a refrigeration system? **[4]**

b) Why fluid expansion is used in refrigeration system? Classify different expansion systems. **[4]**

c) Write advantage of split air-conditioner and explain its working. **[8]**

Q11)a) Draw a typical air flow diagram for an air-conditioning unit and classify ducts and duct material. **[6]**

b) Explain velocity reduction method of duct design. **[4]**

c) Prove that equivalent diameter of a rectangular duct for same discharge rate is given by $D_{eq} = 1.265 \times \left[\frac{a^3 b^3}{a+b}\right]^{1/5}$. **[8]**

OR

Q12)a) Discuss the dynamic losses in duct. **[4]**

b) State various air distribution systems used in air conditioning. Explain any two of them. **[10]**

c) Write a short note on cold storage. **[4]**

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