7E4061

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B. Tech. VII Semester (Main/Back) Examination 2014

MECHANICAL ENGINEERING # 7ME2

REFRIGERATION AND AIR-CONDITIONING

Time : 3 Hours | Min. Passing Marks : 24 | Maximum Marks : 80

Instruction to Candidates :

*Attempt any **five** questions, selecting **one** question from **each** unit. All questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Unit-'I'

1. (*a*) Explain reversed carnot cycle and calculate it's COP. What is the effect of operating temperatures? |8|

(*b*) What are the limitations of simple vapour compression system? What is the system adopted to achieve-50°C temperature, describe with neat sketch. |8|

OR

1. (*a*) Saturated ammonia vapour enters a 15 cm dia×14cm stroke twin cylinder single acting compressor at 0.2365 MPa whose volumetric efficiency is 79% and speed 420 r.p.m. The delivery pressure is 1.1672 MPa. The liquid ammonia at 21°C enters the expansion value. For ideal cycle find.

(i) The rate of circulation of ammonia

(ii) The refrigeration in tons

(iii) COP of the cycle. Take specific heat and density of ammonia as 2.19 kJ/Kg-K and 0.77 Kg/m^3 respectively. |10|

Pressure (MPa)	Sat. Temp. °C	Sp. Volume of Vap at Sat m^3/kg	Enthalpy kJ/Kg		Entropy kJ/Kg-K	
			Sat liq	Sat Vap	Sat liq	Sat Vap
0.2365	-15	0.5106	-831.46	481.52	5.4387	10.526
1.1672	+30	0.11084	-620.70	523.42	6.1853	9.9606

(*b*) Describe with neat sketch the liquid vapour heat exchanger. |6|

Unit-'II'

2. (*a*) Describe the simple gas cycle and hence show that the COP is the function of the pressure ratio of the cycle. |8|

(*b*) Describe the expansion device used in gas cycle. List the reasons for use of such device. |8|

OR

2. (*a*) What are the considerations for an aircraft refrigeration system. |6|

(*b*) A Bell Coteman refrigeration system is used to produce 10 tons of refrigeration. The cooler and refrigerator pressure are 4.2 bars and 1.4 bars. Air is cooled in the cooler to 45°C and the temperature of air at the inlet of the compressor is -20°C. For the ideal cycle, calculate COP, mass of air circulated/min, theoretical piston displacement of compressor and power required per ton of refrigeration. Assume Cp for air as 1.005 kJ/Kg-K. Find the cylinder dimensions if the compressor is single acting. Single cylinder with stroke/diameter ratio of 1.2 and runs at 600 rpm. Take γ = 1.4, K = 0.287. |10|

Unit-'III'

3. (*a*) Evaluate carbon dioxide as an refrigerant. |8|

(*b*) Describe the working of an electrolux refrigerator. What are it's limitations. |8|

OR

3. (*a*) What are commonly used refrigerants in the vapour absorbent system? Evaluate two commonly used refrigerant in such system. |8|

(*b*) Describe the working of a Rotary compressor what are the advantages of a centrifugal compressor? |8|

Unit-'IV'

4. (*a*) Describe the terms wet bulb temperature and humidity ratio. How these are measured? |8|

(*b*) The moist air enters the refrigeration coil of a dehumidifier at 32°C and 60% relative humidity at the flow rate of 1.5 Kg/s. The air at exit is saturated at temperature of 15°C. Show the process on Psychrometric Chart and find the amount of condensate removed and the tons of refrigeration required. |8|

OR

4. (*a*) What is the effect of heat of body on the work performance? |8|

(*b*) Calculate all the Psychrometric properties of air at 1 bar and 25°C dbt and 15°C wbt using the following properties of water.

Temp (°C)	Sat Pressure (bar)	Sp Volume of water (m^3/Kg)	Enthalpy kJ/Kg	
			Sat Liqd.	Sat Vap
25	0.03166	43.40	62.94	25473
15	0.01703	77.98	—	—
10	0.01078	—	—	—
0	0.01002	—	—	—

Use the following expression

$$P_v = \frac{(P_{v\,Sat})t_{wbt} - (P - P_{v\,Sat})(dbt - wbt)\times 1.8}{2854 - 1.325(1.8 + dbt + 32)}$$

|8|

Unit-'V'

5. (*a*) With a neat sketch, explain the winter air conditioning system. Why a single psychrometric process cannot be applied in winter air conditioning? |6|

(*b*) A shop in a mall is to be air conditioned for sensible load of 58.15 KW and latent heat load of 14.55 KW. The inside design conditions are 25°C dbt and 50% RH. The outside design conditions are 40°C dbt and 27°C wbt. If the quantity of fresh air supplied is 70 m^3/min, find.

(i) The ventilation load

(ii) Total load to be taken by plant

(iii) Effective sensible heat factor

(iv) Apparatus dew point

(v) Dehumidified air quantity. |10|

OR

5. (*a*) Explain unitary air conditioning and list its advantages. |6|

(*b*) What are the equipments used for cooling and dehumidification in air conditioning? How the apparatus dew point and dehumidified air quantities are calculated? Explain with the help of psychrometric chart. |10|