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Total No. of Questions : 09] **[Total No. of Pages : 02**

B.Tech. (Sem. – 5th)
HEAT EXCHANGERS & AIR CONDITIONING
SUBJECT CODE : AE - 307
Paper ID : [A0716]
[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:
1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section – A ***(10 × 2 = 20)***

Q1) a) How are heat exchangers classified? Why is counter flow HX better than Parallel-flow HX?
b) What is overall heat transfer coefficient? Derive an expression for overall heat transfer for a tubular heat exchanger (HX) based on inner surface area.
c) Write a short note on correction factor chart for the cross flow heat exchanger.
d) What are the limitations of the reversed Carnot cycle if it is used for refrigeration?
e) Discuss the following refrigerants along with their name and area of applications: R-11, R-12, R-22, R-717, R-744 and R-118.
f) Compare the performance of the reciprocating and centrifugal compressors.
g) What is the necessity of the expansion valve in the refrigeration system? Explain the working of automatic expansion valve with the help of diagram.
h) Define the followings; dry bulb temperature, wet bulb temperature, dew point temperature, apparatus dew point.
i) What is by-pass factor and efficiency of the coil? How it is related to by-pass factor.
j) What is room sensible heat factor (RSHF) & grand sensible heat factor (GSHF).

Section - B

(4 × 5 = 20)

Q2) In a shell and tube heat exchanger, tubes are 4m long, 3.1 cm OD, 2.7cm ID. Water is heated from 22ºC to 45ºC by condensing steam at 100ºC on outside the tubes. Water flow rate through tubes is 10 kg/Sec. Heat transfer coefficient on steam side is 5500 W/m^2K and on the water side 850 W/m^2K. Neglecting all other resistances, find the number of tubes required. Take specific heat for water as 4.170J/kg K.

Q3) Derive an expression for the effectiveness of a parallel flow heat exchanger in the terms of NTU and capacity ratio (C).

Q4) Prove the relationship between degree of saturation and relative humidity as: $\emptyset = \mu P_t/(P_t - (1 - \mu) P_{vs})$, where $\emptyset$ is RH & μ is degree of saturation, Pt is total pressure & P_{vs} is partial vapour pressure.

Q5) 40 m^3 of air per minute at 31ºC and 18.5ºCWBT is passed over the cooling coil whose surface temperature is 4.4ºC. The coil cooling capacity is 3.56 tons under the given condition of air. Determine DBT and WBT of the air leaving the cooling coil.

Q6) Define specific speed of fan and discuss the Fan similarity laws.

Section – C ***(2 × 10 = 20)***

Q7) A shell tube heat exchanger is to be designed for heating 9000kg/hr of water from 15ºC to 85ºC by hot engine oil (Cp = 2.35 kJ/kg K) flowing through the shell of the heat exchanger. The oil makes a single pass entering at 150ºC and leaving at 95ºC with an average heat transfer coefficient of 400 W/m^2K. The water flows through 10 thin walled tubes of 25mm diameter with each tube making 8 passes through the shell. Calculate the length of the tube for the heat exchanger to accomplish the specified heating. The heat transfer coefficient water side is $300W/m^2K$.

Q8) Design the air conditioning system for a hotel when following data is available:

Total heat flow through the walls, roof and floor 21200kJ/hr. Solar heat gain through the glass 6800kJ/hr, Equipment sensible heat gain 10,000kJ/hr, Equipment latent heat gain 2400kJ/hr. Total in filtrated air 400 m^3/hr. Outdoor conditions 35ºCDBT and 26ºCWBT, Inside design conditions 27ºCDBT and 55% RH, Minimum temperature of the air supplied to the room 17ºC DBT, total amount of the fresh air supplied $1600m^3$/hr. The seating chairs for dinning 100, employees serving the meal 10. Total sensible and latent heat added because of these people is 22750kJ/hr and 10300kJ/hr. Determine the followings:

(a) Amount of the air delivered to the room in cum. Per hour
(b) Percentage of the recirculated air
(c) Refrigeration load on the cooling coil in tons of refrigeration
(d) Also find the DPT of the cooling coil and By Pass factor

Q9) What are different types of the compressors used in air conditioning system? Mention the fields for the use of each in refrigeration system giving reasons. If a two stage reciprocating compressor is used in vapour compression refrigeration system between the pressure P_1 and P_3 ($P_3 > P_1$) and if there is perfect intercooling between two stages the prove that best intermediate pressure P_2 is given by $P_2 = V\ (P_1\ P_3)$ for the minimum power consumption by the compressor.