

Printed Pages : 4



EME053

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140853

Roll No.

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B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15

DESIGN OF THERMAL SYSTEMS

Time : 3 Hours]

[Total Marks : 100

Note :- Attempt **All** Questions.

P-H Charts, Steam Table and Psychometric Charts are allowed in examination. Assume suitable data if missing.

1 Attempt any Two of following : 10×2=20

- a. 108 m³ of air per minute at 5°C DBT and 2.5°C WBT is passed through a heating coil which gives 48.85. kW energy to the air. Saturated steam at 110°C and with a rate of 48 kg/hr is mixed with the air leaving the heater. Determine the DBT and WBT of the air after mixing.
Enthalpy of saturated steam at 110°C = 2691 kJ/Kg.
- b. Derive an expression for specific humidity and show that it is function of vapour pressure and barometric pressure of air.

- c. The following data relate to a conference room for seating 80 persons.
 Inside design conditions.....22°C DBT, 55% RH
 Outside design conditions...38°C DBT ,28°C WBT
 Sensible and latent heat loads per person ...75 kW and 45 kW respectively
 Lights and fan loads.....12000 W
 Sensible heat gain through glass walls, ceiling etc.....12000W
 Air infiltration18m³/min.
 Fresh air supply.....80m³/min.
 By-pass factors of supply of the coil.....0.1
 If two-third of recirculated room air and one-third of fresh air are mixed before entering the cooling coils, determine :
- (i) Apparatus dew point,
 - (ii) Grand total heat load, and
 - (iii) Effective room sensible heat factor.

2 Attempt any Two of following : 10×2=20

- a. Following results were obtained in a test conducted on a vapour compression refrigerant :
 Evaporator temperature = -28.5°C, Condenser pressure = 2.75 bar; Refrigerant entering the condenser is 3°C superheat, Refrigerant leaving the condenser is at 12.8°C. Determine the C.O.P.,
 The following properties are given :

Pressure (bar)	Saturation Temp. (°C)	Enthalpy (kJ/kg)		Entropy Vapour (kJ/kg K)	Specific heat (kJ/kg K) At constant pressure	
		Liquid	Vapour		Liquid	Vapour
2.75	14	438.48	802.9	5.5287	1.381	0.669
0.412	-28.5	381.58	783.24	5.6852	--	--

- b. What are the desirable properties of an ideal refrigerant ?
- c. Discuss the performance characteristics of refrigerant reciprocating compressor i.e.
 - (i) Effect of suction temp.
 - (ii) Effect of condenser temp.

3 Attempt any Two of following : 10×2=20

- a. What is the principle of design of turbo machines
- b. Deduce the formulae for optimum pressure ratio during two stage compression for reciprocating compressor.
- c. What are the advantages and disadvantages of Axial flow compressor and centrifugal compressor in refrigeration machine ?

4 Attempt any two form the following : 10×2=20

- a. What is the overall heat transfer coefficient. Explain the phenomenon of rust formation and the deposition of fluid Impurities.
- b. Dry saturated steam at 10 bar enters a counter-flow heat exchanger at the rate of 15 kg/s and leaves at 300°C. The entry of gas at 600°C is with mass flow rate of 25 kg/s. If the condenser tubes are of 30 mm diameter and 3 m long, make calculations for the heating surface area and the number of tubes required. Neglect the resistance offered by the metallic tubes

Take the following properties for steam and gas :

For steam : $t_{\text{sat}} = 180^\circ\text{C}$ (at 10 bar) ; $c_{\text{ps}} = 2.7$ kJ/kgK ; $h_{\text{fs}} = 600$ W/m² -deg

For gas : $c_{\text{pg}} = 1$ kJ/kgK ; $h_{\text{fg}} = 250$ W/m² -deg.

- c. When the NTU approach is required for analysis of heat exchanger ? Derive the formulae

$$NTU = UA / C_{\min.}$$

5 Attempt any Two of following : 10×2=20

- a. What are the factors used for minimization of cost and maximization of performance for cooling tower ?
- b. Develop the computer program to design an evaporator assuming the standard design data.
- c. Write the procedure for analysis of thermal systems using FEM.
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