Sanjay Ghodawat University, Kolhapur

2020-21

Established as State Private University under Govt. of Maharashtra. Act No XL, 2017

EXM/P/09/00

Year and Program: 2020–21, B. Tech. | **School of Technology** | **Department: Mechanical Engg.**

Course Code: MET407.3 | **Course Title: Thermal System Design** | **Semester : VII**

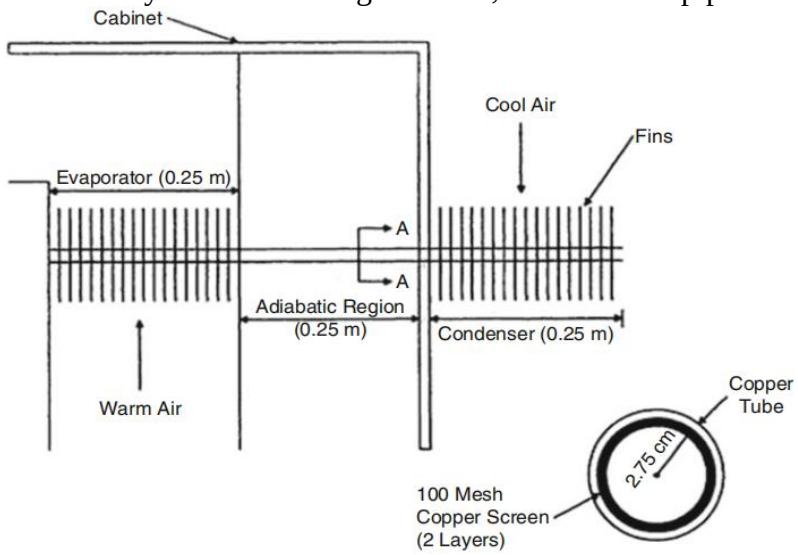
Day : Saturday | **End Semester Examination** | **Time:2 Hrs.**

Date: 26.12.2020 | **Max Marks:50**

Instructions: 1) All Questions are compulsory.
2)Assume suitable data wherever necessary, use of data tables isallowed.

Q.1 **Answer the following (any Two)**

		Marks	Bloom's Level	CO
a)	Consider a typical water cooler for drinking water. If the water intake on a summer day is at 40°C and the cooler must supply drinking water in the range of 14 to 21°C at a maximum flow rate of 1 gallon/min (3.785×10^{-3} m^3/min), give the requirements for the design. Also, choose an appropriate conceptual design and suggest the relevant design variables and constraints.	8	L3	01
b)	A simple horizontal copper–water heat pipe is to be constructed from a 1.5-cm internal diameter, 0.75-m-long tube to cool an enclosed electrical cabinet as shown in Fig. The evaporator and condenser lengths of the heat pipe are 0.25 m each, and the wicking structure consists of two layers of 100-mesh copper screen. The maximum heat transport capacity of the heat pipe is estimated to be 20 W and to occur at an adiabatic vapor temperature of 30°C. If the working fluid is water and is assumed to fully wet the wicking structure, will this heat pipe be adequate?	8	L3	02
c)	Give the application of rotating heat pipes with its working principle.	8	L2	01



Q.2 **Answer the following (any two)**

		Marks	Bloom's Level	CO
a)	Warm water at 45°C enters a cooling tower at the rate of 6 kg/s. An ID fan draws 10 m^3/s of air through the tower and absorbs 4.90 kW. The air entering the tower is at 20°C d_{bt} and 60% relative humidity. The air leaving the tower is assumed to be saturated and its temperature is 26°C. Calculate the final temperature of the water and the amount of makeup water required per second. Assume that the pressure remains constant throughout the tower at 1.013 bar.	8	L3	02
b)	In a chemical industry it is required to cool the process fluid using cooling tower, discuss the steps to follow for the design of cooling plant.	8	L2	02
c)	In an air-conditioning system, the inside and outside conditions are dry bulb	8	L3	03

temperature 25°C, relative humidity 50% and dry bulb temperature 40°C, wet bulb temperature 27°C respectively. The room sensible heat factor is 0.8. 50% of the room air is rejected to atmosphere and an equal quantity of fresh air added before air enters the air conditioning apparatus.
Assume by-pass factor as zero, density of air as 1.2 kg/m^3 at a total pressure of 1.01325 bar.If the fresh air added is 100 m^3/min, determine :
Room sensible and latent heat load;Sensible and latent heat load due to fresh air ;
Apparatus dew point; Humidity ratio and dry bulb temperature of air entering air conditioning apparatus.

Q.3 **Answer the following (any two)**

a) The following are the data collected for a boiler using furnace oil as the fuel. Find out the boiler efficiency by indirect method.

Ultimate analysis (%)

Carbon	=	84
Hydrogen	=	12
Nitrogen	=	0.5
Oxygen	=	1.5
Sulphur	=	1.5
Moisture	=	0.5
GCV of fuel	=	10000 kCal/kg
Fuel firing rate	=	2648.125 kg/hr
Surface Temperature of boiler	=	80 °C
Surface area of boiler	=	90 m^2
Humidity	=	0.025 kg/kg of dry air
Wind speed	=	3.8 m/s

Flue gas analysis (%)

Flue gas temperature	=	190°C
Ambient temperature	=	30°C
Co_2% in flue gas by volume	=	10.8
O_2% in flue gas by volume	=	7.4

9 L3 04

b) From the following data, for 50% reaction steam turbine, determine the blade height:
RPM: 440
Power developed: 5.5MW
Steam mass flow rate: 6.8kg/kW h
Stage absolute pressure: 0.90 bar
Steam dryness fraction: 0.95
Exit angles of the blades: 70^o
(Angle measured from the axial flow direction).
The outlet relative velocity of steam is 1.2 times the mean blade speed. The ratio of the rotor hub diameter to blade height is 14.5. 9 L3 05

c) List out the losses in steam turbine, explain them in brief. 9 L2 05

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