MAY 2022 - ENDSEM EXAM

B. TECH. (MECHANICAL) (SEMESTER - II)

COURSE NAME: DESIGN OF THERMAL SYSTEM

COURSE CODE: MEUA40181D

(PATTERN 2018)

Time: [1 Hr] [Max. Marks: 30]

Question No.	Question Description	Marks	CO mapped	Blooms Taxonomy Level
Q.1 a	What are the methods to augment heat transfer rate without using any auxiliary power supply?	4	4	3
Q.1 b	The engine cylinder of a motorcycle is constructed of (k= 150 w/mK) aluminium alloy and is of height H=0.3 m and outside diameter D=50 mm. Under typical operating conditions, the outer surface of the cylinder is at a temperature of 415 K and is exposed to ambient air at 305 K, with a convection coefficient of 65 W/m^2-K. Annular fins are integrally cast with the cylinder to increase heat transfer to the surroundings. Consider Ten such fins, which are of thickness t=6 mm, length L=20 mm, and equally spaced. What is the heat transfer due to the use of the fins?	6	4	5
	OR			
Q2 a	Why the fins are always attached to the outer surface of the cylinder? How it increase the heat transfer rate?	4	4	3 + 4
Q2 b	A metal rod (k= 73 W/m-deg) 2.55 cm in diameter and 9 cm long protrudes from a wall which is maintained at 250 ^{0}C. The rod is insulated at the tip and exposed to the environment of 33 ^{0}C and h= 55 W/m2-deg. Estimate fin effectiveness and temperature at the tip of the fin.	6	4	5
Q.3 a	Differentiate the manufacturing methods available for plate-fin heat exchanger.	4	5	4
Q.3 b	Air enters the core of a finned-tube heat exchanger of the type shown in the accompanying figure (σ = 0.494,D_h = 0.48 cm) at 1 atm and 30 ^{0}C. The air flows at a rate of 1555 kg/hr perpendicular to the tubes and exits with a mean temperature of 95 ^{0}C. The core is 0.4 m in length with a 0.2 m^2 frontal area. Air density at inlet = 1.177 kg/m^3, Air density at outlet = 0.954 kg/m^3, μ (kg/ms)= 1.92 x 10^{-5}, Pr=	6	5	5

	0.72, Cp= 1.005 kJ/kg K. Evaluate the average heat transfer coefficient on the airside.			
	OR			
Q.4 a	In the plate-fin type of heat exchanger what different structures of fins are used.	4	5	4
Q.4 b	Air at 1 atmosphere and 330 K flows with a velocity of u_∞ = 15 m/s across plain fins in a plate and fin heat exchanger with the following dimensions σ (Free flow area / Frontal area) = 0.52, Hydraulic diameter Dh = 0.178 cm, Friction factor f = 0.035, L/D_h = 5. Air properties at the bulk mean temperature of 330 K are. Investigate the core pressure drop in the heat exchanger (in Pa)	6	5	5
Q.5 a	Justify the statement "The performance of the Phase changer heat exchangers in terms of LMTD is independent of the direction of the fluid"	4	6	5
Q.5 b	A Shell and Tube heat exchanger act as a condenser has 80 tubes. For inline arrangement, 8 columns can be considered with 10 tubes in each column. For the Staggered arrangement, the number of columns is 11 and the number of tubes in each column is 7. Estimate the average shell side heat transfer coefficient for each of the configurations [by using Nusselt correlation]. The heat transfer coefficient of the first tube is 1625 w/m^{2}K. Also, Calculate the heat transfer coefficient of the 6th tube for an inline arrangement	6	6	5
	OR			
Q.6 a	Explain the different types of Evaporators with application.	4	6	5
Q.6 b	In a steam condenser, there are 2500 numbers of tubes with 30mm diameter. Cooling water (Cp =4.187 kJ/kg K) enters the tubes at 15°C with a mass flow rate of 2500 kg/s. The steam condenses at 65°C, and the condenser load is 180MW. The latent heat of steam is 2380kJ/kg. Assuming a counter-flow arrangement, Determine the length of the tube. The overall heat transfer coefficient is 7000 W/m^2°C.	6	6	3