Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, July 2020

Programme Name: B. Tech. APE (Gas) **Semester : IV**

Course Name : Heat Transfer **Time : 3 hr**

Course Code : CHCE 2009 **Max. Marks: 100**

Nos. of page(s) : 3

Instructions:

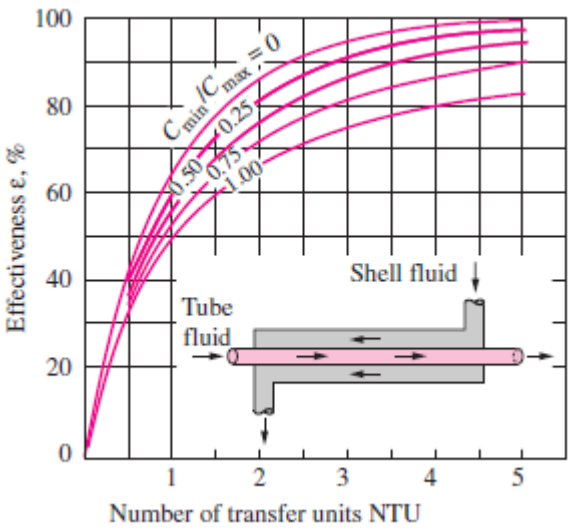
The question paper consists of one section. Answer the questions section wise in the answer booklet.

Assume suitable data wherever necessary. The notations used here have the usual meanings.

SECTION A (Attempt All Questions)

S. No.		Marks	CO
1.	Differentiate between mechanisms of heat transfer by free and forced convection. Mention some of the areas where these mechanisms are predominant. An electronic package for an experiment in outer space contains a transistor a capsule, which is approximately spherical in shape with a 2 cm diameter. It is contained in an evacuated case with nearly black walls at 30^{o}C. The only significant path for heat loss from the capsule is radiation to the case walls. If the transistor dissipates 30 mW, what will the capsule temperature be if it is (i) bright aluminum (ϵ = 0.035) and (ii) black anodized aluminum (ϵ = 0.80).	**10+10**	**CO1**
2.	Define the overall heat transfer coefficient? Obtain the expression for composite wall with three layers with convective conditions over the wall. A square plate heater (15 cm x 15 cm) is inserted between two slabs. Slab A is 2 cm thick (k = 50 W/m-^{o}C) and slab B is 1 cm thick (k = 0.2 W/m-^{o}C). The outside heat transfer coefficients on side A and side B are 200 W/m^2-K and 50 W/m^2-K respectively. The temperature of surrounding air is 25^{o}C. If rating of heater is 1 kW, find, (a) Maximum temperature in the system (b) Outer surface temperature of two slabs	**10+10**	**CO2**

3.	Derive an expression to characterize heat transport during free convection. A shell and tube steam condenser is to be constructed of 2.5 cm O.D., 2.2 cm I.D., single pass horizontal tubes with steam condensing at 54^{o}C on the outside of the tubes. The cooling water enters at 20^{o}C and leaves at 36^{o}C at a flow rate of 1 kg/sec. The heat transfer coefficient for the condensation of steam is 7900 W/m^{2}-^{o}C. Calculate the tube length. If the latent of condensation is 2454 kJ/kg, calculate the condensation rate per tube. The properties of water are as follows: Specific heat 4180 J/(kg-^{o}C) Viscosity 0.86 x 10^{-3} kg/m-sec Thermal conductivity 0.61 W/(m-^{o}C) The heat transfer coefficient for turbulent flow in a pipe may be determined by $Nu = 0.023\ Re^{0.8} Pr^{0.4}$	**10+10**	**CO3**
4.	Explain what you mean by absorptivity, reflectivity and transmissivity and derive general relation for the net radiation heat transfer between infinitely plane surfaces.	**20**	**CO4**
5.	Derive an expression for LMTD in case of a parallel flow double pipe heat exchanger. Oil (C_p = 2500 J/kg-K) is to be cooled from 110^{o}C to 30^{o}C in a single pass counter flow heat exchanger. The cooling water (C_p = 4180 J/kg-K) enters at 20^{o}C and leaves at 80^{o}C. If the water flow rate is 0.42 kg/sec, find the oil flow rate and heat exchanger area required. Take the overall heat transfer coefficient as 1500 W/m^{2}-K. If the water flow rate is decreased to 0.28 kg/sec for the same oil flow rate, find the exit temperatures of oil and water. Take the same value of the overall heat transfer coefficient. Calculate the % change in heat flow. Comment on the result.	**10+10**	**CO5**


100
80
60
40
20
0
Effectiveness ε, %
$C_{min}/C_{max} = 0$
0.25
0.50
0.75
1.00
Shell fluid
Tube fluid
1
2
3
4
5
Number of transfer units NTU