Name:

Enrolment No:

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Fluid flow and heat transfer equipment design **Semester:** I
Program: M. Tech (CE+PD) **Time 03 hrs.**
Course Code: CHPD7005 **Max. Marks: 100**

Instructions: *The question paper consists of two sections. Answer the questions section wise in the answer booklet.
Note: Assume suitable date if necessary.

SECTION A

S. No.		Marks	CO
Q 1	A 20 cm diameter pipe carrying steam is provided with 5 cm thick insulation whose thermal conductivity varies with temperature as $k(T) = 0.062\ (1 + 0.362 \times 10^{-2}\ T)$ W/m ^oC where T is in ^oC. The temperature at the pipe surface and at the outer surface of the insulation are 275^{o}C and 65^{o}C respectively. Calculate (a) the rate of heat transfer per unit meter length of the pipe, (b) the temperature at the mid thickness of the insulation, and (c) the temperature gradients at the pipe surface, the mid thickness of the insulation, and the outside surface of the insulation. Sketch the temperature profile.	**15**	**CO2**
Q 2	In the convection section of a refinery furnace, tubes are 5 in. OD on 8 $^1/_4$ in. centers, spaced on equilateral triangular pitch. The flue gases at the row of tubes under consideration are at 1500^{o}F; the tube temperature is 650^{o}F. The flue gases contain 10.84% CO_2, and·12.48% H_2O by volume; Calculate the radiant-heat transfer between the gas and tubes in terms of a coefficient which can be added to the convection-heat-transfer coefficient.	**15**	**CO5**
Q 3	Determine the pinch temperature and the minimum utility requirements for the process set out below. Take the minimum approach temperature as 15^{o}C. Devise a heat exchanger network to achieve maximum energy recovery.	**15**	**CO4**
Q 4	Discuss in detail about fluid moving machineries.	**15**	**CO1**

Stream number	Heat capacity, kW/^{o}C	Source Temp., ^{o}C	Target Temp., ^{o}C
1	13.5	180	80
2	27.0	135	45
3	53.5	60	100
	23.5	35	120

SECTION B

Q 5	175,000 lb/hr of distilled water enters an exchanger at 93°F and leaves at 85°F. The heat will be transferred to 280,000 lb/hr of raw water coming from supply at 75°F and leaving the exchanger at 80^{o}F. A 10 psi pressure drop may be expended on both streams while providing a fouling factor of 0.0005 for distilled water and 0.0015 for raw water when the tube velocity exceeds 6 fps. Available for this service is a 15 $^1/_4$ in. ID exchanger having 160 $^3/_4$ in. OD, 18 BWG tubes 16'0" long and laid out on $^{15}/_{16}$-in. triangular pitch. The bundle is arranged for two passes, and baffles are spaced 12 in. apart. Will the exchanger be suitable?	**40**	**CO3**