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UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

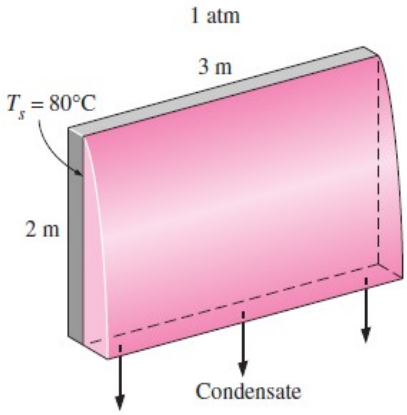
End Semester Examination, May 2018

Program: B. Tech (ET_IPR) **Semester – IV**
Subject (Course): Heat and Mass Transfer Process **Max. Marks : 100**
Course Code : GNEG 353 **Duration : 3 Hrs**
No. of page/s: 03

Instructions:

Assume suitable data if missing with proper justification

	Section-A **Answer all the questions**		
Q. No	**Question**	**Marks**	**CO**
1	A 100 mm diameter pipe carrying a hot chemical at 250°C is covered with layers of insulation, each 50mm thick. The length of the pipe is 5 m. The outer surface temperature of the composite is 35°C. The rate of heat loss through the pipe is 270 W. If the thickness of the outer insulation is increased by 25%, the heat loss is reduced to 260 W. Calculate the thermal conductivities of the two insulating materials.	12	CO1
2	Discuss overall heat transfer coefficient (U) for a parallel flow heat exchanger. Also consider fouling factor	12	CO4
3	A mixture of He and N_2 gas is contained in a pipe at 298 K and 1 atm total pressure which is constant throughout. At one end of the pipe at point 1 the partial pressure pA1 of He is 0.60 atm and at the other end 0.2m pA2 = 0.20 atm. Calculate the flux of He at steady state if DAB of the He-N_2 mixture is 0.687×10^{-4} m^2/s	12	CO5
4	Consider the 5-m × 5-m × 5-m cubical furnace, whose surfaces closely approximate black surfaces. The base, top, and side surfaces of the furnace are maintained at uniform temperatures of 800 K, 1500 K, and 500 K, respectively. Determine (*a*) the net rate of radiation heat transfer between the base and the side surfaces, (*b*) the net rate of radiation heat transfer between the base and the top surface, and (*c*) the net radiation heat transfer from the base surface Data: $F_{12} = 0.2$	12	CO3
5	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 $(1+0.362\times10^{-2}T)$ W/m ^{0}C where T is in ^{0}C. The temperatures at	12	CO1

	the pipe surface and at the outer surface of the insulation are 275^{0}C and 65^{0}C respectively. Calculate (a) the rate of heat transfer for the meter length of the pipe (b) the temperature at the mid-thickness of the insulation.		
	SECTION-B **Answer all the questions**		
6	(a) Discuss about dropwise condensation	8	CO2
	(b) Saturated steam at atmospheric pressure condenses on a 2-m-high and 3-m wide vertical plate that is maintained at 80°C by circulating cooling water through the other side. Determine (*a*) the rate of heat transfer by condensation to the plate and (*b*) the rate at which the condensate drips off the plate at the bottom.  	12	CO2
	Section-B **Answer all the questions**		
7	(a) Discuss boiling curve and boiling regims in pool boiling	8	CO2
	(b) Water is to be boiled at atmospheric pressure in a mechanically polished stainless steel pan placed on top of a heating unit. The inner surface of the bottom of the pan is maintained at 108°C. If the diameter of the bottom of the pan is 30 cm, determine (*a*) the rate of heat transfer to the water and (*b*) the rate of evaporation of water. The properties of water at the saturation temperature of 100°C are $\sigma = 0.0589$ N/m $\rho_l = 957.9$ kg/m^3 $h_{fg} = 2257.0 \times 10^3$ J/kg $Pr_l = 1.75$ $\rho_v = 0.6$ kg/m^3 $\mu_l = 0.282 \times 10^{-3}$ kg. m/s $C_{pl} = 4217$ J/kg.°C $C_{sf} = 0.0130$ $n = 1.0$	12	CO2