Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

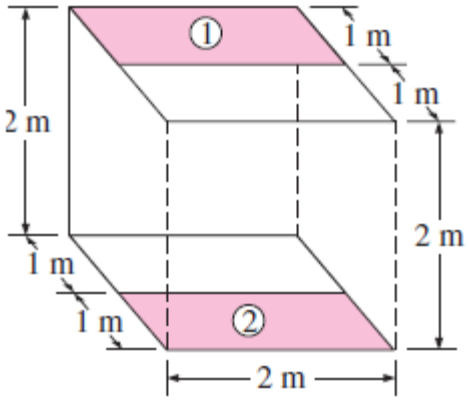
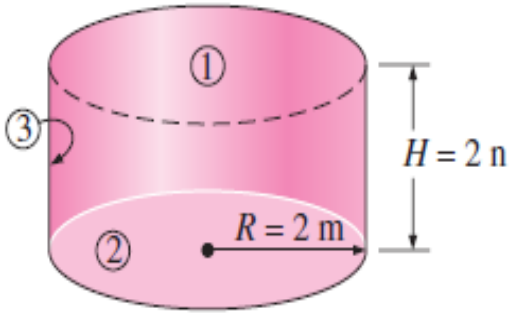
Course: B.Tech. **Semester: VI**
Program: ADE
Time: 03 hrs. **Max. Marks: 100**

Instructions:

i. ***Answer all questions in SECTION-A.***
ii. ***Section B and Section C have internal choice questions.***
iii. ***Use of HMT data book and Steam Tables allowed during the examination. Assume any missing data appropriately.***

SECTION A

S. No.		**Marks**	**CO**
Q 1	Why the analysis of critical radius of thickness is important in industrial applications. Mention three industrial applications for employment of critical thickness concepts.	**4**	**CO1**
Q 2	Discuss the significance of Prndtl number, Grashof number, Nusselt number in heat transfer and mention the characteristic lengths for different shapes.	**4**	**CO2**
Q 3	Explain the term Shape Factor and mention its properties & algebraic rules. How do you determine radiative heat transfer rate with consideration of shape factor.	**4**	**CO3**
Q 4	Explain the Effectiveness-NTU methodology for finding overall heat transfer coefficient in parallel flow and counter flow heat exchangers.	**4**	**CO4**
Q 5	Differentiate the single effect and multiple effect evaporators with neat diagrams.	**4**	**CO5**
	SECTION B		
Q 6	A 0.8 m high and 1.5 m wide glass window with a thickness of 8 mm and a thermal conductivity of 0.78 W/m^{o}C. Determine the steady rate of heat transfer through this glass window and the temperature of its inner surface for a day during which the room is maintained at 20 ^{o}C while the temperature of the outdoors is -10 ^{o}C. Take the heat transfer coefficients on the inner and outer surfaces of the window to be 10 W/m^2 ^{o}C and 40 W/m^2 ^{o}C respectively.	**10**	**CO1**

Q 7	A copper tube of 20 mm outside diameter is losing heat at a rate of 90 w/m due to convection alone to a stream of air flowing across it. If the surface temperature is 90°C and the air temperature is 30°C, determine the velocity of air.	**10**	**CO2**
Q 8	A furnace is of cylindrical shape with radius 2m and height 2m. The base, top, and side surfaces of the furnace are all black and are maintained at uniform temperatures of 500, 700, and 1200 K, respectively. Determine the net rate of radiation heat transfer to or from the top surface during steady operation with consideration of shape factors. (or) Determine the shape factor F12 for the following figures (a) and (b)  Fig. (a) Cubical section  Fig. (b) Cylindrical section	**10**	**CO3**
Q 9	A counter flow double pipe heat exchanger using superheated steam is used to heat water at the rate of 10500 kg/h. The steam enters the heat exchanger at 180 °C and leaves at 130 °C. The inlet and exit temperature of water are 30 °C and 80 °C respectively. If the overall heat transfer coefficient from steam to water is 814 W/m^{2}K, calculate the heat transfer area. What would be the increase in area if the flow were parallel?	**10**	**CO4**
	SECTION-C		
Q 10	Hydrogen at 20°C and at a pressure of 1 atm. is flowing along a flat plate at velocity of 3 m/s. If the plate is 0.3m wide and at 70°C determine the following at x = 0.3 m and at the distance corresponding to the transition point. Hydrogen properties at 1 atm. are Density = 0.07722 kg/m^3; Thermal conductivity =0.191 w/m°C; Viscosity =122.5×10^{-6} m^2/s; Pr =0.701	**20**	**CO2, CO4**

	Hydrodynamic boundary layer thickness (cm) ; Local friction coefficient; Average friction coefficient; Drag force (N); Thickness of thermal boundary layer (cm); Local convective heat transfer coefficient; Average heat transfer coefficient; Rate of heat transfer (W) (or) A heat exchanger is to be designed to condense the vapour at a rate of 8.3 kg/s which is available at its saturation temperature of 355 K. Cooling water at 286 K is available at a flow rate of 60 kg/s. U= 475 W/m2^{o}C, Latent heat of condensation of the vapor is 600 kJ/kg. Calculate (i) number of tubes required, if tubes of 25 mm outer diameter, 2mm thick and 4.8 m long available (ii) number of passes, if cooling water velocity should not exceed 2 m/s.		
Q 11	(a) A 20 cm diameter spherical ball at 800 k suspended in air. Assume ball is closely approximated as black body, determine (i) the total black body emissive power, (ii) total amount of radiation emitted by ball in 5 minutes, and (iii) spectral black body emissive power at a wave length of 3 micrometers. (b) Water is to be boiled at atmospheric pressure in a mechanically polished steel pan placed on top of a heating unit. The inner surface of the bottom of the pan is maintained at 110 ^{o}C. If the diameter of the bottom of the pan is 25 cm, determine (i) the rate of heat transfer to the water and (ii) the rate of evaporation	**20**	**CO3, CO5**