Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, January 2021

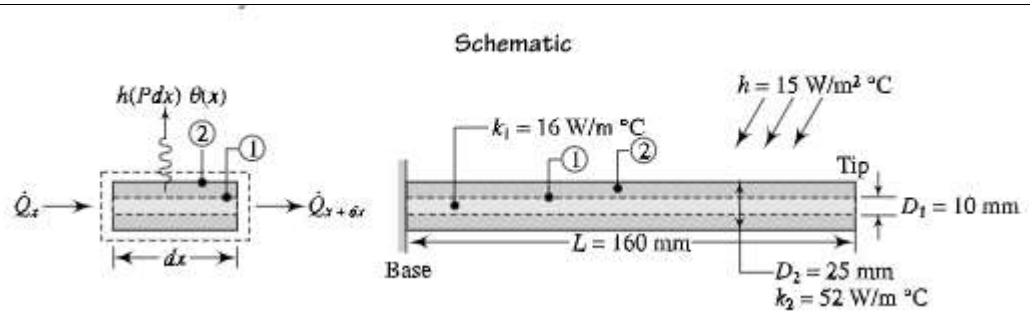
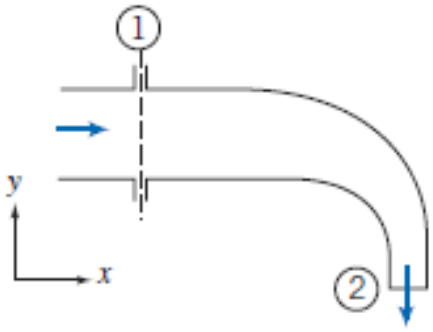
Course: Advanced Fluid Mechanics and Heat Transfer-ASEG7019 **Semester: I**
Programme: M.Tech CFD
Time: 03 hrs. **Max. Marks: 100**

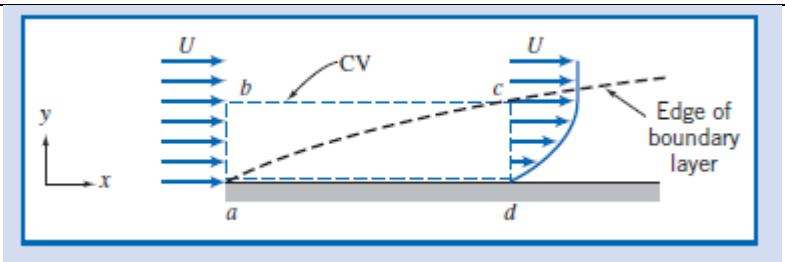
SECTION A

S. No.	This section is having Five Question and all are Compulsory to answer	Marks	CO
Q 1	Describe the physical mechanism of convection. How is the convection heat-transfer coefficient related to this mechanism.	**4**	**CO1**
Q 2	Describe body forces and surface forces, and explain how the net forces acting on a control volume is determined?	**4**	**CO2**
Q 3	Once finite-difference equations are obtained for a conduction problem, what methods are available to effect a solution? What are the advantages and disadvantages of selected method, and when would the technique be applied	**4**	**CO1**
Q 4	Explain the importance of fins and types of fins and its effectiveness based on geometry and shape.	**4**	**CO3**
Q 5	What is the Eulerian description of fluid motion? How does it differ from the Lagrangian description?	**4**	**CO1**

SECTION B

Q 6	A composite fin is made from two materials. The inner material of 10 mm diameter has a thermal conductivity of 16 W/m ^{o}C while the outer material of 25 mm outside diameter has a thermal conductivity of 52 W/m ^{o}C. The convection coefficient is 15 W/m ^{o}C and the fin length is 160 mm. Determine the fin efficiency assuming adiabatic fin tip. $m = \sqrt{\frac{hP}{k_1 A_1 + k_2 A_2}}$ $\eta_f = \frac{\tanh mL}{mL}$	**10**	**CO2**

			
Q 7	Water flows steadily through the 90^o reducing elbow shown in the diagram. At the inlet to the elbow, the absolute pressure is 220 kPa and the cross-sectional area is 0.01 m^2. At the outlet, the cross-sectional area is 0.0025 m^2 and the velocity is 16 m/s. The elbow discharges to the atmosphere. Determine the force required to hold the elbow in place. 	**10**	**CO3**
Q 8	Derive the Navier-Stokes Equations and Explain the terms in the Final set of the expression.	**10**	**CO1**
Q 9	A cylinder of 0.12 m radius rotates concentrically inside a fixed hollow cylinder of 0.13 m radius. Both the cylinders are 0.3 m long. Determine the viscosity of the liquid which fills the space between the cylinders if a torque of 0.88 Nm is required to maintain an angular velocity of 2π rad/s	**10**	**CO3**
	SECTION-C		
Q 10	The fluid in direct contact with a stationary solid boundary has zero velocity, there is no slip at the boundary. Thus the flow over a flat plate adheres to the plate surface and forms a boundary layer, as depicted below. The flow ahead of the plate is uniform with velocity V=Ui, U=30 m/s The velocity distribution within the boundary layer $(0 \leq y \leq \delta)$ along cd is approximated as $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - (\frac{y}{\delta})^2$	**20**	**CO5**

	 The boundary layer thickness at location d is δ=5 mm. The fluid is air with density ρ=1.24 kg/m^3. Assuming the plate width perpendicular to the paper to be w=0.6 m. Calculate the mass flow rate across surface bc of control volume abcd		
Q11	(a). The inside and outside surface temperatures of a glass window are 20 and 20ºC respectively. If the glass is 60 cm× 30 cm with 18 mm thickness, Determine the heat loss through the glass cover in 3 hrs. Take the thermal conductivity of the window glass as 0.78 W/m K (b). A 0.8 m high, 1.5 m wide double pane window consists of two 4 mm thick layers of glass (k=78 W/mK) and it is separated by a 10 mm wide stagnant air space (k=0.026 W/mK). The room is at 20 ºC and the outer air is at -10 ºC. The heat transfer coefficients are h_i= 10 and h_o= 40 W/m^2 K. Find the rate of heat transfer through the window, and also find the inside surface temperature	**20**	**CO4**