ME231A Quiz#4; April 20, 2017 **Total Time: 30 minutes, Total Marks: 30 points**

Roll	Name	Signature

Marks will be awarded only when the answers are correct. There will be no part marking.

For all questions, DO NOT show your calculations, write only the answer.

Q1. The flow past three bluff bodies at a particular Reynolds number has been depicted in Fig. 1 shown below.

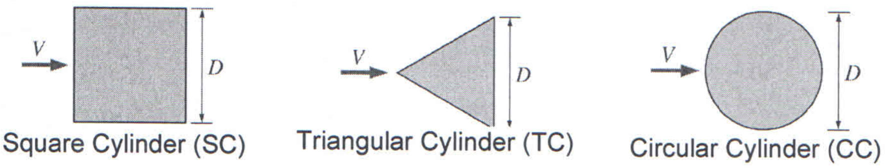


Fig. 1

(a) Arrange the above shapes (SC, TC and CC) in the increasing order of bluffness, (b) Comment (increasing/decreasing/no change of bluff bodies shown above with increasing bluffness) on the magnitudes of lift coefficient experienced by the three different objects (SC, TC and CC). **Marks 4+2**

Answer: (a) CC < TC < SC

(b) NO CHANGE

Q2. In Fig.2 the cast iron pipe entrance ($\varepsilon/D=0.005$) is sharp-edged. If the flow rate of water (density=998 kg/m^3 and viscosity is 0.001 kg/m-s, g=9.81 m/s^2) is 0.004 m^3/s, what power, in Watts, is extracted by the turbine? **Marks 9**

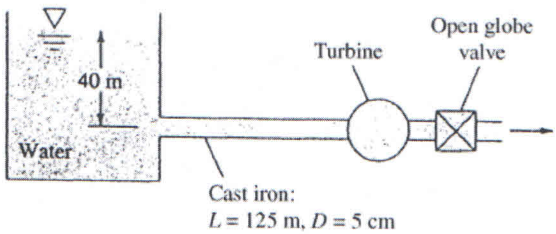


Fig. 2

K=0.5 (Entry)
K=6.9 (Open glove valve)

Answer: Power (in W) = - 832-915 W

Q3. The developing laminar flow between two parallel plates shows (Fig. 3) an accelerating core (dependent on the streamwise direction) at the central region of the channel. Write down the expression for U(x) at any streamwise location in terms of the uniform velocity at inlet U_o, half height of the channel h and displacement thickness at the same streamwise location. Also draw the qualitative distribution of wall shear stress on the developing region of the channel.

Marks 6+2

U_o

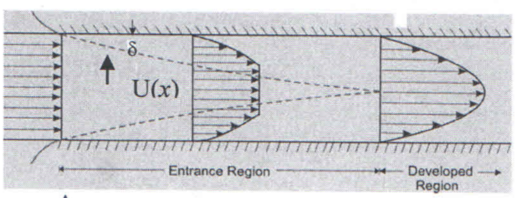
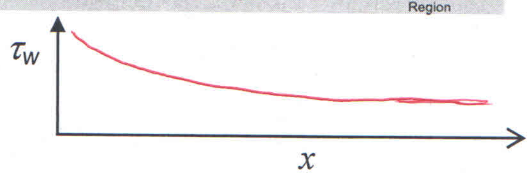


Fig. 3

Answer:



$$U(x) = \frac{U_o h}{(h-\delta^*)}$$

Q4. A 1 m diameter cylinder rotates at 1500 rpm in an air flow (potential flow, density=1.22 kg/m^3) of 20 m/s. The Magnus force (in N) acting on the cylinder per unit length (span) is

Marks 7

Answer: Force (in N) 6015 – 6025 N