Faculty of Engineering at Shubra . Mechanical Engineering Department
Fluid Dynamics 2nd- Year Power April 2010. Time 2 hours

Please attempt all questions

1)Choose the most appropriate statement for each of the following statement

a) for fully turbulent pipe flow the friction coefficient f is function of 1) Reynolds Re number only. 2) both Re and relative roughness ε/D. 3) ε/D only

b) The condition for flow separation is 1) u = 0 at the wall. 2) shear stress τ is maximum. 3) $\frac{\partial u}{\partial y} = 0$ at the wall.

c)The pressure increase due to sudden valve closure equals 1) $\rho V^2/2$ 2)$\rho V C$ 3) $2\rho VL/t_c$

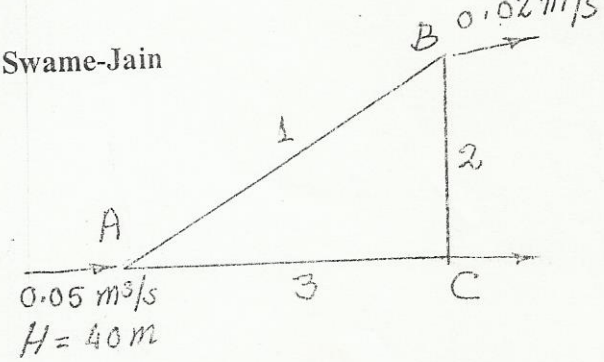
d) Valve closure is considered sudden if the closure time t_c is 1) <2L/C 2) < L/C 3) < 4L/C where L is pipe length and C is wave speed.

e) For potential flow the 1) velocity is zero. 2) vorticity is zero. 3) viscosity is constant.

f) Ideal flow around half body can be made by adding 1)source and sink. 2 Doublet and uniform flow. 3) Source and uniform flow.

2- you can use the following relation for f given by Swame-Jain

$$f = \frac{1.325}{[\ln(0.27\frac{\varepsilon}{D} + \frac{5.74}{\mathrm{Re}^{0.9}})]^2}$$



Given below the characteristics of three pipes

Pipe	Є/D	L m	D cm	∑k
1	0.002	50	20	2
2	0.002	30	20	1
3	0.002	40	20	3

If these 3 pipes make a loop as shown, use Hardy Cross method to find the discharge in each pipe and the head at B and C. Assume the flow to be fully turbulent (check later)

3) A pipe line of length 3 km and diameter 50 cm with water velocity 3 m/s. The pipe is made of steel with Young modulus of elasticity E= 2.2 X 10^{11} Pa. Water bulk modulus of elasticity K=2.2 G Pa and its kinematic viscosity ν =10^{-6} m^2/s Pipe wall thickness t=6 mm. The pipe is equipped with expansion joints throughout. Evaluate the speed of pressure wave C Find the amplitude of pressure increase if the valve is closed in 2 s.

$$C^2 = \frac{K/\rho}{1+(K/E)(D/t)}$$

4) Use Navier –Stokes equation for 2-dimensional incompressible steady developed flow between two parallel fixed plates separated by a distance b to show that:

$$u = \frac{1}{2}(\frac{dpb^2}{dx\mu})\left[(\frac{y}{b})^2 - (\frac{y}{b})\right]$$