Faculty of Civil Engineering
Department of Civil Engineering

Hydraulics and Water Resources Division

AKM 204 (CRN 21669) – Fluid Mechanics

Homework-II

Notes about submitting the homework:

- Deadline for submitting the homework : ***19.04.2016***
- The homework should be done in a format according to the engineering standards (smooth, clean and comprehensible).

Question 1. Write the Newtonian shear stress formula and explain the meaning of every term. Interpret the results of this equation for hydrostatic condition and for the flow of ideal fluids.

Question 2. Define the concepts of streamline and path line. Give explanation as to when they overlap.

Question 3. Explain the Reynold's experiment. Write the Reynold's number formula. Show whether it is dimensionally homogenous and explain the meanings of all the parameters in the equation. What is the purpose of using this number in fluid mechanics?

Question 4. Explain the concepts of laminar and turbulent flows.

Question 5. For one-dimensional (1D) laminar and turbulence flows, graph the variation of velocity components with respect to time at any point in the flow field. Show how to compute time averaged velocity with the help of instantaneous velocities.

Question 6. Derive the Euler's equation of motions.

Question 7. Drive the continuity equation for three - dimensional (3D) flow.

Question 8. Show that piezometric pressure does not change from point to point within a cross-section in pressurized flows.

Homework-II

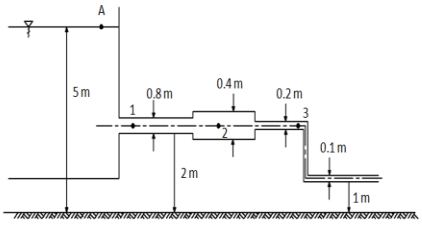
Question 9. What are venturi-meter and pitot-tube (pipe) and what are they used for? What are the operating principles of these equipments? Derive the statements of the quantities that they measure.

Question 10. What are the reasons responsible for the formation of shear stresses in laminar and turbulent flows? Explain how we can determine whether a flow is laminar or turbulent.

Question 11. For the reservoir - pipe system shown in the figure;

a- Find the fluid's pressures at Points 1, 2, 3.

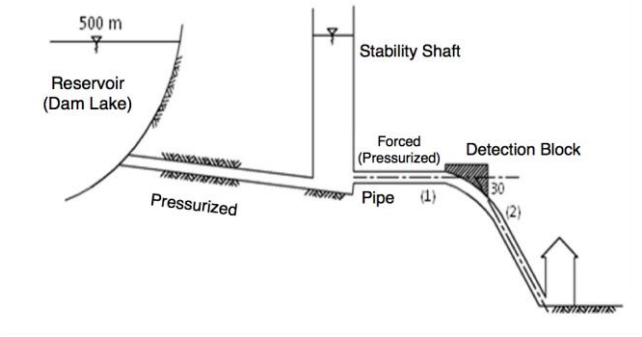
b- Draw the gage pressure and piezometric lines.



Answer: p_1=2.95 t/m^2; p_2=2.98 t/m^2; p_3=2.75 t/m^2

Question 12. A discharge Q of 10 m^3/s taken from hydroelectric plant's reservoir is delivered to the stability shaft via gallery and to a pressurized pipe. Then, it is conveyed to the power plant by the pressurized pipe to be used for producing energy. Axis of the pressurized pipe is bent 30^0 along cross-section (1) to cross-section (2). Taking the weight of the water at this section as 0.250 t, find the minimum value of the weight of the detection block that will be placed on the bending section. Given values: v_1=5 m/s, p_1=14t/m^2, z_1=10 m, D_1=1.6m, D_2=1.5 m ve z_2=8 m.

Homework-II

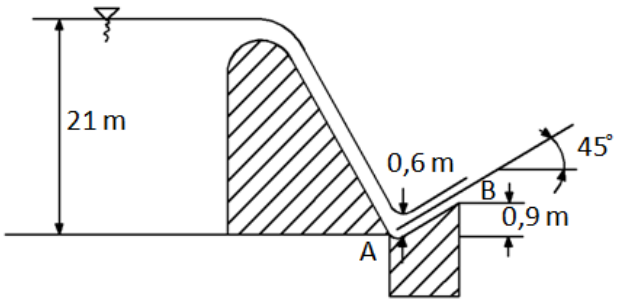


Question 13. Show that both velocity potential function and stream function satisfy Laplace's differential equation.

Question 14. Based on the drawing given below,

a- Calculate the velocities and discharges at cross-sections A and B.

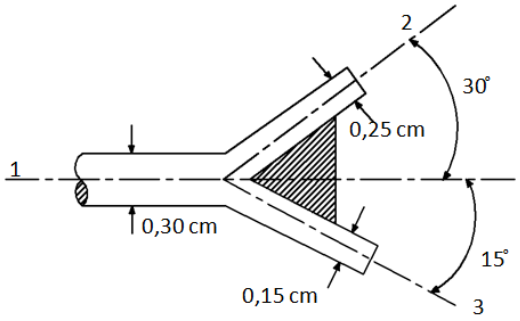
b- Find the horizontal and vertical components and the directions of the force acting on the lined obstacle. (Weight of the water between cross sections A and B is 0.27 t).



Answer: a - $v_a = v_b = 20\,m/s;\ q = 12\ m^3/s/m$ b- $R = 19.04\ t$

Question 15. When the velocities in the separated pipes of the system in the figure given below are 2.5 m/s, find the discharge on the separated pipes and the force acting on the

body at the separation point if we consider the system is positioned on the horizontal plane. Pipes 2 and 3 are opened to the atmosphere after the elbow.



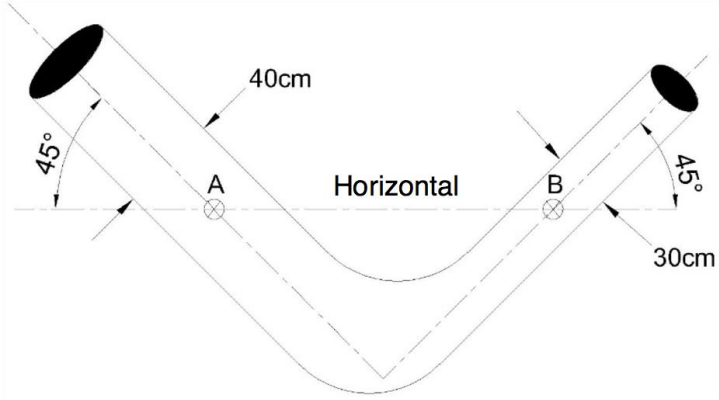
Answer: Q_2=123 lt/s; Q_3=44.2 lt/s; K=13.58 kgf

Question 16. Write down the Bernoulli's equation and explain for what type of fluids it is valid. Explain the geometric and physical interpretations of the equation and it's various parameters.

Question 17. Write the Euler's equation of motions for two-dimensional (2D) case where the body forces are only arising from gravitational acceleration and derive the hydrostatic pressure law by making use of these equations.

Question 18. For the elbow in the drawing, which is positioned on the horizontal plane, the volume of water between the cross sections A and B is 0.1 m^3. The flow's direction is from A to B. Since we know the gage pressure at point A is 10 t/m^2, find the force that occurs on the elbow for a discharge of 35 lt/sn.

Homework-II



Question 19. The water in the very wide tank shown in the figure is poured in to the atmosphere via the horizontal pipe located at the bottom of it. Find the maximum value of "h" which makes the discharge poured in to the atmosphere maximum when the fluid is ideal, incompressible and given absolute vapor pressure is 0.025 kg/cm^2. If a given value of h is greater than the maximum h value you found previously, will the discharge change or not ? Make a reasoned statement. Draw the gage energy and piezometer energy lines of the system.