BHAGWAN MAHAVIR COLLEGE OF ENGINEERING AND TECHNOLOGY

APPLIED FLUID MECHANICS (2160602)

ASSIGNMENT 1:- FLOW THROUGH PIPES

1). Explain the terms:

(i) Hydraulic grade line

(ii) Total energy line

(iii) Equivalent pipe

2). Derive an expression for loss of head due to sudden contraction.

3). Water is flowing through a pipe 1200 m long and 0.9 m diameter with a velocity 1 m/s. Find the head loss due to friction by :

(i) Darcy's formula with f =0.005

(ii) Chezy's formula with C = 64.

4). A pipe 60 mm diameter is 8 m long and the velocity of flow of water is 2.5 m/sec. What loss of head and the corresponding power would be saved if the central 2 m length of pipe is replaced by 80 mm diameter pipe, the change of section being sudden? Take friction factor f = 0.04 for both the pipes.

5). Two tanks having difference in water level equal to 12m are connected by a series of pipes of length 300m , 170mand 210 and of diameters 300mm, 200mm, and 400mm respectively. If the coefficient of friction are 0.005, 0.0052, and 0.0048 respectively, find the rate of flow.

(i) Considering minor losses

(ii) Neglecting minor losses

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ASSIGNMENT 2:- BEHAVIOR OF REAL FLUIDS

1). Explain Euler's equation of motion for three dimensional flow. State its applications.

2). Explain the force acting in moving fluid.

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ASSIGNMENT 3:- STEADY VISCOUS FLOW

1). Prove that the loss of pressure head for viscous flow through a pipe gives by

$$h_f = \frac{32\ \mu VL}{\gamma d^2}$$

where, μ = dynamic viscosity of the fluid

V = mean velocity

L = Length of pipe

d = Pipe diameter

γ = Unit weight of fluid

2). Derive an equation for velocity distribution in viscous flow between two parallel plates.

3). Describe Reynold's experiment.

4). An oil of viscosity 0.1 N.s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 liters/s. Find the pressure drop in a length of 300 m and shear stress at the pipe wall.

5). For laminar flow an oil having dynamic viscosity 1.766 N.s/m^2 in a pipe of 3 cm diameter , the maximum velocity is 3 m/s at the centre of the pipe. Calculate the shearing stresses at the pipe wall and within 50 mm from the pipe wall.

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ASSIGNMENT 4 :- TURBULENT FLOW IN PIPES

1). Explain hydro dynamically smooth and rough pipes.

2). Explain Prandtl's mixing length theory.

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ASSIGNMENT 5 :- UNSTEADY FLOW IN PIPES

1). Define : Gradual closure of valve.

2). The water is flowing with a velocity 2.0 m/s in a pipe of length 3 km and diameter 500 mm. the valve at the end of pipe is closed in 25 second. If velocity of pressure wave is 1400 m/s, Find the rise in pressure.

3). A steel pipe 3.5 km long, 80 cm internal diameter and 1 cm wall thickness conveys water at the rate of 1.75 m^3/s. Determine the increase in pressure when the valve at the downstream end of the pipe is closed suddenly. Consider pipe to be elastic and bulk modulus of water $K = 2 \times 10$ N/m^2, $E = 2 \times 10$ N/m^2 . Also calculate longitudinal and circumferential stresses.

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ASSIGNMENT 6 :- BOUNDARY LAYER

1). Explain the concept of laminar and turbulent boundary layer growth over a flat plate.

What is boundary layer separation ?

2). Define :

(i) Displacement thickness

(ii) Energy thickness

3). Discuss the phenomenon of boundary layer separation.

4). How separation of boundary layer separation can be controlled ?

5). Air is flowing over a flat plate of length 1.2 m and width 0.8 m at a velocity of 10 m/s. Assuming that laminar boundary layer exist up to a Reynolds number 2×10^5, determine

(i) The maximum distance from the leading edge upto which laminar boundary layer exists.

(ii) Maximum thickness of laminar boundary layer . Take kinematic viscosity of air = 0.15 stokes. The velocity profile for laminar boundary layer is given by $\frac{u}{U}=2(\frac{y}{\delta})^2-(\frac{y}{\delta})^2$

6). Examine the following velocity profile to state if the flow is attached or separated.

(i) $\frac{u}{U}= -2(\frac{y}{\delta}) +(\frac{y}{\delta})^2$

(ii) $\frac{u}{U}=2(\frac{y}{\delta})^2+(\frac{y}{\delta})^3 - 2(\frac{y}{\delta})$

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ASSIGNMENT 7 :- OPEN CHANNEL FLOW

1). Describe the specific energy curve with sketch.

2). Explain the term :

(i) Uniform flow

(ii) Supercritical flow

(iii) Rapidly varied flow

(iv) Gradually varied flow

3). Derive the geometrical condition for the most economical section of a trapezoidal channel.

4). Classify open channel flow and explain each in brief.

5). Find the discharge and best economic section for a rectangular channel having a cross section of 4.5 m^2 . The bed slope is 1 in 900. Take N = 0.03

6). A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and bed slope 1 in 1500. The area of the section is 40 m^2 . determine the dimension of the most economic section and discharge through the channel . Take C = 50

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ASSIGNMENT 8 :- NON-UNIFORM FLOE IN CHANNEL

1). Derive differential equation of gradually varied flow with assumption made in it.

2). Classify different type of hydraulic jumps as per USBR.

3). What is hydraulic jump ? How it is formed ? Give used of hydraulic jump.

4). Determine the slope of water surface at a point in a rectangular channel in which discharge is 0.84 cumec. The bed width of channel is 3 m, depth of flow is 0.75 m and bed slope is 0.15 m per km, Take C = 55.

5). A sluice gate discharge water into a horizontal rectangular channel with a velocity of 8 m/s and depth of water is 0.5 m. The width of channel is 5 m. Determine whether a hydraulic jump will occur, and if so, Find its height and corresponding energy loss.

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ASSIGNMENT 9:- TURBO MECHINRY

1) Differentiate between impulse turbine and reaction turbine. Explain significance of specific speed.
2) What is draft tube? Why it is required in case of a reaction turbine?
3) Draw a general layout of hydro electric power plant and describe its element.
4) Explain various efficiencies of hydraulic turbine.
5) A Pelton Wheel is to be designed for the following Specification:
   Shaft power=6000 kW
   Net head=300m
   Speed=550 rpm
   Jet diameter = $\frac{1}{10}$ of wheel diameter
   Overall efficiently = 85%

   Deter mine (i) diameter of wheel (ii) diameter of jet (iii)Quantity of water required (iv) Number of jets

6) A conical draft tube of 5 m length has a diameter of 2.0 m at its top. Water discharge through it with flow at rate 25 m^3/s and 1.2 m/s velocity at the outlet. The pressure head at the top is 7.0 m of water (vacuum) and atmospheric pressure equal 10.3 m of water. Calculate the length of draft tube immersed in water. Neglect is friction loss.

7). A Hydraulic turbine is to operate under a head of 25 m at 200 rpm. The Discharge is 9 m^3/s and efficiency of turbine is 90%. Determine (i) power generated (ii) specific speed (iii) type of turbine

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ASSIGNMENT 10 :- CENTRIFUGAL PUMPS

1). Derive an equation of specific speed of centrifugal pump.

2). Explain cavitations in turbines and centrifugal pump and write the effects.

3).Explain main parts of a centrifugal pump with a neat sketch. Discuss effects of cavitations on the Performance of pumps.

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ASSIGNMENT 11 :- DIMENSIONAL ANALYSIS AND SIMILITUDE

1). Explain Buckingham π - theorem method.

2). What is meant by dimensional analysis ? What are its limitations and advantages ?

3). What is undistorted and distorted model ? What are the advent ages of using distorted model?

4). Explain different type of hydraulic similarity that must exist between a prototype and its model.

5). A partially submerged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ Of water , length l of the body, velocity v of the body and the acceleration due to gravity g. Show that the resistance to the motion can be expressed in the form,

$$R = \rho L^2 V^2 \phi\left[\frac{\mu}{\rho VL} , \frac{lg}{V^2}\right]$$

Use Rayleigh's method

6). Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]}$ where H is the head causing flow, D is the diameter of the orifice, μ is dynamic viscosity , ρ is the mass density of fluid and g is the acceleration due to gravity.