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Code No: A109210105 **R09** **Set No. 2**

II B.Tech I Semester Examinations,MAY 2011
FLUID MECHANICS
Civil Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 litres/s.
   (b) Water is flowing through a horizontal pipe of diameter 200 mm at a velocity of 3 m/s. A circular solid plate of diameter 150 mm is placed in the pipe to obstruct the flow. Find the loss of head due to obstruction in the pipe if $C_c = 0.62$. [7+8]

2. Find the displacement thickness, momentum thickness and energy thickness for the Velocity distribution in the boundary layer given by $u/U = y/\delta$ where u is the velocity at a distance y from the plate and u=U at $y=\delta$, where δ= boundary layer thickness. [15]

3. (a) Calculate the velocity at the point (5,5) for the following stream functions:
   i. ψ = -x ln xy + x
   ii. $\psi = 1/2(3y^2-4x^2)+xy+6$
   (b) Write short notes on:
   i. Path line, streak line and stream tube
   ii. Stream function, velocity potential function and flow nets. [7+8]

4. Two parallel plates kept 75 mm apart have laminar flow of glycerine between them with a maximum velocity of 1 m/s. Calculate the discharge per metre width, the shear stress at the plates, the difference in pressure between two points 25 m apart, the velocity gradients at the plates and velocity at 15 mm from the plate. Take μ of glycerine as 8.35 poise. [15]

5. (a) A fireman holds a water hose ending into a nozzle that issues a 25mm diameter jet of water. If the pressure of water in the 60mm diameter hose is 750kPa, find the force experienced by the fireman.
   (b) Derive Euler's equation of motion along a stream line. [10+5]

6. (a) The pressure inside a droplet of water is $0.04N/cm^2$ greater than the atmospheric pressure. Calculate the diameter of the droplet. Take surface tension (water with air) = 81N/m.
   (b) A velocity profile of a flowing fluid over a flat plate is parabolic and given by $u = ay^2+by+c$ where a, b and c are constants. The velocity of fluid is 1.4m/s at 15cm from the plate. The plate is the vertex point of the velocity

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distribution. Find out the velocity gradients and shear stresses at y = 0, 8 and 18 cm respectively. [4+11]

7. (a) A suppressed rectangular weir is constructed across a channel of 0.77 m width with a head of 0.39 m and the crest 0.6 m above the bed of the channel. Estimate the discharge over it. Consider velocity of approach and assume C_d = 0.623.

   (b) A sharp crested rectangular weir of 1 m height extends across a rectangular channel of 3 m width. If the head of water over the weir is 0.45 m, calculate the discharge, Consider velocity of approach and assume C_d = 0.623. [7+8]

8. A rectangular lamina 3m×1m is held in water at a depth of 1.5m below the free water surface:

   (a) If the 3m height is vertical, determine the total pressure force on the lamina and depth of centre of pressure.

   (b) If 1m side lies in the vertical plane at the same depth, then find out the change in total pressure force acting and depth of centre of pressure.

   (c) Another circular lamina having same area of rectangle is also kept at 1.5m below the free water surface. Find the total pressure force acting on the circular lamina and centre of pressure. [15]

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Code No: A109210105 **R09** **Set No. 4**

II B.Tech I Semester Examinations,MAY 2011
FLUID MECHANICS
Civil Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1. A discharge of 2000 m^3/s is to pass over a rectangular weir. The weir is divided into a number of openings each of span 10 m. If the velocity of approach is 4 m/s, find the number of openings needed in order that the head of water over the crest is not to exceed 2 m. [15]

2. Find the total pressure and depth of centre of pressure on a triangular plate of base 3m and height 3m which is immersed inwater such that plane of the plate makes an angle of 60^0 with the free surface. The base of the plate is parallel to water surface and at a depth of 2m from water surface. [15]

3. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head, determine the rate of flow. Take f = 0.1 for both sections of the pipe. [15]

4. (a) Explain the terms:
   i. path line
   ii. streak line
   iii. stream line and
   iv. stream tube.

   (b) A fluid flow field is given by $V = x^2y^3i+y^2zj-(2xyz+yz^2)k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity at the point (2,3,7). [7+8]

5. Obtain an expression for the boundary shear stress in terms of momentum thickness. [15]

6. (a) State the assumptions involved in Bernoulli's energy theorem. Write any four limitations of the theorem.

   (b) The diameter of a pipe changes from 220mm at a section 6m above datum to 95mm at a section 2.5m above datum. The pressure of water at first section is 400 kPa. If the velocity of flow at the first section is 2m/s, determine the intensity of pressure at the second section. [7+8]

7. Lubricating oil of specific gravity 0.82 and dynamic viscosity 12.066×10^2 N.s/m^2 is pumped at a rate of 0.02 m^3/s through a 0.15 m diameter 300m long pipe. Calculate

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the pressure drop, average shear stress at the wall of the pipe and the power required to maintain flow, if the pipe is inclined at 15 degree with the horizontal and the flow is in downward direction. [15]

8. A hydraulic lift consists of a 25cm diameter ram which slides in a 25.015cm diameter cylinder, the annular space being filled with oil having a kinetic viscosity of 0.025 cm^2/sec and specific gravity of 0.85. If the rate of travel of the ram is 9.15m/min, find the fractional resistance when 0.3m of the ram is engaged. [15]

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Code No: A109210105 **R09** **Set No. 1**

II B.Tech I Semester Examinations,MAY 2011
FLUID MECHANICS
Civil Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principles and state the assumptions made for such a derivation. [15]

2. Show that ψ=x^2-y^2 represents on two dimentional irrotational flow. Find the potential function [15]

3. Find the thickness of the boundary layer at the trailing edge of smooth plate of length 4m and of width 1.5m, when the plate is moving with a velocity of 4m/s in stationary air. Take kinematic viscosity of air as 1.5×10^{-5} m^2/s. [15]

4. (a) A piston 886mm diameter and 250mm long works in a cylinder of 900mm diameter. If the annular space is filled with a lubricating oil of viscosity 6 poise, calculate the speed of descent of piston in vertical position. The weight of piston and axial load are 11.8N.
   (b) Explain the phenomenon of vapour pressure. [10+5]

5. The friction factor for turbulent flow through rough pipes can be determined by Karman- Prandtl equation, $1/\sqrt{f} = 2 \log_{10} (R_0/k) + 1.74$ where f= friction factor, R_0 = pipe radius, k = average roughness.
   Two reservoirs with a surface level difference of 20 metres are to be connected by 1 metre diameter pipe 6 km long. What will be the discharge when a cast iron pipe of roughness k = 0.3 mm is used ? what will be the percentage increase in the discharge if the cast iron pipe is replaced by a steel pipe of roughness k = 0.1 mm? Neglect all local losses. [15]

6. (a) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid.
   (b) Find the total pressure and position of centre of pressure on a triangular plate of base 2.4m and height 3.6m which is immersed in water in such a way that the plan of the plate makes an angle of 60^0 with the free surface of the water. The base of the plate is parallel to water surface and is at a depth of 3.0m from water surface. [7+8]

7. Lubricating oil of specific gravity 0.82 and dynamic viscosity 12.066×10^2 $N.s/m^2$ is pumped at a rate of 0.02 m^3/s through a 0.15 m diameter 300m long pipe. Calculate the pressure drop, average shear stress at the wall of the pipe and the power required to maintain flow, if the pipe is inclined at 15 degree with the horizontal and the flow is in upward direction. [15]

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8. (a) Find the throat diameter of a venturimeter, when fitted to a horizontal main 10 cm diameter having a discharges of 20 liters per second. Pressure gauges inserted at the entrance and throat indicate pressures 158 kPa and 82 kPa respectively. Take $C_d = 0.95$.

   (b) If instead of pressure gauges, the entrance and throat of the meter are connected to the two limbs of a U-tube mercury manometer, determine its reading in cm of differential mercury column.

   (c) In case the venturimeter is located in a vertical pipe, with water flowing upwards, find the difference in the readings of the mercury manometer. Throat section is 20 cm above the entrance section of the venturimeter. Further, dimensions of pipe and venturimeter remain unaltered, as well as the discharge through the pipe. [6+5+4]

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Code No: A109210105 **R09** **Set No. 3**

II B.Tech I Semester Examinations,MAY 2011
FLUID MECHANICS
Civil Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Compare the advantages of using venturimetrs and orifice meters in fluid flow measurements.
   (b) A venturimeter of throat diameter 6 cm has a discharge coefficient of 0.97, and with a flow of 0.025 m^3/s, the pressure differential is 10 N/m^2. Make calculations for the flow rate, when an orifice of 6 cm is installed in the same pipe. The discharge coefficient for the orifice is 0.62 and the pressure differential is the same. [7+8]

2. Derive the equation to find velocity at a particular point from the centre of an inclined pipe through which a laminar flow is there. [15]

3. An U-tube differntial manometerwas used to connnect two pressure pipes P and Q as shown in figure 3. The pipe 'P' contains a liquid having specific gravity of 1.8 under a pressure of 95 KN/m^2. The pipe 'Q' contains another liquid having specific gravity 0.9 under a pressure of 180 kN/m^2. Find the difference of pressure if mercury is used as a U-tube liquid. [15]

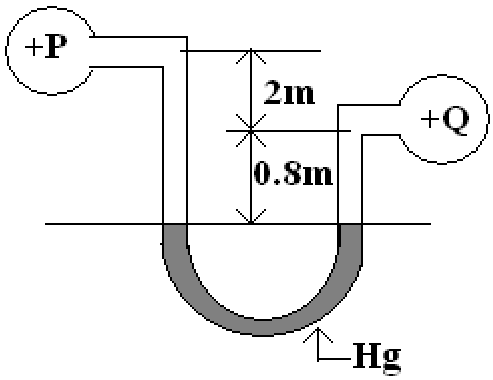

Figure 3

4. (a) A pipe line AB of diameter 300 mm and of length 400 m carries water at the rate of 50 litres/s. The flow takes place from A to B where point B is 30 metres above A. Find the pressure at A if the pressure at B is 19.62 N/cm^2 Take f = 0.008.
   (b) Water is flowing through a horizontal pipe of diameter 250 mm at a velocity of 4 m/s. A circular solid plate of diameter 170 mm is placed in the pipe to obstruct the flow. Find the loss of head due to obstruction in the pipe if C_c = 0.63. [7+8]

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5. (a) The stream function in a two dimensional flow is ψ = 3x-2y+5xy. Verify whether the flow is irrotational. Determine the direction of stream line at a point (1,-2). Determine also the expression for the velocity potential.

   (b) What do you mean by flow net? Cite any two examples where the flow net is utilized as a tool in analyzing flow problems. Also show that the stream lines and equipotential lines form a net of mutually perpendicular lines. [7+8]

6. A trapezoidal plate of parallel sides 'l' and '2l' and height 'h' is immersed vertically in water with its side of length 'l' horizontal and topmost. The top edge is at a depth 'h' below the water surface. Determine:

   (a) Total force on one side of the plate

   (b) Location of the centre of pressure. [15]

7. A smooth flat plate of length 5 m and width 2 m is moving with a velocity of 4 m/s in stationary air of density as 1.25 kg/m^3 and kinematic viscosity 1.5×10^{-5} m^2/s. Determine thickness of the boundary layer at the trailing edge of the smooth plate. Find the total drag on one side of the plate assuming that the boundary layer is turbulent from the very beginning. [15]

8. In a 45^0 bend a rectangular air duct of 1m^2 cross sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of force required to hold the duct in position, if the velocity of flow at 1 m^2 section is 10m/sec and pressure is 30 kN/m^2. Assume specific weight of air as 0.0118 kN/m^3. [15]

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