Code No: R050210104 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the phenomena surface Tension and capillarity. [4+4]
   (b) Two coaxial cylinders 12cm and 11.80cm in diameter and 3.5cm high have both their ends open and have a viscous liquid filled in between. A torque of 1.3N.m is produced on the inner cylinder when the outer one rotates at 80RPM. Determine the coefficient of viscosity of the liquid. [8]

2. (a) What do you mean by Hydrostatic pressure.
   (b) Define Total pressure and centre of pressure
   (c) A circular plate 2.5m in diameter is submerged in water as shown in figure 2c. Its greatest and least depths below free surface of water are 3m and 2m respectively. Find
      i. Total pressure on front face of the plate and
      ii. the position of centre of pressure [3+4+9]

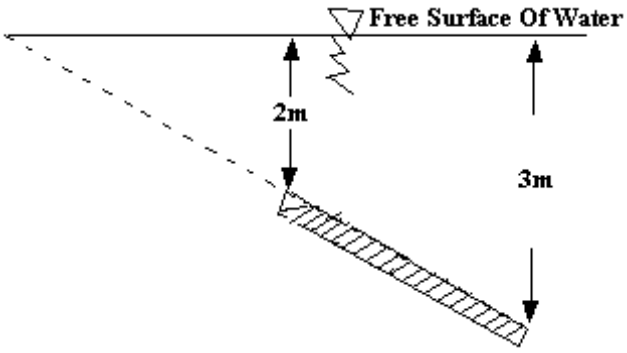

Figure 2c

3. (a) Identify the common features and differences between stream and velocity potential factions
   (b) Examine whether the velocity field, $U = 2ax(3y^2 - x^2)$ and V = 2ay $(3x^2 - y^2)$ represents a possible two dimensional incompressible fluid flow. [8+8]

4. (a) State and derive Bernoullis theorem, mentioning clearly the assumptions underlying it.
   (b) A 45^0reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 40 cm and 20 cm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet of bend is $21.58N/cm^2$. The rate of flow of water is 500 lit/ sec. [8+8]

5. (a) Explain how laminar and turbulent boundary layers are formed and distinguish between their characteristics.

   (b) A thin flat plate measuring 75 cm × 25 cm is exposed parallel to a stream of water of uniform velocity 1.2 m/sec. The flow takes place parallel to 25 cm side of the plate. If the kinematic viscosity of water is 1.1 centistokes, determine the maximum boundary layer thickness, shearing stress at the trailing edge and the drag an both sides of the plate. [8+8]

6. (a) Draw a neat sketch of Reynolds apparatus and explain how the laminar flow can be demonstrated with the help of the apparatus.

   (b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/sec. Calculate discharge per metre width, shear stress at the plates and the difference in pressure between two points 20m apart. Assume viscosity of oil to be 24.5 poise. [8+8]

7. (a) What do you mean by compound pipe and pipes in parallel connection. What purpose is served by using pipes in parallel connection.

   (b) What do you mean by equivalent pipe.

   (c) Water flows through a pipe at the rate of 1.1 m^3/sec. For certain length of the pipe, the diameter is 200 mm and for remaining length of the pipe diameter is 400 mm. Pressure of water at the larger diameter part is 1 Mpa. Determine head lost due to sudden enlargement of cross sectional area and the pressure of water in the smaller diameter part of the pipe. [4+3+9]

8. (a) What is meant by an orifice. Give the complete classification of orifices.

   (b) What is vena contract. Explain.

   (c) Water issues from an orifice 80 mm diameter under a head of 10m. Determine the velocity of the jet of water and discharge through the orifice. Also calculate coefficient of contraction. Take $C_d = 0.6$ and $C_V = 0.9$. [6+2+8]

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Code No: R050210104 **Set No. 2**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Distinguish between
   i. Ideal and Read Fluids
   ii. Newtonian and Non- Newtonian Fluids
   iii. Gases and Vapours.
   iv. Adhesion and cohesion
   (b) The velocity distribution in a fluid is give by u = 40000 y (1-2y) where u is the velocity in m/sec at a distance of y meters normal to the boundary. If the dynamic viscosity of fluid is 1.8×10^{-4} poise, determine the shear stress at y = 0.2m. [8+8]

2. (a) What do you mean by Hydrostatic pressure.
   (b) Define Total pressure and centre of pressure
   (c) A circular plate 2.5m in diameter is submerged in water as shown in figure 2c. Its greatest and least depths below free surface of water are 3m and 2m respectively. Find
   i. Total pressure on front face of the plate and
   ii. the position of centre of pressure [3+4+9]

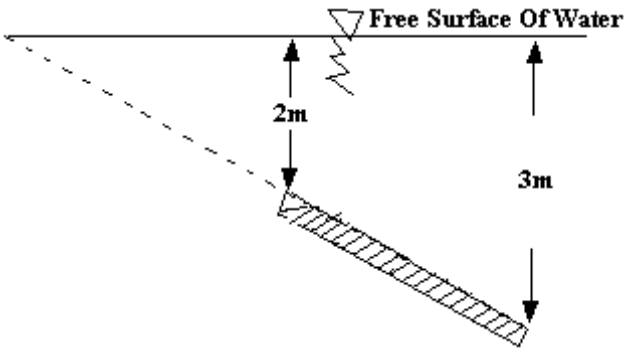

Figure 2c

3. (a) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow.
   (b) If stream function exists in a flow problem does it imply that velocity potential also exists. Explain.
   (c) The flow field of a fluid is given by $V = xyi + 2yzj - (yz + z^2)K$
   i. Show that it represents a possible three dimensional steady incompressible continuous flow.

ii. Is this flow rotational or irrotational ?. If rotational, determine at point A (2,4,6). [3+4+9]

4. (a) State and derive impulse momentum equation. What are the applications of impulse momentum equation.

   (b) A pipe line 0.6 cm diameter conveying oil (specific granity 0.85) at the flow rate of 1800 lit/sec has a 90^0 bend in the horizontal plane. The pressure at the entrance to the bend is $147.15 KN/m^2$ and loss of head in the bend is 2m of oil. Find the magnitude and direction of the force exerted by the oil on the bend. [8+8]

5. (a) Distinguish between
   i. Bluff bodies and stream lined bodies
   ii. Skin friction Drag and form Drag
   iii. Profile Drag and deformation Drag
   iv. Circulation and lift.

   (b) Calculate Reynolds number and the over turning moment (assuming the drag to be acting at mid height) at the base of a smoke chimney of height 25m and diameter 1.5m in a gale of speed of 200 kmph. $C_D = 0.34$ specific weight of air $=11.8 N/m^3$ and viscosity of air is 0.00018 poise. [8+8]

6. (a) Derive Hagen poiseuille equation and state the assumptions made.

   (b) A fluid of viscosity 0.5 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 10 cm. The maximum shear stress at the pipe wall is given as 147.15 N/m^2 Find pressure gradient, average velocity and Reynolds number of the flow. [8+8]

7. (a) Explain how the following flow problems are analyzed.
   i. Series pipe connection
   ii. parallel pipe connection and
   iii. Equivalent pipe connection.

   (b) Water flows through a 10cm diameter, 30m long pipe at a rate of 1400 lpm. What percent of head would be gained by replacing the central one third length of pipe by another pipe of 20cm diameter. Assume that the changes in section are abrupt and f = 0.008 for all pipes. Neglect entrance and exit losses but consider major loss and losses due to sudden contraction and sudden expansion. [9+7]

8. (a) Explain the principal and working of venturimeter with the help of a neat sketch.

   (b) Water flows through a horizontal venturimeter of inlet diameter 15 cm and inlet pressure 215 kpa (absolute). Find the minimum throat diameter for the meter to pass a discharge of 150 lps without causing cavitations. Assume saturation vapour pressure of water = -80 kpa (gange). Assume atmospheric pressure = 76cm of mercury and Cd of the meter is 0.978. [8+8]

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Code No: R050210104 **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Define vapour pressure, capillarity, compressibility and surface Tension. Also explain the practical significance of them.
   (b) Derive an expression for the capillary rise of a liquid having surface tension σ and contact angle θ between two vertical parallel plates a distance ?d? apart. If the plates are of glass, what will be the capillary rise of water having σ=0.073 N/m =0^0. Take d=1mm [8+8]

2. (a) Find the total pressure and depth of centre of pressure on a triangular plate of base 3m and height 3m which is immersed in water such that plan of the plate makes an angle of 600 with the free surface. The base of the plate is parallel to water surface and at a depth of 2m from water surface.
   (b) Determine the magnitude and direction of the resultant force acting on the radial gate of radius 4m if its length is 4m as shown in figure 2b. [8+8]

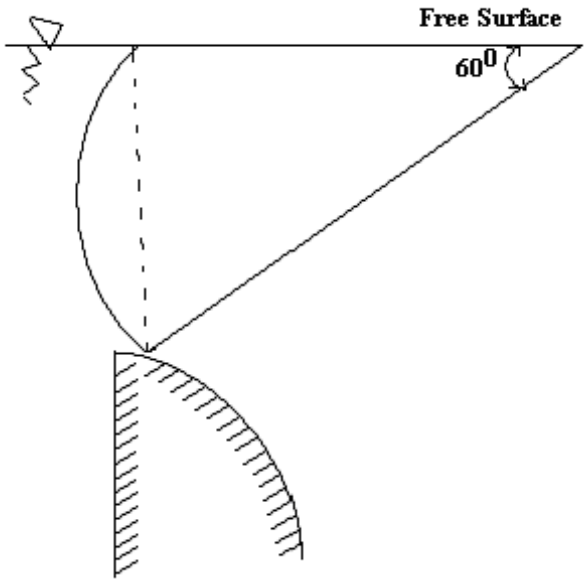

Figure 2b

3. (a) Describe briefly different methods of drawing flow nets.
   (b) The velocity vector in an incompressible flow is given by $V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)K$
      i. Verify whether the continuity equation is satisfied
      ii. Determine the acceleration vector at point A (1,1,1) at t = 1.0 [8+8]

4. (a) What is a flow net. Draw a typical flow net and explain its applications. What are the limitations of flow nets.

   (b) A pipe 50 cm in diameter branches into two pipes of diameters 25 cm and 20 cm respectively as shown in figure 4. It the average velocity in 50 cm diameter pipe is 4m/sec find

      i. Discharge through 50 cm diameter pipe and

      ii. velocity in 20 cm diameter pipe if the average velocity in 25 cm pipe is 3 m/sec

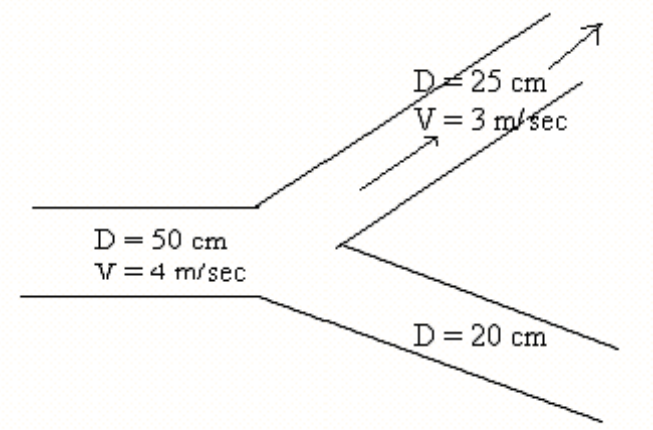

Figure 4

5. (a) Explain why the boundary shear stress in a turbulent boundary layer is more than in a laminar boundary layer for the same Reynolds number.

   (b) Explain clearly the concepts of displacement and momentum thickness of a boundary layer.

   (c) A thin plate is moving in still atmospheric air at a velocity of 4 m/ sec. The length of plate is 0.5 m and width 0.4m calculate

      i. thickness of boundary layer at the end of the plate and

      ii. drag force on one side of the plate. Take density of air as $12.5kg/m^3$ and kinematics viscosity as 0.15 stokes. [4+3+9]

6. (a) Draw a neat sketch of Reynolds apparatus and explain how the laminar flow can be demonstrated with the help of the apparatus.

   (b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/sec. Calculate discharge per metre width, shear stress at the plates and the difference in pressure between two points 20m apart. Assume viscosity of oil to be 24.5 poise. [8+8]

7. (a) Explain how the following flow problems are analyzed.

      i. Series pipe connection

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(b) Water flows through a 10cm diameter, 30m long pipe at a rate of 1400 lpm. What percent of head would be gained by replacing the central one third length of pipe by another pipe of 20cm diameter. Assume that the changes in section are abrupt and f = 0.008 for all pipes. Neglect entrance and exit losses but consider major loss and losses due to sudden contraction and sudden expansion. [9+7]

8. (a) Explain the principal and working of venturimeter with the help of a neat sketch.

(b) Water flows through a horizontal venturimeter of inlet diameter 15 cm and inlet pressure 215 kpa (absolute). Find the minimum throat diameter for the meter to pass a discharge of 150 lps without causing cavitations. Assume saturation vapour pressure of water = -80 kpa (gange). Assume atmospheric pressure = 76cm of mercury and Cd of the meter is 0.978. [8+8]

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Code No: R050210104 **Set No. 4**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Distinguish between
   i. Specific weight and specific volume
   ii. Density and Relative Density
   iii. Adhesion and cohesion
   iv. Dynamic and Kinematic viscosities
   (b) An object having an area of $1.2m^2$ is sliding down an inclined plane at 40^0 to the horizontal with a velocity of 0.42m/sec. There is a thin film of fluid 2.2 mm thick between the sliding object and the plane. If the weight of the object is given by 320 N, find the viscosity of the fluid. [8+8]

2. (a) What do you mean by Hydrostatic pressure.
   (b) Define Total pressure and centre of pressure
   (c) A circular plate 2.5m in diameter is submerged in water as shown in figure 2c. Its greatest and least depths below free surface of water are 3m and 2m respectively. Find
   i. Total pressure on front face of the plate and
   ii. the position of centre of pressure [3+4+9]

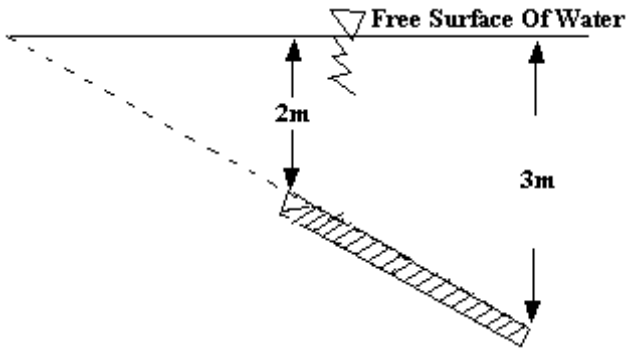

Figure 2c

3. (a) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow.
   (b) If stream function exists in a flow problem does it imply that velocity potential also exists. Explain.
   (c) The flow field of a fluid is given by $V = xyi + 2yzj - (yz + z^2)K$
   i. Show that it represents a possible three dimensional steady incompressible continuous flow.

ii. Is this flow rotational or irrotational ?. If rotational, determine at point A (2,4,6). [3+4+9]

4. (a) Define potential head, velocity head and datum head.
   (b) List out the assumptions and limitations of Bernoulli?s equation.
   (c) 360 liters per second of water is flowing in a pipe. The pipe is bent by 120^0 The diameters at the inlet and outlet of the bend being 360 mm 240 mm respectively and volume of the bend is $0.14m^3$. The pressure at the entrance is $72KN/m^2$ and the exit is 2.4m above the entrance section. [3+3+10]

5. (a) Distinguish between
      i. Bluff bodies and stream lined bodies
      ii. Skin friction Drag and form Drag
      iii. Profile Drag and deformation Drag
      iv. Circulation and lift.
   (b) Calculate Reynolds number and the over turning moment (assuming the drag to be acting at mid height) at the base of a smoke chimney of height 25m and diameter 1.5m in a gale of speed of 200 kmph. $C_D = 0.34$ specific weight of air $=11.8N/m^3$ and viscosity of air is 0.00018 poise. [8+8]

6. (a) Derive the expressions for discharge per unit width and shear stress for flow of viscous fluid between two parallel plates when one plate is moving and other at rest.
   (b) Two parallel plates kept 75 mm apart have laminar flow of glycerin between them with a maximum velocity of 1 m/sec. Calculate the difference in pressure between two points 25 m apart and the velocity gradients at the plates and velocity at 15 mm from the plate. Take viscosity of glycerine as 8.35 poise. [8+8]

7. (a) What do you mean by compound pipe and pipes in parallel connection. What purpose is served by using pipes in parallel connection.
   (b) What do you mean by equivalent pipe.
   (c) Water flows through a pipe at the rate of 1.1 m^3/sec. For certain length of the pipe, the diameter is 200 mm and for remaining length of the pipe diameter is 400 mm. Pressure of water at the larger diameter part is 1 Mpa. Determine head lost due to sudden enlargement of cross sectional area and the pressure of water in the smaller diameter part of the pipe. [4+3+9]

8. (a) Define coefficient of discharge, coefficient of contraction and coefficient of velocity. What is the relation among them.
   (b) Derive the formula for velocity of flow through an orifice.
   (c) A 4cm diameter orifice in the vertical side of a tank discharges water. The water surface in the tank is at a constant level of 2m above the center of the orifice. If the head loss in the orifice is 0.2 m and the coefficient of contraction can be assumed to be 0.63 estimate

i. the values of the coefficient of velocity and coefficient of discharge
ii. the discharge through orifice and
iii. location of point of impact of the jet on a horizontal plane located 0.5 m below the center of orifice. [6+4+6]

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