Code No: RR210106 **Set No. 1**

II B.Tech I Semester Supplementary 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. The shaft of a thrust bearing of diameter D rotates at N R.P.M. The clearance between its base and the pad on which it rests is dy and is filled with an oil of viscosity μ. Derive an expression for the power required to overcome the friction of the bearing. [16]

2. (a) An isosceles triangular lamina of base 5 m and height 7.5 m is immersed vertically in water with its base horizontal and the apex above the base. If the center of pressure is 6 m below the water surface, find the depth to the base of the lamina. Also find the total force exerted by water on one side of the lamina.

   (b) A horizontal rectangular tunnel 2.5 m wide and 6 m high and running full with water is to be closed by a vertical gate of the same size. If the pressure at the bottom of the gate is 147.15 kPa, what is the total thrust on the gate and where does it act. [8+8]

3. In a circular pipe the velocity varies as $v = v_m \left(1 - \frac{r^2}{R^2}\right)$ where v is the velocity at a radial distance r from the axis of the pipe and V_m is the maximum flow at the axis. Find the ratio of average velocity in the pipe to maximum velocity. [16]

4. (a) State Impulse-momentum equation. Give practical examples where this equation can be applied.

   (b) A pipe of 30 cm diameter conveying 0.20 cumecs of water has a 900 bend in horizontal plane. The pressures at inlet and outlet of the bend are 30 N/cm^2 and $0.28 N/cm^2$ respectively. Find the force on the bend. [8+8]

5. (a) Differentiate between

      i. Stream line body and bluff body

      ii. Friction drag and pressure drag.

   (b) A kite 60cm x 60cm weighing 2.943 N assumes an angle of 10^o to the horizontal. If the pull on the string is 29.43N when the wind is flowing at a speed of 40 km/hr. Find the corresponding coefficient of drag and lift. Density of air is given as 1.25 kg/m^3. [8+8]

6. (a) Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. Also prove that maximum velocity is equal to half the average velocity.

(b) Water is flowing between two large parallel plates which are 2mm apart. Determine maximum velocity, the pressure drop per unit length and shear stress at walls of the plate if the average velocity is 0.4 m/sec. Take viscosity of water as 0.01 poise. [8+8]

7. If two pipes of diameter D and d and equal length L are arranged in parallel the loss of head for a flow of Q is h. If the same pipes are arranged in series the loss of head for the same flow Q is H. If d= 0.5D find the percentage of total flow through each pipe when placed in parallel and the ratio (H/h). Neglect minor losses and assume‘ f ’ to be constant. [16]

8. (a) Show that a capolletti weir can be treated as equivalent to suppressed rectangular weir.

   (b) Water flows through a rectangular channel 1m wide and 0.5 m deep and then over a sharp crested Cipolletti weir of crest length 0.6 m. If the water level in the channel is 0.225 m above the weir crest find the discharge over the weir, if velocity of approach is neglected and find the discharge if it is considered. Take $c_d = 0.6$. [8+8]

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Code No: RR210106 **Set No. 2**

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FLUID MECHANICS
(Civil Engineering)

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

Answer any FIVE Questions
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1. A plate having an area of $0.6m^2$ is sliding down the inclined plane at 30^0 to the horizontal with a velocity of 0.36 ms^{-1}. There is a cushion of fluid 1.8 mm thick between the plane and the plate. Find the viscosity of the fluid if the weight of the plate is 280N. [16]

2. A rectangular door 1.8 m high and 0.9 m wide closes an opening in the vertical side of a tank which retains water on one side of it up to a depth of 1.8 m above the top edge of the door, the door is supported by two hinges placed 10 cm from the top and 10 cm from the bottom of one of the vertical sides and it is fastened by a bolt fixed at the centre of the other vertical side. Determine the force on each bolt and on the hinge. [16]

3. In a circular pipe the velocity varies as $v = v_m \left(1 - \frac{r^2}{R^2}\right)$ where v is the velocity at a radial distance r from the axis of the pipe and V_m is the maximum flow at the axis. Find the ratio of average velocity in the pipe to maximum velocity. [16]

4. (a) A turbine is set 40 m below the water level of a reservoir and is fed by 60 cm diameter pipe. If short pipe of 45 cm diameter discharges water from the turbine to atmosphere, neglecting friction, estimate the power extracted by the turbine when the discharge is 0.8 m^3/s.
   (b) Describe that each term in the Bernouli?s equation represents the energy per unit weight. [8+8]

5. (a) What are the boundary conditions that must be satisfied by a given velocity profile in laminar boundary layer flows. Also explain why boundary layer increase with distance from the upstream edge.
   (b) A smooth flat plate of length 5m and width 2m is moving with a velocity of 4m/sec in stationary air of density as 1.25 kg/m^3 and kinematic viscosity 1.5 x $10^{-5}m^2$/sec. 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. [8+8]

6. (a) What is Hagen poiseuille?s equation. Derive the same for Laminar flow through pipes.
   (b) What power is required per kilometer of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of diameter 10cm at the rate of 10 lit/sec. Take viscosity as 8 poise and kinematic viscosity as 6 stokes. [8+8]

7. If two pipes of diameter D and d and equal length L are arranged in parallel the loss of head for a flow of Q is h. If the same pipes are arranged in series the loss of head for the same flow Q is H. If d= 0.5D find the percentage of total flow through each pipe when placed in parallel and the ratio (H/h). Neglect minor losses and assume‘ f ’ to be constant. [16]

8. A flow from a channel is controlled by a trapezoidal notch so that the full supply discharge of $2m^3/s$ flows over the notch at a head of 1.2m measured over the crest. At half of this head, a discharge of $0.6m^3/s$ passes over the notch. Assuming C_d=0.62, calculate the base width and side slopes of the notch. [16]

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Code No: RR210106 **Set No. 3**

II B.Tech I Semester Supplementary 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) A liquid at 20^0C has a relative density of 0.80 and a kinematic viscosity of 2.3 centi-stokes. Determine its dynamic viscosity and specific weight.
   (b) The velocity distribution in a Viscous flow over a plate is given by u = 4y - y^2 for y <= 2 m where, u is the velocity in m/sec at a point, which is at a distance of y m from the plate. Plot the velocity distribution. If the viscosity is 15 poise, determine the shear stress at y=0 and y=2m. [8+8]

2. A vertical gate of width 2.0 m and height 2.5 m controls a sluice opening in a dam. The top of the gate is 10 m below the water surface. If the gate weighs 80 kN, find the vertical force required to raise the gate. The coefficient of friction between the gate and the guides can be assumed to be 0.25. Neglect buoyancy effect on the gate. [16]

3. (a) What is a potential flow?
   (b) Write down the continuity equation for a unidimensional unsteady state incompressible flow.
   (c) The stream function for fluid flow is given by Ψ= m $\tan^{-1}$(y/x). Sketch the streamlines and equipotential lines. [4+4+8]

4. (a) A tank has a nozzle of exit diameter D_1 at a depth H_1 below the free surface. At the side opposite to that of nozzle 1, another nozzle is proposed at a depth $H_1/2$. What should be the diameter of the second nozzle D_2, interms of D_1 so that the net horizontal force on the tank is zero?
   (b) In a pump the suction and delivery pipes are of the same size and are at the same level. At a given discharge the loss of head between a point A on the suction side and a point B on the delivery side is 3.0 m. If the pressure at point B is 120 KPa and the head developed by the pump is 10 m, find the pressure at point A. [8+8]

5. (a) Differentiate between
      i. Stream line body and bluff body
      ii. Friction drag and pressure drag.
   (b) A kite 60cm x 60cm weighing 2.943 N assumes an angle of 10^o to the horizontal. If the pull on the string is 29.43N when the wind is flowing at a speed of 40 km/hr. Find the corresponding coefficient of drag and lift. Density of air is given as 1.25 kg/m^3. [8+8]

6. (a) Describe Reynold's experiment with a neat sketch. What are the outcomes of Reynolds experiment.

   (b) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 10cm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. [8+8]

7. Two reservoirs are connected by three pipes laid in parallel, their diameters are d, 2d and 3d respectively, and they are of the same length. Assuming f to be the same for all pipes, find the discharge through each of the larger pipes and also the total discharge in 3 pipes if the smallest pipe is discharging 1 cumec. [16]

8. (a) What will be the ratio of the area of the supply pipe to the area of the nozzle for maximum transmission of power through nozzle.

   (b) A nozzle is fitted at the end of a pipe of length 300 m and of diameter 10 cm . For the maximum transmission of power through the nozzle, find the diameter of nozzle. Take f= 0.009. [8+8]

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Code No: RR210106 **Set No. 4**

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

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

Answer any FIVE Questions
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1. (a) Explain briefly the following: Surface tension, Compressibility
   (b) Calculate the gauge pressure and absolute pressure with in
      i. a droplet of water 0.4cm in diameter and
      ii. A jet of water 0.4 cm in diameter. Assume the surface tension of water as 0.073 N/m and the atmospheric pressure as 101.3 KN/m^2. [8+8]

2. An inverted differential manometer is connected to two pipes A and B carrying water under pressure as shown in figure2. The fluid in the manometer is oil of relative density 0.75. Determine the pressure difference between A and B. [16]

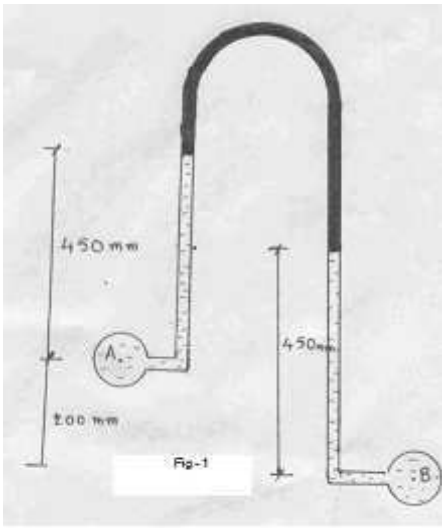

Figure 2

3. (a) The velocity of a 3-D flow field is given by V = $(y^2+z^2)i + (x^2+z^2)j + (x^2+y^2)k$ Determine the acceleration components at a point (1,2,3)
   (b) Derive the continuity equation for a 3-D fluid flow. [8+8]

4. (a) A tank has a nozzle of exit diameter D_1 at a depth H_1 below the free surface. At the side opposite to that of nozzle 1, another nozzle is proposed at a depth $H_1/2$. What should be the diameter of the second nozzle D_2, interms of D_1 so that the net horizontal force on the tank is zero?
   (b) In a pump the suction and delivery pipes are of the same size and are at the same level. At a given discharge the loss of head between a point A on the suction side and a point B on the delivery side is 3.0 m. If the pressure at point B is 120 KPa and the head developed by the pump is 10 m, find the pressure at point A. [8+8]

5. (a) Differentiate between
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6. (a) Describe Reynold's experiment with a neat sketch. What are the outcomes of Reynolds experiment.
   (b) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 10cm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. [8+8]

7. The population of a city is $8X10^5$ and it is to be supplied with water from a reservoir 6.4 km away. Water is to be supplied at the rate of $0.14m^3$ per head per day and half the supply is to be delivered in 8 hours. The full supply level of the reservoir is R.L 180.00. and its lowest water level is R.L.105.00. The delivery end of the main is at R.L 22.50 and the head required there is 12m. Find the diameter of the pipe. Take f= 0.04. [16]

8. A venturimeter having inlet diameter 100 mm and throat diameter 25 mm is fitted in a vertical pipe, throat is 0.3 m below the inlet, for measuring the flow of petrol of specific gravity 0.78. Pressure gauges are fitted at inlet and throat. Taking loss of head between inlet and throat as 36 times the velocity head at inlet, find c_d of the meter and the discharge when the inlet gauge reads 274.68 KN/m^2. [16]

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