Sem-V / mech / 10-12-10 / Fluid mechanics.

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6202–10. **(REVISED COURSE)** **GT–6636**

(3 Hours) **[Total Marks : 100**

N. B. : 1. Q.No.1 is compulsory.

2. Answer any 4 of the remaining questions

3. Assume suitable data, if necessary

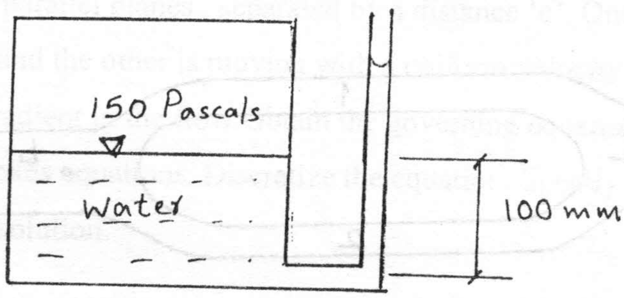
Q.No.1

1. A 150mm diameter pipe reduces in diameter abruptly to 100 mm. If the pipe carries water at 30 litres/sec calculate the pressure loss across the contraction and express this as a percentage of the pressure loss to be expected if the flow were reversed. Take the coefficient of contraction as 0.6. (5)

2. Show that the two-dimensional flow described by the equation $\psi = x + 2x^2 - 2y^2$ is irrotational. What is the velocity potential of the flow? If the density of the fluid is 1.12 kg/m^3 and the pressure at a point (1, -2) is 4.8 KPa what is the pressure at the point (9,6)? (5)

3. What is the difference between a structured grid and an unstructured grid in CFD?What is meant by grid skewness, aspect ratio and grid independence? (5)

4. The glass tube shown below is used to measure the pressure of water in the tank. The tube diameter is 1mm and the surface tension coefficient $\sigma = 0.0712$ N/m for the interface. After correcting for surface tension what is the true water height in the tube? What percentage error is made if no correction is computed? (5)



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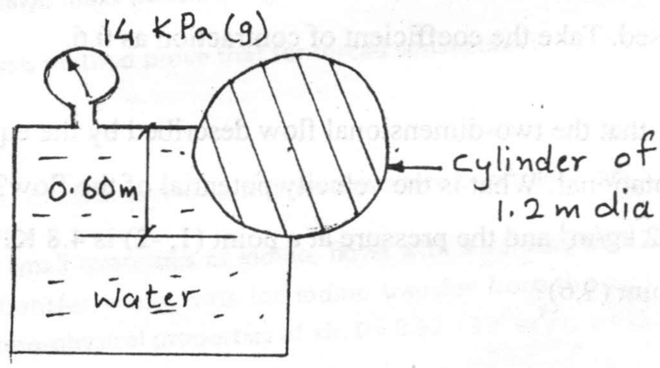
Q.No.2

1. In an infinite two-dimensional flow field a sink of strength -3 m^3/s per metre is located at the origin and another of strength - 4m^3/s per metre is located at (2 m ,0). What is the magnitude and direction of the velocity at (0, 2 m)? Where is the stagnation point? (10)

2. A tank is under pressure as shown in the diagram below. It is 1.2 m long and filled with water. The cylinder is kept in position by applying a force . What should be the horizontal and vertical component of this force? Neglect the weight of the cylinder (10)



Q.No.3

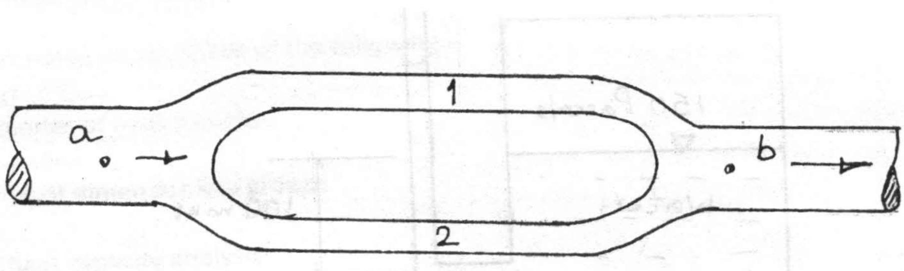
1. In the piping network shown below, find the diameters d_1 and d_2 if the flow rate through pipe 1 is twice the flowrate through pipe 2. The data is as follows:

P_a = 1.5 Kgf/ cm^2 P_b = 0.8 Kgf/ cm^2

Qa = 2000 litres per minute

d_a = 100mm d_b = 75 mm

$L_1 = L_2$ = 100m ; $f_1 = f_2$ = 0.02 , where L and f are the lengths and the friction factor respectively (10)



2. A venturimeter is installed in a vertical pipeline. The inlet diameter is 300 mm and the throat diameter is 150 mm. The flow is downwards and the throat is 0.6m below the inlet. The pressure gauges at the inlet and throat read 207 kPa and 138 kPa respectively. Calculate the flowrate if C_d for the venturi is 0.98. What is the head loss between the inlet and the throat? (10)

Q.No.4

1. The velocity profile within a turbulent boundary layer is given as :

$$U / U\alpha = (y / \delta)^{1/7}$$

Calculate the following (in terms of Re no.):

(a) Displacement thickness at the trailing end of a plate of length L

(b) Drag coefficient at the trailing end

(c) Drag force over the entire plate

Where U is the velocity at a height 'y' above the surface and the free stream velocity is Uα and δ is the boundary layer thickness (14)

2. How far below the oil surface should a vertical square , 1.22m on a side with two sides horizontal be immersed so that the centre of pressure is 76 mm below the centre of gravity? What will be the total force on the square? Specific gravity of oil is 0.85. (6)

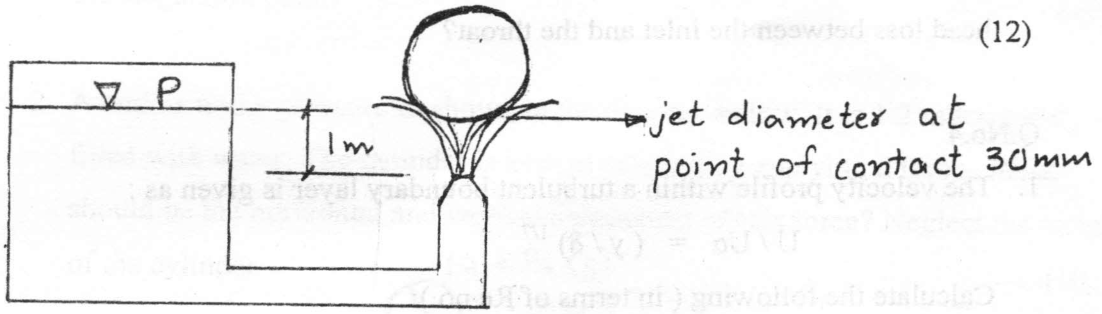
Q.No. 5

1. Consider a two dimensional viscous incompressible flow of a Newtonian fluid between 2 parallel planes , separated by a distance 'c'. One of the plates is stationary and the other is moving with a uniform velocity V. There is no pressure gradient in the flow.Obtain the governing equations from the general Navier- Stokes equations. Discretize the equation. Specify the boundary condition for a CFD solution. (12)

2. Derive the differential form of the general mass conservation equation for a fluid. (8)

Q.No.6

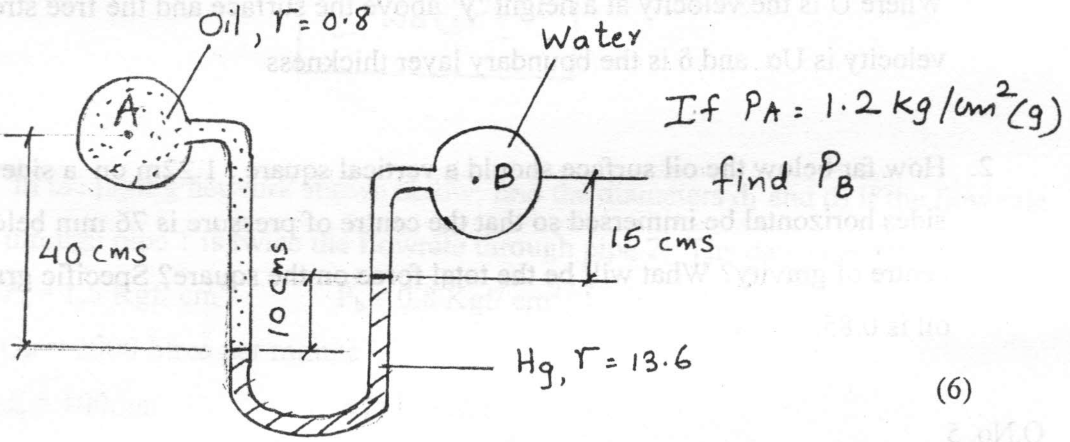
1. Find the pressure P on the surface of water if the mass of the ball is 5 Kgs. The ball is balanced by the jet of water issuing out of a nozzle of 20 mm diameter. The diameter of the pipe is 50 mm and the flow is assumed frictionless. Solve by defining appropriate control volumes and using the Reynold's Transport theorem. (12)



2. Discuss the phenomenon of boundary layer separation? Distinguish between skin friction drag and form drag? Give examples of how boundary layer separation is controlled? (8)

Q.No.7

1.



(6)

2. Glycerine having a sp.gravity of 1.26 and viscosity of 0.9 Pa s is pumped at 20 lit/s through a straight , 100 mm diameter pipe, 45 m long. The gauge pressure at the inlet end of the pipe is 590 kPa. Verify that the flow is laminar and find the pressure at the outlet end of the pipe and the shear stress at the wall. (10)

3. Convert the following: (4)

(i) -200 mm of Hg into kPa absolute

(ii) 125990 Pascal (absolute) into metres of oil column gauge. Sp.gr. of oil is 0.8.