Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–III • EXAMINATION – WINTER 2013

Subject Code: X 31901 Date: 18-12-2013

Subject Name: Fluid Mechanics

Time: 10.30 am - 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Discuss with the help of a neat sketch Reynold's experiment. **04**

(b) State the applications and limitations of Dimensional Analysis **04**

(c) Discuss the propagation of pressure disturbances in a compressible fluid for sub-sonic, sonic and supersonic flows. Hence explain Mach cone, Mach angle and Mach line. **06**

Q.2 **(a)** A conical pipe diverges uniformly from 100 mm to 200 mm in diameter over a length of 1 m. Determine the local and convective acceleration at the center of the pipe for the case **07**

(i) The rate of fluid flow is 0.15 m^3/sec

(ii) The Flow rate doubles in a time of 5 sec. calculate the acceleration at t = 2 seconds.

(b) The friction factor for turbulent flow through pipe can be determined by the Kaman – Prandtl equation $\frac{1}{\sqrt{f}} = 2\log_{10}(R_O / K) + 1.74$. Where, f is the friction factor, R_O is the pipe radius and K is the average roughness of pipe. **07**

If two reservoirs that are 6 km apart are connected by a pipe line diameter 1m, experience a head loss of 20 m calculate the discharge through a cast iron pipe of average roughness 0.1mm. Calculate the corresponding loss in hydraulic power.

OR

(b) (i) State few engineering problems where the compressibility factor has to be considered for fluids. **02**

(ii) Derive an expression to determine the velocity of sound in a compressible fluid media. **05**

Q.3 **(a)** What do you understand by (i) Ideal and real fluid (ii) Hydrostatic paradox (iii) continuum in a fluid flow. **04**

(b) A wooden block of width 150 mm, depth 300 mm and length 1500 mm as shown in figure 1 floats horizontally in sea water. The density of the wooden material is 700 kg/m^3 and density of sea water is 1020 kg/m^3. Comment on the stability of the object. **10**

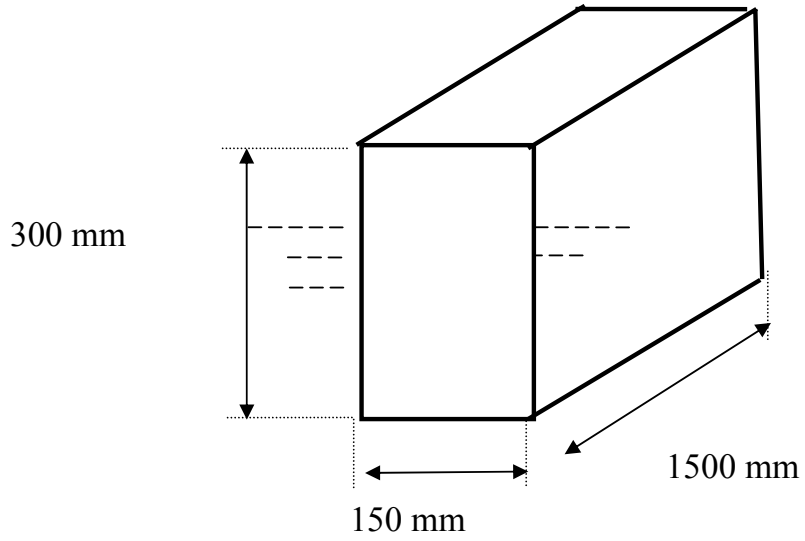

Figure 1

OR

Q.3 **(a)** Prove that in a 2-D fluid flow the stream lines are always perpendicular to Equipotential lines. **07**

(b) A rectangular plate of 2m length and 1m height as shown in figure 2 is immersed vertically in oil of Specific gravity 0.75 at the depth of 1m from the free surface. A square hole of 0.5m is cut through the centre of the plate. Determine the total pressure exerted by liquid on the plate and the depth of centre of pressure. **07**

Q.4 **(a)** With the help of a neat sketch explain the method to determine the viscosity of a liquid using Rotating cylinder method. **05**

(b) A Horizontal venturimeter is used measuring a maximum Flow rate of 486 m^3 / hr. The diameter of pipe where it is to be fitted is 200 mm. The pressure head is 7.6 m of the flowing fluid. Determine the least diameter of the throat to ensure pressure remains equal to atmospheric pressure. Consider coefficient of discharge as 0.96. **09**

OR

Q.4 **(a)** A shaft of 100 mm diameter rotates at 60 RPM in a 200 mm long Journal bearing. The radial distance between the bearing and the shaft is 0.5 mm. Assuming a linear velocity distribution calculate the power absorbed in the bearing. The Dynamic viscosity of lubricating oil is 0.04 poise. **06**

Q.4 **(b)** Using the dimensional analysis technique derive an equation for the thrust developed by a propeller. The thrust produced P depends on Angular velocity ω, Speed of advance V The diameter of propeller D, dynamic viscosity μ, Mass density ρ, and the elasticity of the fluid medium which can be denoted by the velocity of the sound C. **08**

Q.5 **(a)** State and Prove Pascal's Law. **06**

(b) Prove that in a compressible flow $\frac{dA}{A} = \frac{dV}{V}(M^2 - 1)$, where A is the area of flow, V is the velocity of flow and M is the Mach number **08**

OR

Q.5 **(a)** A clean tube of diameter 2.5 mm is immersed in a liquid with a surface tension of 0.4 N/m. The angle of contact of liquid with glass is 135^{o}. The density of liquid is 13600 kg/m^3. Comment on the level of liquid inside the tube. **03**

(b) Discuss the various types of fluid flow. **04**

(c) Derive the relationship for Shear stress and Pressure gradient in a laminar flow and hence prove that the pressure gradient in the direction of flow is equal to the shear gradient in the direction normal to the direction of flow. **07**

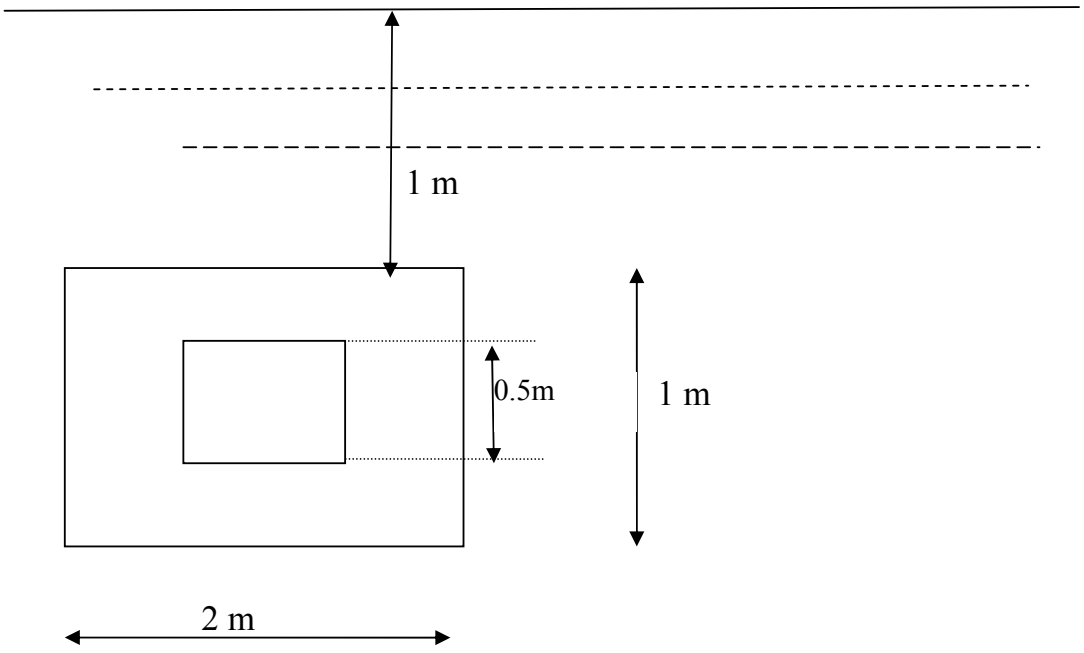

Figure 2

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