Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III • EXAMINATION – WINTER 2013

Subject Code: 130101 **Date: 30-11-2013**

Subject Name: Fluid mechanics

Time: 02.30 pm - 05.00 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)** Define: specific weight, cohesion, capillarity, ideal fluid. **07**

The capillary rise in the glass tube is not to exceed 0.4 mm of water. Determine its minimum size, given that surface tension for water in contact with air σ = 0.0725 N/m and contact angle $\theta = 25^0$.

(b) Explain: Newton's law of viscosity. **07**

A rectangular plate, 1m X 0.5m, weighing 980.7 N slides down a 30º inclined surface at a uniform velocity of 2.0 m/sec. If the 2 mm gap between the plate and the inclined surface is filled with caster oil, determine the viscosity (in Poise) of the castor oil.

Q.2 **(a)** Enlist different types of manometers and explain the working of a differential U-tube manometer. **07**

(b) (i)Distinguish between 'absolute pressure' and 'gauge pressure'. **04**

An open tank contains water up to a depth of 2m and above it, oil of specific gravity 0.9 for 1m depth. Find the pressure at the bottom of the tank

(ii)State and discuss: Hydrostatic law of pressure variation. **03**

OR

(b) Distinguish between centre of pressure and centre of gravity. **07**

A rectangular plate 3m X 5m is immersed vertically in water such that the 3m side is parallel to the water surface. Determine the hydrostatic force and the depth of centre of pressure if the top edge of the plate is 2m below water surface.

Q.3 **(a)** Explain the terms: Rotational flow, relative equilibrium, buoyant force. **07**

A tank, 1 m wide, 6 m long and 2.5 m deep is open at top. It contains water to a depth of 2 m. If the tank is accelerated at 2 m/s^2, calculate the volume of water spilled out of the tank.

(b) (i)Explain 'Buoyant force'. Discuss different stability conditions for a floating body. **03**

(ii)A rectangular body 2 m long, 1 m wide and 0.8 m deep floats in water. The depth of immersion is 0.6 m. What is the weight of the body? Is the body in stable equilibrium? **04**

OR

Q.3 **(a)** Differentiate between streamline and equipotential line. **07**

For a 2-D flow field, the velocity potential is given as $\varphi = 2xy - x$. Determine the stream function ψ at a point P(2, 2).

(b) Explain: Vena-contracta. Discuss the characteristics of flow at vena-contracta, in case of an orifice. **07**

The co-ordinates of a point on a free jet issued from an orifice under the head of 1.8m are (1.5, 0.4). If the dia. of the orifice is 2cm and origin of co-ordinate system is the centre of the jet at vena-contracta, find coefficient of velocity.

Q.4 **(a)** A horizontal venturimeter (VM) connected to a pipe of 20 cm dia. has 10 cm dia. throat. The difference of pressure between the inlet and the throat is measured by a differential mercury manometer, which shows the deflection of 30 cm. If the coefficient of discharge of VM is 0.97, calculate the discharge of water passing through the pipe. **07**

(b) (i)State 'Bernoulli's theorem'. What are the assumptions in Bernoulli's theorem? **03**

(ii) Sketch the VM and show all the component parts. Why is the length of diverging cone kept larger than the length of converging cone? **04**

OR

Q.4 **(a)** (i)Distinguish clearly, between Total Energy Line (TEL) and Hydraulic Grade Line (HGL). Sketch TEL and HGL for the flow through a Venturimeter (VM). **03**

(ii) A sharp crested rectangular notch is 60cm long and has a head of 18cm. Calculate the discharge, if $C_d = 0.63$. Consider the effect of the two ends of the notch. **04**

(b) State and explain: Momentum principle. What are its applications? **07**

A horizontal water jet of 5cm dia. strikes a flat vertical stationary plate. If the jet velocity is 5 m/s, calculate the force exerted on the plate.

Q.5 **(a)** Show, using Buckingham's π-theorem, that the resistance (F) to the motion of a sphere of diameter (D) moving with a uniform velocity (V) through a real fluid of density (ρ) and viscosity (μ) is given by: **07**

$$F = \rho D^2 V^2 . \Phi \left(\frac{\mu}{\rho V D} \right)$$

(b) Explain: Mach cone, Zone of silence, stagnation pressure, adiabatic process. **07**

Derive the energy equation for compressible flow in an adiabatic process.

OR

Q.5 **(a)** Explain the propagation of pressure waves when the speed of the object is more than the speed of sound. Also, derive the relation between Mach number and Mach angle. **07**

(b) (i)Discuss different similarity conditions for the model similitude. **04**

(ii) Define: Reynolds number. Also, explain "Reynolds' model law". **03**

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