Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III • EXAMINATION – WINTER 2013

Subject Code: 130602 Date: 30-12-2014

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 the following terms: **06**
Weight density, Specific gravity, Capillarity, Surface tension, Stream function, Velocity potential function

(b) 1) Differentiate between the following in brief: **04**
(i). Laminar flow and Turbulent flow
(ii). Steady flow and Unsteady flow
(iii). Rotational flow and Irrotational flow
(iv). Free vortex flow and forced vortex flow

2) Left limb of a simple U-tube mercury (specific gravity = 13.6) manometer is attached to a pipe carrying flow of water and the right limb is open to atmosphere. If levels of mercury in the left and right limbs are 20 and 30 cm below centre of the pipe respectively, calculate absolute pressure in the pipe. **04**

Q.2 **(a)** Derive equation for static thrust and centre of pressure for an inclined plane surface immersed in static liquid. **07**

(b) A cylindrical gate, having diameter 3 m and length 5 m, is placed on a 5 m wide horizontal canal bed with its axis parallel to the floor. The gate retains 1.5 m depth of water on only one side, calculate magnitude, direction and coordinates of point of application of the total force exerted by water on the gate. **07**

OR

(b) A tank having 2 m x 2 m dimension in plan is filled with water up to depth of 3 m. A circular opening having diameter 0.2 m is provided at a depth of 1.5 m from the free surface, which is closed with a circular plate. Calculate static thrust and depth of centre of pressure on: (i) one of the sides of the tank, (ii) bottom of the tank and, (iii) the circular plate. **07**

Q.3 **(a)** Derive Bernoulli's equation for steady-incompressible fluid flow. State assumptions made in the derivation. **07**

(b) (i). The velocity potential function for a two-dimensional flow is given by $\Phi = 2xy - 3x$. Calculate the velocity and value of the stream function at a point (2, 3) in the flow field. **04**

(ii). For a two-dimensional flow, the velocity components are represented by $u = x/(x^2 + y^2)$ and $u = y/(x^2 + y^2)$. Determine whether the flow is irrotational. **03**

OR

Q.3 **(a)** Define hydraulic coefficients for flow through an orifice and derive relationship between these coefficients. **07**

(b) A venturimeter having inlet and throat diameters 0.3 and 0.15 m respectively is fitted in a vertical pipe which carries water in upward direction. The differential mercury manometer shows a deflection reading of 0.35 m. The difference in elevation of the **07**

throat and inlet sections is 0.25 m. calculate, (i) rate of flow of water and, (ii) differential pressure between the inlet and throat sections. Take coefficient of discharge = 0.98.

Q.4 **(a)** Enlist major and minor energy losses for flow through pipes. Derive the Darcy-Weisbach equation for frictional head loss for the flow. **07**

(b) A horizontal pipe of diameter 25 cm and length 500 m connects two tanks. The rate of flow through the pipe is 200 liters/sec. Determine difference of elevations between the water surfaces in the two tanks. Also sketch total energy line and hydraulic gradient line. Take value of the coefficient of friction as 0.004 **07**

OR

Q.4 **(a)** Give classification of notches and weirs. Derive equation for the flow over a triangular notch. **07**

(b) Discuss conditions of stability for a floating body and describe method of experimental determination of the metacentric height. **07**

Q.5 **(a)** (i). Define subsonic, sonic and supersonic flows. **03**

(ii). Write Bernoulli's equations for isothermal and adiabatic processes. **04**

(b) Prove that velocity of sound wave in a compressible fluid is given by $C = (k/\rho)^{1/2}$, where k and ρ are bulk modulus and density of fluid respectively. **07**

OR

Q.5 **(a)** Enlist various types of manometers and explain inverted differential manometer in details. **07**

(b) Derive equation for time required for emptying a tank through an orifice provided at base of the tank. **07**

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