

GUJARAT TECHNOLOGICAL UNIVERSITY
B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 160602**Date: 03/01/2013****Subject Name: Applied Fluid Mechanics****Time: 02.30 pm - 05.00 pm****Total Marks: 70****Instructions:**

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

- Q.1** (a) Derive an equation for velocity distribution in viscous flow between two parallel plates. **04**
- (b) Differentiate between hydro-dynamically smooth and rough boundaries. **04**
- (c) Calculate the ratio of displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by the following expression: **06**

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

Where, u is the velocity at a distance y from a surface, U is a uniform free-stream velocity and δ is boundary layer thickness.

- Q.2** (a) Explain dynamic similarity between a prototype and its model. Describe Reynolds' number and Froude's number used in the model analysis. **07**
- (b) Write short note on π -theorem dimensional analysis. How repeating variables are selected in the analysis? **07**

OR

- (b) The pressure difference Δp in a pipe due to viscous flow depends on the diameter of the pipe, D ; length of the pipe, l ; velocity of flow, v ; dynamic viscosity, μ and density, ρ . Obtain an expression for Δp by performing dimensional analysis. **07**

- Q.3** (a) Draw a typical specific energy diagram for the open channel flow and explain it. Also define critical velocity. **07**
- (b) Find the width and depth of a rectangular channel to convey a discharge of $1.5 \text{ m}^3/\text{s}$ at a velocity of 0.5 m/s . Take Chezy's constant equal to 60 and the channel bed slope equal to 0.00012. **07**

OR

- Q.3** (a) What does it implied by a channel of 'optimum section' or 'most economical channel section'? Show that the hydraulic mean depth for such a trapezoidal channel is one-half the depth of flow. **07**
- (b) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 8 m/s and depth of water is 0.5 m . The width of the channel is 5 m . Determine whether a hydraulic jump will occur, and if so, find its height and **07**

corresponding loss of energy.

- Q.4 (a)** Differentiate between impulse and reaction turbines. **07**
Explain significance of specific speed.
- (b)** Explain main parts of a centrifugal pump with a neat sketch. Discuss effects of cavitation on the performance of pumps. **07**

OR

- Q.4 (a)** Differentiate between natural and mechanical ventilations. **07**
State requirements of a ventilation system.
- (b)** A turbine is running at 180 rpm under a head of 30 m and the discharge is $10 \text{ m}^3/\text{s}$. Determine the speed, discharge and power developed by the turbine under the reduced head of 20 m. Take overall efficiency of the turbine equal to 80%. **07**

- Q.5 (a)** Explain concept of laminar and turbulent boundary layer growth over a flat plate. What is boundary layer separation? **07**
- (b)** An oil of viscosity 1 poise and specific gravity 0.85 is flowing through a circular pipe of diameter 10 cm at a rate of 6 liters/s. Calculate, i) pressure drop in a length of 400 m and, ii) shear stress at the pipe wall. **07**

OR

- Q.5 (a)** Differentiate between stream-lined body and bluff body. Also prove that the coefficient of drag for sphere is given by $24/Re$, when Reynolds' number (Re) ≤ 0.2 . **07**
- (b)** Explain Prandtl's mixing length theory. **07**
