

**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  $\delta$  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  $\pi$ -theorem dimensional analysis. How repeating variables are selected in the analysis? **07**

**OR**

- (c) The pressure difference  $\Delta p$  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,  $\mu$  and density,  $\rho$ . Obtain an expression for  $\Delta p$  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  $0.5 \text{ m/s}$ . 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  $8 \text{ m/s}$  and depth of water is  $0.5 \text{ m}$ . The width of the channel is  $5 \text{ m}$ . 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 ( $Re$ )  $\leq 0.2$ . **07**
- (b) Explain Prandtl's mixing length theory. **07**

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