GUJARAT TECHNOLOGICAL UNIVERSITY PDDC - SEMESTER-III • EXAMINATION - SUMMER 2015

Subject Code:X30604 **Subject Name: Advanced Fluid Mechanics** Time: 02.30pm-05.00pm Instructions: 1. Attempt all questions. 2. Make suitable assumptions wherever necessary.

- 3. Figures to the right indicate full marks.
- Q.1 A partially submerged body is towed in water. The resistance R to its motion 07 (a) depends on the density ρ , the viscosity μ of water, length 1 of the body, velocity V of the body and acceleration due to gravity. Show that the resistance to motion can be expressed in the form

 $R = \rho L^2 V^2 \phi \left[(\mu / \rho LV) (\lg/v^2) \right]$

- Enlist various methods for measuring the coefficient of viscosity of liquids and **(b)** 07 explain the falling sphere method in detail.
- **O.2** Explain what is meant by separation of boundary layer. Describe the methods to 07 (a) control separation.
 - **(b)** Explain the Buckingham's Pi theorem method for dimensional analysis. 07

OR

- Explain the Reynolds experiment, classifying the pipe flows in laminar, turbulent **(b)** 07 and transition types.
- Q.3 Derive Bernoulli's equation of motion. Describe limitations of the equation 07 (a) **(b)** 07
 - Derive the continuity equation in three dimension

OR

- Explain the applications of the Bernoulli's equation of motion. Q.3 **(a)**
 - Explain the criteria for classification of rough and smooth pipe boundaries in a 07 **(b)** fluid field velocity field is given by:

 $V = (3x+2y)I + (2z+3x^2)j + (2t-3z)k$

Determine the velocity components u, v, w at any point in the field, the speed at point (1,1,1) and the speed at time t=2s at point (0,0,2)

- Q.4 **(a)** Derive the Hagen-Poiseulle equation for laminar flow through circular pipe.
 - An oil of viscosity 9 poise and specific gravity 0.9 is flowing through a **(b)** 07 horizontal pipe of 60mm diameter. If pressure drop in 100m length of pipe is 1800kN/m², determine the rate of flow of oil and velocity at 30mm distance from pipe boundary.

OR

- Derive Darcy-Weisbach equation for loss of head due to friction 07 **Q.4 (a)**
 - A rough plastic pipe 500mm in diameter and 300m in length carrying water with 07 **(b)** a velocity of 3m/s has an absolute roughness of 0.25mm and a kinematic viscosity of 0.9 centistokes. (i) is the flow laminar or turbulent (ii) what is head lost in friction.
- Derive an expression for velocity distribution for turbulent flow in smooth pipes. Q.5 07 **(a)**
 - What do you mean by most economical section of an open channel? How is it 07 **(b)** determined?

Date: 05/06/2015

Total Marks: 70

07

07

- Q.5 (a) What is specific energy curve? Derive expression for critical velocity and critical 07 depth.
 - (b) Determine the most economical section of rectangular channel carrying water at the rate of 0.5 m³/s. The bed slope of the channel section being 1 in 2000. Take Chezy's constant C=50.
