

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 711201N**Date: 13-06-2014****Subject Name: Advanced 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) Explain various types of water surface profile with figure, Give example of each. **07**
 (b) Write down prandtl mixing length theory for turbulent shear stress. **07**

- Q.2** (a) Derive the differential equation of spatially-varied flow for decreasing discharge. **07**
 (b) Explain uniformly progressive wave. **07**

OR

- (b) Show that the gradually varied flow equation for flow in a rectangular channel **07**

of variable width b may be expressed as $\frac{dy}{dx} = \frac{S_b - S_c + \left(\frac{V^2}{gb}\right) \frac{db}{dx}}{1 - F^2}$

- Q.3** (a) Explain the method of characteristics. **07**
 (b) Rectangular channel carries water at a depth of 2m and width 3m at a velocity 1 m/s. At a certain section the width is reduced to 1.8 m and the bed is raised by 0.65m. Will the upstream depth be affected? If so, to what extent? **07**

OR

- Q.3** (a) Define the term (i) Sediment load (ii) Bed load (iii) Suspended load. **07**
 (b) A rectangular flume 2m wide carries discharge at the rate of 2 m³/s. The bed slope of the flume is 0.0004. At a certain section, the depth of flow is 1m. Find the distance of the downstream where the depth of flow is 0.9m. Solve by direct step method. Assume regosity coefficient as 0.014. Is the slop of the channel mild or steep? How is this type of surface profile classified? **07**

- Q.4** (a) Obtain Von-Karman momentum integral equation. **07**
 (b) A fluid of dynamic viscosity of 1 poise is filled between two horizontal plates 15 mm apart. If the upper plate is moving at 1.5 m/s with respect to lower plate which is fixed and the pressure difference between two section 100 m apart is 50 kN/m². Calculate (a) The velocity distribution (b) Discharge per unit width and (c) The shear stress at upper plate. **07**

OR

- Q.4** (a) Explain Reynolds stress in turbulent flow. **07**
 (b) The hydrodynamically rough pipe of diameter 40 cm having turbulent flow, the centerline velocity is 3 m/s and local velocity at 15 cm from pipe centre is 2.5 m/s. Find the discharge and the height of the roughness projections. **07**

- Q.5** (a) Develop the continuity equation in Cartesian Coordinates for a three dimensional flow. **07**
 (b) A plate of 80 cm length and 50 cm wide is immersed in a fluid of specific gravity 0.9, a kinematic viscosity of 10⁻⁴ m²/sec. The fluid is flowing with a velocity of 6 m/s. Find (a) The boundary layer thickness, (b) Shear stress at the end of the plate (c) Drag force on one side of the plate. **07**

OR

- Q.5** **(a)** Explain Boundary layer separation and discuss how we can prevent separation of boundary layer. **07**
- (b)** Explain water hammer, derive expression for rise in pressure for Gradual closure of valve, Sudden closure of valve for rigid and elastic pipe. **07**
