

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 711201N**Date: 23-12-2013****Subject Name: Advanced Fluid Mechanics****Time: 10.30 am – 01.00 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) Describe prandtl concept of boundary layer. **07**
 (b) Explain the direct integration procedure for computing the GVF profiles and obtain the Bress's function. **07**

- Q.2** (a) Draw sketches to explain S1, S2 and S3 profiles in gradually varied flow. Give examples of each. **07**
 (b) Show that for a horizontal wide channel, by using Chezy's $C = \text{constant}$, **07**
- $$x = \frac{C^2}{g} \left[y - \frac{y^4}{4y_c^3} \right] + \text{Const}$$

OR

- (b) Explain Falling Sphere method for measurement of viscosity. **07**
- Q.3** (a) Explain flownet with it's limitation and utility. **07**
 (b) Water at 20°C is to be transported through a 20 cm diameter pipe at a flow rate of $0.0003 \text{ m}^3/\text{s}$. Calculate the pressure drop for the length of 100 m. Viscosity of water at 20°C is 0.001 N-s/m^2 . Also calculate the power required to maintain the flow. **07**

OR

- Q.3** (a) Explain Prandtl's mixing length theory. **07**
 (b) In a hydrodynamically rough pipe of diameter 40 cm having turbulent flow, the centerline velocity is 3 m/s and the local velocity at 15 cm from the pipe centre is 2.5 m/s. find the discharge and the height of the roughness projections. **07**
- Q.4** (a) Obtain Von Karman momentum integral equation. **07**
 (b) Water is flowing over a thin smooth plate of length 4 m and width 2 m at a velocity of 1.0 m/sec. If the boundary layer flow changes from laminar to turbulent at a Reynold number 5×10^5 , find (i) The distance from leading edge up to which boundary layer is laminar, (ii) The thickness of the boundary layer at the transition point, and (iii) The drag force on one side of the plate. Take viscosity of water $\mu = 1.0 \times 10^{-4} \text{ kgf-sec/m}^2$. **07**

OR

- Q.4** (a) What is meant by separation of boundary layer? How is the separation point determined? State the reasons for separation. **07**
 (b) A streamline train is 300 m long with a typical cross section having a perimeter of 8 m above the wheels. Evaluate the approximate surface drag (friction drag) of the train when running at 100 km/hr. The kinematic viscosity of air at the prevailing temperature is $1.49 \times 10^{-5} \text{ m}^2/\text{s}$ and its specific weight 1.24 kg/m^3 (12.25 N/m^3 in SI units). **07**
- Q.5** (a) Derive the sequent depth ratio and energy loss for the hydraulic jump in a rectangular section. **07**

- (b) A 2.5 m wide rectangular channel is carrying a flow of $5 \text{ m}^3/\text{s}$ at a flow depth of 2 m . Determine the height of surge wave and its velocity if the discharge is suddenly increased to $10 \text{ m}^3/\text{s}$ at the upstream end. **07**

OR

- Q.5** (a) Derive the differential equation of SVF for decreasing discharge. **07**
(b) A rectangular flume 2 m wide carries discharge at the rate of $2 \text{ m}^3/\text{s}$. The bed slope of the flume is 0.0004. At a certain section the depth of flow is 1 m. Calculate the distance of the section downstream where the depth of flow is 0.9 m. Solve by single step method. Assume rugosity coefficient as 0.014. **07**
