Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. IST Semester–Remedial Examination – July- 2011

Subject code:711201

Subject Name: Advanced Fluid Mechanics

Date:07/07/2011 **Time: 10:30 am – 01:00 pm**

Total Marks: 60

Instructions:

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

Q.1 **(a)** Develop the gradually varied flow equation **06**

$\frac{dy}{dx} = \frac{S_o - S_f}{1 - \frac{Q^2 T}{gA^3}}$, Where the terms have their usual meaning.

(b) The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500m and of diameter 500mm. At the end of the pipe, a valve is provided. Find the rise in pressure if the valve is closed in 25 seconds. Take the value of velocity of pressure wave, C=1460 m/s. **06**

Q.2 **(a)** Develop the continuity equation in Cartesian Coordinates for a three dimensional flow. **06**

(b) The width of a horizontal rectangular channel is reduced from 3.5 m to 2.5 m and the floor is raised by 0.25 m in elevation at a given section. At the upstream section, the depth of flow is 2.0 m and Kinetic energy correction factor α is 1.15. If the drop in water surface elevation at the contraction is 0.20 m. Calculate the discharge if the energy loss is neglected. The Kinetic energy correction factor at contracted section may be assumed to be unity. **06**

OR

(b) Draw sketches to explain S_1, S_2 and S_3 profiles in gradually varied flow. Give examples of each. **06**

Q.3 **(a)** Explain the separation of boundary layer, its effect on moving bodies and control measures to be taken for it. **06**

(b) Oil with a free stream velocity of 2 m/s flows over a thin plate 2 m wide and 2 m long. Calculate the boundary layer thickness and the shear stress at the tailing end point and determine the total surface resistance of the plate. Take specific gravity as 0.86 and Kinematics Viscosity as 10^{-5}. **06**

OR

Q.3 **(a)** Starting from N.S. equation derive an expression for velocity distribution, shear force and discharge for the laminar flow between two parallel plates. **06**

(b) Two fixed parallel plate kept 8cm apart have laminar flow of oil between them with a maximum velocity 1.5 m/s. Taking dynamic viscosity of oil to be $\mu = 0.20$ kgf s/m^2. Compute (i) the discharge per meter width (ii) the shear stress at the plate (iii) the pressure difference between two points 25 m apart (iv) velocity at 2cm from the plate. **06**

P.T.O.

Q.4 **(a)** Explain Prandtl's mixing length theory. **06**

(b) A rectangular channel 7.5 m wide has a uniform depth of flow 2.0m and has a bed slope of 1 in 30000. If due to weir constructed at the down stream end of the channel, water surface at a section is raised by 0.75 m, determined the water surface slope with respect to horizontal at this section. Assume Manning's n=0.02. **06**

OR

Q.4 **(a)** A circular pipe of radius R_1 is placed concentrically in side an other pipe of radius R_2, if the flow in the annular space is laminar show that the maximum velocity occurs at **06**

$$r = \sqrt{\frac{R_2^2 - R_1^2}{2\log_e \frac{R_2}{R_1}}}$$

(b) (i) Develop the continuity equation for unsteady flow of the form $\frac{\partial Q}{\partial x} + T\frac{\partial y}{\partial t} = 0$, Where the terms have their usual meaning. **04**

(2)Define (A) Bed load and Suspended load **02**
(B) Rigid and Mobile boundary channel.

Q.5 **(a)** Draw sketches and mark the various parameters for the four types of surges in the open channel. Explain the notations marked in the figure. **06**

(b) The tidal bore in an estuary is observed to be traveling upstream at a velocity of 8.0 m/s. The depth and velocity of flow under the steady, uniform conditions prevailing prior to the arrival of bore are 3.2 m and 1.0 m/s respectively. Estimate the height of the bore. **06**

OR

Q.5 **(a)** Discuss with sketches the various types of hydraulic jump. **06**

(b) (i) Discuss the applications of hydraulic jump **02**

(ii)A hydraulic jump occurs in 0.5 m wide rectangular channel at the point where depth of water is 0.15 m and the Froude number is 2.5. Calculate the specific energy, critical and sequent depth. **04**

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