Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Remedial Examination April 2010

Subject code: 711201
Subject Name: Advanced Fluid Mechanics

Date: 06 / 04 / 2010 **Time: 12.00 noon – 02.30 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 continuity equation in cylindrical polar coordinates for a three dimensional flow. **05**

(b) A valve is closed in 4 seconds at the downstream end of a 2500 m long pipe having a diameter of 1.25 meter and a thickness of 1.25 cm and carrying water at velocity of 2.5 m/s. Calculate the peak water hammer pressure. **05**

(c) Define spatially varied steady and spatially varied unsteady flow giving example of each. **02**

Q.2 **(a)** Develop the gradually varied flow equation $\frac{dy}{dx} = \frac{S_o - S_f}{1 - \frac{Q^2 T}{g A^3}}$, where the terms have their usual meaning. **06**

(b) Draw sketches to explain M1, M2 and M3 type profiles in a gradually varied flow. Give examples of each **06**

OR

(b) A 10 meter wide rectangular channel laid at a slope of 0.0001 carries a discharge of 30 m^3 / sec. If at a section in this channel the depth is1.6 meter. How far from this section and u/s or d/s the depth will be 1.7 meter. **06**

Q.3 **(a)** Discuss the phenomenon of separation in a diverging flow. Discuss various methods for prevention of separation. **05**

(b) Oil with free stream velocity of 3 m/s flows over a thin plate 1.25 meter wide and 2 meter long. Calculate the shear stress at mid length and total double sided resistance of the plate. ρ = 860 kg/m^3, $\upsilon = 10^{-5}$ m^2 /sec, skin friction coeff. = 1.717 x 10^{-3} **05**

(c) Write the momentum equation for compressible and incompressible flow and give the significance of the terms. **02**

OR

Q.3 **(a)** Draw sketches and mark the various parameters for the four type of surges in the open channels. Explain the notations marked in the figure. **05**

(b) Using the continuity and momentum equation develop a mathematical expression for absolute velocity of surge in terms of channel velocity, channel flow depth and depth at surge for a positive surge moving downstream. **05**

(c) State Navier Stokes equation in the mathematical form and explain significance of each term. **02**

Q.4 **(a)** A circular pipe of radius R_1 is placed concentrically inside an other pipe of radius R_2. if the flow in the annular space is laminar show that the maximum velocity occurs at $r = \sqrt{\frac{R_2^2 - R_1^2}{2 \log_e \frac{R_2}{R_1}}}$ **05**

(b) A rectangular channel with bottom width 4 meter and bottom slope 0.0008 has discharge 1.50 cubic meters per second in a gradually varied flow profile. In this channel the depth at certain location is 0.3 meter, determine the type of GVF profile taking n = 0.016. **05**

(c) Write the energy equation per unit weight and per unit mass of liquid and significance of each term. **02**

OR

Q.4 **(a)** Define isotropic and homogenous turbulence, convective turbulence and turbulence intensity. **02**

(b) Water flows from an under sluice into a very wide rectangular channel having bed slope of 1 in 1000. The sluice is regulated to give a discharge of 6 m^3 /s per meter width of the channel, the depth at vena contracta being 0.5 meter , find if hydraulic jump will occur. Find the type of slope in the channel. Take n = 0.015. **05**

(c) State and explain the steps to find out the location of hydraulic jump formed below a regulating sluice in a mild sloped channel **05**

Q.5 **(a)** Define bed load, suspended load, saltation load rigid and mobile boundary channel **02**

(b) Draw a sketch of the Shields curve. Explain the critical points and the utility of the curve **05**

(c) While measuring the discharge in a small stream it was found that depth of flow increases at the rate of 0.10 m /hr. If the discharge at that section was 25 m^3 /sec and surface width of stream 20 meter, estimate the discharge 1 km upstream. **05**

OR

Q.5 **(a)** Relate total flow resistance, resistance due to bed forms and due to grains for a mobile bed giving significance of each term. **02**

(b) 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. **05**

(c) A rectangular channel 2.5 meter wide carries a discharge of 6 m^3/sec at a flow depth of 0.5 meter. Calculate the height of the flat topped hump required to be placed at a section to cause critical flow. Take energy loss due to obstruction by hump as 0.1 times the upstream velocity. **05**

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