Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Examination January 2010

Subject code: 711201 **Subject Name: Advanced Fluid Mechanics**

Date: 20 / 01 / 2010 **Time: 12.00 – 2.30 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)**	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)	The normal Depth of flow of water, in a rectangular channel 1.5m wide is 1m . The bed slope of the channel is 0.0006 and Manning's roughness coefficient n= 0.012. Find the critical depth. At a certain section of the same channel the depth is 0.92 m while at a second section the depth is 0.86 m. Find the distance between the two sections (use one reach in the calculations). Also find whether the section is located downstream or upstream with respect to the first section.	**06**
Q.2	**(a)**	Explain the finite difference schemes for solving St Venant equation.	**06**
	(b)	For the sluice gate shown in **Fig 1** determine the force required to hold the gate in place. Assume gate width to be 2.0m and Cc = 0.60.	**06**
		OR	
	(b)	A wide rectangle channel in a alluvium of median size 3.0mm (Relative density = 2.65) has a longitudinal slop of 0.0003. Estimate the depth of flow in this channel which will cause incipient motion.	**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)	A river flowing toward the sea at a velocity of 5 km/ h and having a depth of 2.0 m encounters an incoming tide which increases the depth to 5.0m and a tidal bore travels upstream. Estimate the speed of the bore, speed and direction of flow after the passage of the bore	**06**
		OR	
Q.3	**(a)**	Explain method of characteristics.	**06**
	(b)	A 900 mm diameter steel pipe carries water at the rate of 1.5 m^3/s. The pipe wall has a thickness of 1cm. The elastic modulus of steel is 2×10^{11} N/m^2 and the bulk modulus of water is 2.1×10^9 N/m^2 . Determine the increase in pressure if the valve at the end of 3.5 km long pipe line is closed in 3.5 seconds.	**06**
Q.4	**(a)**	Explain prandtl's mixing length theory	**06**
	(b)	In a rectangular channel 3.5 m wide, laid at a slope of 0.0036 , uniform flow occurs at a depth of 2.0 m. Find how high can a hump be raised on the channel bed without causing a change in the upstream depth. If the upstream depth is to be raised to 2.4 m what should be the height of the hump ? Assume Manning's n = 0.015 .	**06**
		OR	
Q.4	**(a)**	Derive differential equation of SVF with increasing discharge.	**06**

(b) A submarine can be assumed to have cylindrical shape with rounded nose. Assuming its length to be 55 m and diameter 6.0 m , determine the total power required to overcome boundary friction if it cruises at 8.0 m/s velocity in sea water at 20º c (ρ = 1030 kg/m^3 , ν = 1 x 10^{-6} m^2/s) **06**

Q.5 **(a)** Sketch the possible GVF profiles in the following serial arrangement of channels **06**

(i) Steep – Mild – Sluice gate – Mild – Sudden drop

(ii) Steep – Horizontal – Mild slop

(iii) Sluice gate – Adverse – Horizontal – Steep slope

(b) Water flows through a pipe of diameter 250 mm . The local velocities at the centre and mid radius are 2.31 m/s and 2.09 m/s . Find the discharge and pipe roughness. **06**

OR

Q.5 **(a)** Obtain Von Karman momentum integral equation. **06**

(b) The effluent from an industrial plant is discharged at the centre line of a slowly meandering channel. The channel is 50 m wide and has a depth of 1.0 m . The slope is 2 x 10^{-4} and n = 0.02 . Find the length of the channel required for complete mixing over the cross section. **06**

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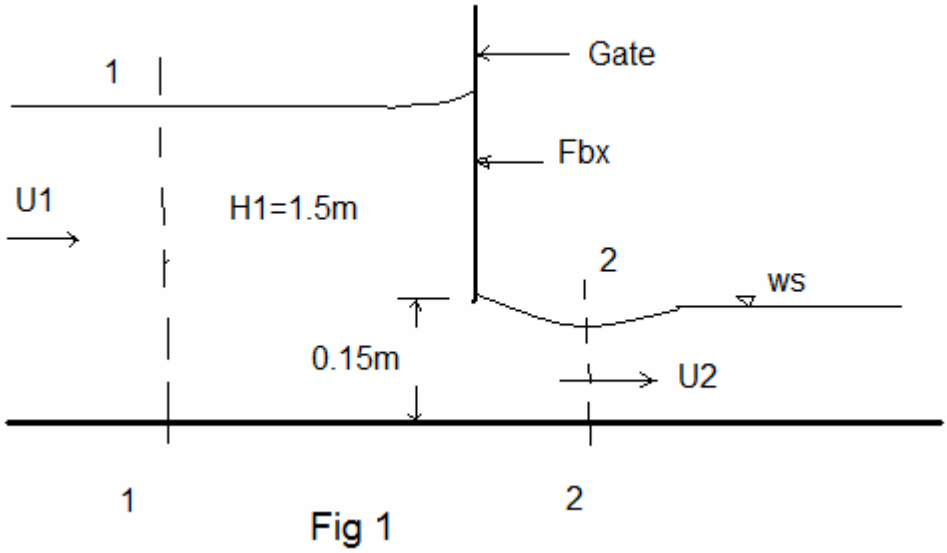

Fig 1