Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 711201N Date: 05/07/2012

Subject Name: Advanced Fluid Mechanics

Time: 2:30 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)** Derive the equation of conservation of mass in 3D.State the assumption made in it. **07**

(b) Sketch the possible GVF profiles in the following serial arrangements of channel and controls. The flow is from left to right: **07**

1. steep – mild – sluice gate – mild – sudden drop
2. Sluice gate – adverse – horizontal – steep slope

Q.2 **(a)** Explain application of N.S equation. **07**

(b) Show that for a horizontal wide channel, by using Chezy's C=constant, **07**

$$x = \frac{C^2}{g}\left[y - \frac{y^4}{4y_c^3} \right] + Const$$

OR

(b) What is meant by separation of boundary layer? How is the separation point determined? State the reasons for separation. **07**

Q.3 **(a)** Starting from N.S equation derive an expression of velocity distribution, shear force and discharge for the laminar flow between two parallel plates. **07**

(b) A 0.20m diameter pipe 20km long transports oil at a flow rate of 0.01m^3/s. Calculate the power required to maintain the flow if the dynamic viscosity and density of oil are 0.08 Ns/m^2 and 900 kg/m^3 respectively. **07**

OR

Q.3 **(a)** Prove that the stream lines and potential lines are orthogonal to each other. **07**

(b) A rough pipeline of 10 cm diameter carries water at the rate of 50 lit/sec. If the average height of the prolusions on the pipe surface is 0.015cm, calculate the friction factor; the maximum velocity; shear stress at the pipe surface and the shear velocity. Assume viscosity of water as one centistokes. **07**

Q.4 **(a)** Describe prandtl concept of boundary layer. **07**

(b) The 3m by 1.2m rectangular is held in water moving at 1.2 m/sec parallel to its length. Assuming laminar conditions in the boundary layer at the leading edge of the plate, (a) location where the boundary layer of law changes from laminar to turbulent, (b) estimate the thickness of the boundary layer at this point, and (c) compute the friction drag of the plat. **07**

OR

Q.4 **(a)** Integrate the differential equation of GVF for a horizontal channel to get the profile equation as: **07**

$$x = \frac{y_c}{S_c}\left[\frac{(y/y_c)^{N-M+1}}{N-M+1} - \frac{(y/y_c)^{N+1}}{N+1} \right] + Const$$

(b) A rectangular flume 2m wide carries discharge at the rate of 2 m^3/s. The bed slope of the flume is 0.0004. At a certain section the depth of flow is 1m. Calculate the distance of the section downstream where the depth of flow is 0.9m. Solve by single step method. Assume rugosity coefficient as 0.014. **07**

Q.5	**(a)**	Explain the method of characteristics.	**07**
	(b)	Classify the types of flow in open channel based on channel characteristics and Flow Properties.	**07**

OR

Q.5	**(a)**	Derive the differential equation of SVF for increasing discharge	**07**
	(b)	A tidal estuary is flowing at the rate of 6.5 km/hr and a depth of 2m. Owing to the tide in the sea, the level rapidly rose and the resulting surges or 'bore' took one hour to reach a spot 22.5 km up the stream. Compute the height of the bore above the initial depth of flow. What speed and direction will the flow have after the bore has passed?	**07**

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