GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2713303 Subject Name: ADVANCED FLUID MECHANICS Time: 2:30 pm to 5:00 pm

Date:05/01/2017

Total Marks: 70

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- (a) Describe Navier-Stock's equation and its applicability in fluid flow problems. 07 0.1
 - (b) Write assumption in GVF and develop the gradually varied flow equation for 07

wide rectangular channel
$$\frac{dy}{dx} = S_0 \left(1 - \left(\frac{y_0}{y}\right)^{\frac{10}{3}} \right) / \left(1 - \left(\frac{y_c}{y}\right)^3 \right)$$
 where the terms

have their usual meaning.

- What factors account for the loss of energy in Laminar flow? How does the 07 0.2 (a) energy loss very with velocity of flow?
 - (b) Oil of viscosity 0.97 poise and relative density 0.9 is flowing in a horizontal 07 circular pipe of diameter 100 mm and of length 10 m. if 100 kg of oil is collected at the outlet of pipe in 30 seconds, calculate the difference in pressure at the two ends of the pipe. Also verify that the flow is laminar.

OR

- (b) A smooth plate 2 m wide and 2.5 m long is towed in oil (sp. Gr. = 0.8) at a 07 velocity of 1.5 m/s along its length. Find the thickness of boundary layer and shear stress at the trailing edge of the plate. $v = 10^{-4} \text{ m}^2/\text{s}$.
- (a) How is turbulent motion classified? What are the characteristics of a turbulent 0.3 07 flow?
 - (b) A smooth pipe 200 mm in diameter crude oil at a velocity of 2.5 m/s. what is 07 the type of flow? Estimate the loss of head in 100 m and power required to maintain the flow. Assume $v = 0.40 \text{ cm}^2/\text{s}$ and relative density = 0.90.

OR

- (a) Obtain an expression for the Prandtl's universal velocity distribution for Q.3 07 turbulent flow in pipes.
 - (b) Explain classification of flow in open channel.
- 0.4 (a) Explain briefly the term Boundary layer. What is the slip condition at the 07 boundary?
 - (b) A 12 m wide rectangular channel carries a discharge of $30 \text{ m}^3/\text{s}$ with a bed slope 07 of 1 : 5000, the depth of flow at a section is 1.5 m. find the type of water surface profile.(n=0.015)

OR

(a) Explain briefly classification of flow profiles with sketches. 07 Q.4

07

- (b) Sketch the possible GVF profiles in the following serial arrangement of channels
 (i) Steep Steeper –Mild Milder slope
 (ii) Steep Horizontal Mild slop
 (iii) Mild Sluice gate Steep Horizontal Sudden drop
- Q.5 (a) A 2 m wide rectangular channel carries a discharge of 3 m³/s at a velocity of 3 m/s. determine whether a hydraulic jump will form? If so, calculate the height, length of jump. Also calculate the loss of energy per kg of water.
 - (b) A rectangular channel (n = 0.017) is 3.0 m wide and is laid on a bottom slope of 0.0009. It carries a discharge of 10 m³/s and the flow is nonuniform. If the depth at a section A is 2.5 m, calculate the distance to the section B where the depth of flow is 2.70 m, by using direct step method having only one step.

		OR	
Q.5	(a)	Explain classification of Hydraulic jump.	07
	(b)	Derive differential equation of SVF with increasing discharge.	07

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