

2023

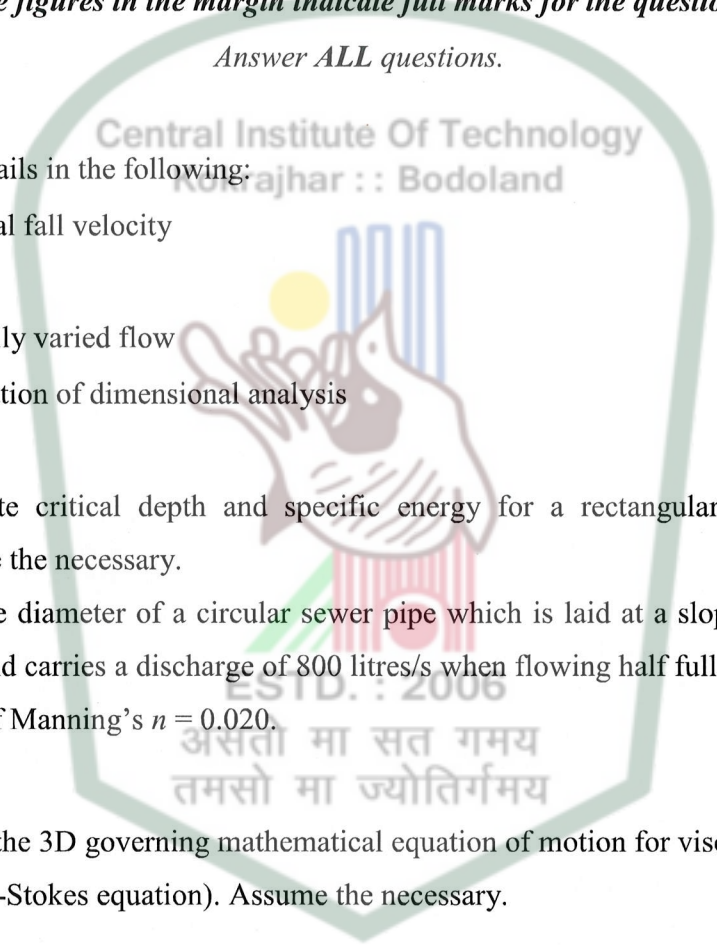
**HYDRAULIC ENGINEERING**

Full Marks : 100

Time : Three hours

*The figures in the margin indicate full marks for the questions.*

*Answer ALL questions.*

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1. Write in details in the following: 5\*4 = 20
- Terminal fall velocity
  - syphon
  - Gradually varied flow
  - Application of dimensional analysis
2. a) Calculate critical depth and specific energy for a rectangular channel. 8  
Assume the necessary.
- b) Find the diameter of a circular sewer pipe which is laid at a slope of 1 in 8000 and carries a discharge of 800 litres/s when flowing half full. Take the value of Manning's  $n = 0.020$ . 12
3. a) Derive the 3D governing mathematical equation of motion for viscous flow 14  
(Navier-Stokes equation). Assume the necessary.
- b) Write a short note on hydraulic jump. Draw the necessary figure. 6
4. a) The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500 m and of diameter 500 mm. At the end of pipe, a valve is provided. Find the rise in pressure if valve is closed in 25 sec. Take velocity of sound is 1460 m/s. 13

If, the valve is closed in 2 sec., then find the rise in pressure behind the valve. Consider pipe to be rigid and bulk modulus of water is  $19.62 \times 10^4$  N/cm<sup>2</sup>.

- b) Write a short note on boundary layer separation. Draw the necessary figure. 7
5. a) Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by 12

$$\frac{u}{v_0} = 2 \left( \frac{y}{\delta} \right) - \left( \frac{y}{\delta} \right)^2$$

- b) A rectangular channel with a bottom width of 4.0 m and bottom slope of 0.0008 has a discharge of  $1.50 \text{ m}^3/\text{s}$ . In a gradually varied flow in this channel, the depth at a certain location is found to be 0.30 m. Assume, Manning's  $n = 0.016$ . Determine the type of gradual varied flow profile. 8

