B.E. Fifth Semester (Civil Engineering) (CGS)

Fluid Mechanics - II : 5 CE 02

P. Pages : 3 | AU - 3529

Time : Three Hours | Max. Marks : 80

* 0 8 2 3 *

Notes :
1. All question carry marks as indicated.
2. Answer **three** question from Section A and **three** question from Section B.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Diagrams and chemical equations should be given wherever necessary.
6. Illustrate your answer necessary with the help of neat sketches.
7. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Derive an expression for the velocity distribution for turbulent in smooth pipes. **7**

b) What is meant by smooth boundary and rough boundary. **6**

OR

2. a) A smooth pipe of 80 mm diameter and 100 m long is carrying water at the rate of 9 lit/sec. If kinematics viscosity of water is 0.015 stokes and value of co-efficient of friction 'f' is given by the relation $f = \frac{0.0791}{(Re)^{1/4}}$. **8**

where, Re is Reynold's number.
Calculate :
i) Loss of head.
ii) Wall shearing stress.
iii) Centre - line velocity.
iv) Velocity and shear stress at 25 mm from the pipe wall and
v) Thickness of laminar sublayer.

b) In rough pipe of dia. 0.8 m and length 4500 m water is flowing at the rate of $0.9 m^3/s$. If the average height of roughness is 0.5 mm, find the power required to maintain this flow. **5**

3. a) State the conditions under which the rectangular section of an open channel will be most economical. Derive these conditions. **6**

b) In a rectangular channel of 0.6 m width a hydraulic jump occurs at a point where depth of water flow is 0.20 m and froude number is 2.5. **7**
Determine :
i) Specific energy.
ii) The critical and subsequent depth.
iii) Loss of head.
iv) Energy dissipated.

OR

4. a) Prove that the critical flow in a channel. 7
   i) The kinetic head is equal to half the hydraulic depth, and
   ii) Critical depth is equal to two - third of minimum specific energy.

   b) Design an earthen trapezoidal channel for water having a velocity of 0.6 m/s, side slope of channel is 1 : 1.5 and quantity of water flowing is $3\,m^3$ / sec . Assume C in Chezy's formula as 65. 6

5. a) A sluice gate discharges water into a horizontal rectangular channel with velocity of 6 m/sec and depth of flow 0.08 m. The width of channel 7.8 m. Determine whether a hydraulic jump will occur and find its height and loss of energy per kg. Also determine power lost in hydraulic jump. 7

   b) State the various assumptions made while analysing the gradually varied flow. 6

OR

6. a) Show that for hydraulic jump in a horizontal rectangular channel, 6

$$F_2 = F_1 \left[\frac{y_1}{y_2}\right]^{3/2}.$$

   b) In a rectangular channel 13 m wide and 3.8 m deep water is flowing with a velocity of 1.2 m/s. The bed slope of the channel is 1 in 4000. If flow of water through the channel is regulated in such a way that energy line is having a slope of 0.004. Find the rate of change of depth of water in channel. 7

SECTION - B

7. a) State Buckingham's π theorem. Show that the velocity through circular orifice is given by 7

$$V = \sqrt{2gH} \cdot \phi \left[\frac{D}{H}, \frac{\mu}{\rho.V.H}\right].$$

   b) What is mean by repeating variables? How are the repeating variables selected in dimensional analysis? 6

OR

8. a) The performance of spillway in an irrigation project is to be studied by means of model constructed to a scale of 1 : 10. Determine : 7
   i) Rate of flow in model for a prototype discharge of $1500\,m^3$ / sec .
   ii) Dissipation of energy in prototype hydraulic jump, if the pump in model dissipates 0.33 kW.

   b) Explain : 6
   i) Geometric similarity
   ii) Kinematic similarity
   iii) Dynamic similarity

9. a) Show that for a series of flate plates mounted on a periphery of a wheel and jet striking normally on each plate in succession, the max. efficiency never exceeds 50%. 7

   b) Draw a neat sketch of Pelton wheel turbine and describe its working. 7

OR

10. a) A jet water of 70 mm diameter strikes a curved vane at its centre with a velocity of 18 m/s. The curved vane is moving with a velocity of 8 m/s. in the direction of jet. The jet deflected through an angle 165°. Assuming the plate to be smooth find, **7**
i) Force on the plate in the direction of jet.
ii) Power of jet.
iii) Efficiency of jet.

b) Derive an expression for the force exerted by a jet of water on a stationary curved plate when **7**
i) Jet strikes the curved plate at centre.
ii) Jet strikes the curved plate at one end tangentially when the plate is symmetrical.

11. a) What is priming & why it is necessary. **6**

b) A double acting reciprocating pump has a stroke of 25 cm and a piston diameter of 10.5 cm. The centre of the pump is 4 m above the level of water in the sump and 30 m below delivery water level. The lengths of suction & delivery pipes are 6.5 m and 34.5 m respectively and their diameters are both 10 cm. Take friction factor of pipes $f = 0.04$. If pump is working at 30 r.p.m. Find the pressure head in meters of water on piston at **8**
i) beginning of suction stoke.
ii) middle of suction stoke &
iii) end of suction stoke.

OR

12. a) Define specific speed of a centrifugal pump. Derive an expression for the same. **7**

b) A centrifugal pump lifts water against a static head of 30 m. The major loss of head in suction and delivery pipe is 0.8 m and 2.8 m respectively. The impeller is 300 mm in dia and 25 mm wide at outlet. It reloves at 1325 rpm and blade angle is 35° at exist. Determine the discharge of the pump and power required to drive the pump, if manometric efficiency is 74%. **7**

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