Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CE-OLD)/SEM-3/CE-302/2012-13

2012

FLUID MECHANICS

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

i) The centre of buoyancy of a submerged body

a) coincides with the centre of gravity of the body

b) coincides with the centroids of the displaced volume F_r (F.No.) of the fluid

c) is always below the centre of gravity of the body

d) is always above the centre of the displaced volume of liquid.

ii) In laminar flow through a pipe the Darcy-Weishbach friction factor f is given by f =

a) $64/Re$ b) $24/Re$

c) $16/Re$ d) $3/16\ Re$,

where Re is Reynolds number.

iii) The flow in open channel is laminar if the Reynolds number is

a) 2000 b) less than 2000

c) less than 500 d) none of these.

iv) In open channels flow if $F_r > 1$, the flow is

a) critical flow b) sub-critical flow

c) supercritical flow d) none of these.

Where F_r = Froude number.

v) A U-tube manometer measures

a) absolute pressure at a point

b) local atmospheric pressure

c) difference in total energy between two points

d) difference in pressure between two points.

vi) The dimensions of Chezy's coefficient C are

a) $M^0 L^0 T^0$ b) L

c) $L^{1/2} T^{-1}$ d) $ML^{-1/3} T$.

vii) The dimensions of Mannig's roughness coefficient are

a) $L^{-1/3} T$ b) $L^{1/2} T^{-1}$

c) $M^0 L^0 T^0$ d) $LT^{-1/3}$.

viii) In a uniform steady flow of water through an open channel, the depth of flow is 250 mm. The slope is 0·0004. The shear stress at the wall in N/m^2 is

[Take $g = 10$ m/sec^2]

a) 1 b) 0·1

c) 2·5 d) 0·4.

ix) For a most hydraulically efficient trapezoidal channel section, the wetted perimeter P is given in terms of bed width b and depth of flow h as

a) $P = b + h$ b) $P = b + 2{\cdot}31\, h$

c) $P = b + 2h$ d) $P = b + 4h$.

x) The depth of flow in a rectangular channel is 2m. The velocity head is 1m. The specific energy of flow is

a) 3 m b) 2 m

c) 1 m d) 4 m.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. The model of a boat is prepared to a scale 1 : 10 and towed in a water tunnel. If the speed of the boat is 20 m/sec., determine the towing speed of the model.

   Assume that the boat is subjected to only wave resistance.

3. A rectangular channel carries water at the rate of 400 lit/sec when the bed slope is 1 in 2000. Find the most economical dimension of the channel if $C = 50$.

4. What is specific energy curve ? Draw a specific energy curve, and then derive expressions for critical depth of flow.

5. A closed cylinder of radius 10 cm and height 30 cm is filled with water. If the cylinder is rotated about its vertical axis at a speed of 240 rpm, calculate the force exerted at the top and bottom covers of the cylinder.

6. An oil of sp. gravity 0·9 and viscosity 0·06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 lit/sec. Find the head loss due to friction for a 500 m length of pipe. Also find the power required to maintain this flow.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Prove that for the trapezoidal channel of most economic section “Half of the top width = length of one of the sloping sides”.

   b) A Trapezoidal channel to carry 142 m^3/min of water is designed to have a minimum cross-section. Find the bottom width and depth if the bed slope is 1 in 1200, the side slopes at 45° and Chezy’s co-efficient, $C = 55$.

8. A horizontal pipeline 40 m long is connected to a water tank at one end and it discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is of 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head, which occur

   a) determine the rate of flow (Take $f = 0{\cdot}01$ for both)

   b) draw the Hydraulic and total energy gradient.

9. a) Derive expression for discharge through a channel by Chezy's formula.

   b) For a trapezoidal channel with bottom width 4 m, side slope 2 H : 1 V, Manning constant 0·015, bottom slope 0·0002, Q = 60 cumec, determine normal depth.

10. Differentiate between the following : $5 \times 3 = 15$

    i) Uniform and non-uniform flow

    ii) Steady and unsteady flow

    iii) Laminar and turbulent flow

    iv) Critical, supercritical and sub-critical flow

    v) Rapidly varied flow and gradually varied flow.

11. Using Buckingham π theorem, prove that the discharge over a weir is given by

$$Q = VL^2 \, \phi \left[(gL)^{1/2} / V. \frac{H}{L} \right].$$