

Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

2012

FLUID MECHANICS

Time Allotted : 3 Hours

Ful 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) A floating body is in stable equilibrium so long as
 - a) meta centre M is below the centre of gravity G
 - b) meta centre M is above the centre of gravity G
 - c) the centre of buoyancy B is above the centre of gravity G
 - d) M and G are in same position.
- ii) A hydraulic jump must occur when
 - a) flow is rapid
 - b) depth is less than critical depth
 - c) slope is mild
 - d) flow is increased in a given channel.

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

iii) The unit of kinematic viscosity is

- a) gm/cm-sec^2 b) dyne-sec/cm^2
 c) $\text{gm/cm}^2\text{-sec}$ d) $\text{cm}^2/\text{sec}.$

iv) The metacentric height (GM) is given by

- a) $GM = BG - \frac{1}{V}$ b) $GM = \frac{1}{V} - BG$
 c) $GM = \frac{V}{I} - BG$ d) none of these.

v) Specific speed (N_s) of a pump is given by the expression

- a) $N_s = \frac{N\sqrt{Q}}{H_m^{\frac{5}{4}}}$ b) $N_s = \frac{N\sqrt{Q}}{H_m^{\frac{2}{4}}}$
 c) $N_s = \frac{N\sqrt{P}}{H_m^{\frac{4}{4}}}$ d) $N_s = \frac{N\sqrt{P}}{H_m^{\frac{5}{4}}}.$

vi) Unit power of a turbine is given by

- a) $\frac{P}{H^{\frac{1}{2}}}$ b) $\frac{P}{H^{\frac{5}{2}}}$
 c) $\frac{P}{H^{\frac{3}{2}}}$ d) $\frac{P}{H^{\frac{3}{4}}}.$

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

vii) The error in discharge due to the error in measurement of head over a rectangular notch is given by

a) $\frac{dQ}{Q} = \frac{5}{2} \frac{dH}{H}$ b) $\frac{dQ}{Q} = \frac{7}{2} \frac{dH}{H}$

c) $\frac{dQ}{Q} = \frac{3}{2} \frac{dH}{H}$ d) $\frac{dQ}{Q} = \frac{1}{2} \frac{dH}{H}$.

viii) Reciprocating pump are suitable for

- a) low discharge & high head
- b) low discharge & low head
- c) high discharge & low head
- d) high discharge & high head.

ix) Model analysis of pipe flow are based on

- a) Reynold's number b) Froude number
- c) Mach number d) none of these.

x) Pitot-tube is used to measure

- a) discharge b) average velocity
- c) velocity at a point d) pressure at a point.

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Draw the layout of a hydro-electric power plant showing the reservoir, dam, penstock, turbine, tail race etc.
3. A pipeline 0.225 m in dia & 1580 m long has a slope of 1 in 200 for the first 790 m & 1 in 100 for next 790 m. The pressure at the upper end of the pipe line 107.91 kPa And at the lower end is 53.955 kPa. Taking $f = 0.032$. Determine the discharge from the pipe.
4. a) Define slip, percentage slip and negative slip of a reciprocating pump. 1½
 b) A double acting reciprocating pump, running at 40 rpm is discharging 1.0 m³ of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump. 3½
5. What is specific energy curve ? Draw the specific energy curve and derive the expression for critical depth.
6. What is meant by the most economical channel ? Show that the length of the sloping side is equal to half of the top width for a most economical trapezoidal channel section.
7. Derive the expression for flow over rectangular sharp edged weir or notch.

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

GROUP – C**(Long Answer Type Questions)**Answer any *three* of the following. $3 \times 15 = 45$

8. a) Define metacentre. Derive an expression for determining the metacentric height of a floating body. 8
- b) A circular plate 2.5 m dia is immersed in water, its greatest and least depth below the free surface being 3 m and 1 m respectively. Find (i) the total pressure on one face of the plate and (ii) the position of the centre of pressure. 7
9. a) What is mouthpiece ? What is the advantage of providing a mouthpiece. 5
- b) A large tank having circular orifice $6.45 \times 10^{-4} \text{ m}^2$ in area in its vertical side rests on a smooth horizontal surface when the depth of water in the tank is 1.22 m the discharge through the orifice is 1118.34 N/m^3 and a horizontal force of 9.123 N in line with the centre of the orifice is required to keep the tank at rest. For these data determine the coefficients C_v , C_c , C_d . 10
10. a) Explain the following : 3
- i) Geometric similarity
- ii) Kinematic similarity
- iii) Dynamic similarity.

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

- b) The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho} \right] \quad 12$$

11. a) What is water hammer ? Explain with neat sketch the function of a surge tank to reduce the water hammer action. 2 + 4
- b) Derive an expression for the velocity of pressure wave through an elastic fluid in an elastic pipe 9
12. a) What is priming of a pump and why is it necessary ? 2
- b) Why are centrifugal pumps used sometimes in series and sometimes in parallel ? Draw the following characteristics curves for a centrifugal pump : Head, Power & Efficiency *vs* Discharge at constant speed. 2 + 3
- c) A centrifugal pump discharges $0.15 \text{ m}^3/\text{s}$ of water against a head of 12.5 m , the speed of the impeller being 600 rpm . The outer and inner diameters of the impeller are 500 mm and 250 mm respectively and the vanes are bent back at 35° to the tangent at the exit. If the area of flow remains 0.07 m^2 from inlet to outlet, calculate
- i) Manometric efficiency of pump
 - ii) Vane angle at inlet
 - iii) Loss of head at inlet to impeller when the discharge is reduced by 40% without changing the speed. 8

CS/B.TECH(CE-NEW)/SEM-4/CE-401/2012

13. a) Show that for a hydraulic jump in a horizontal rectangular channel, the alternate depths are related by the expression $y_2 = \frac{y_1}{2} \left[\sqrt{8F_1^2 + 1} - 1 \right]$ with usual notations. Also show that the loss of energy E_L due to hydraulic jump in the rectangular channel with horizontal bottom is given by $E_L = \frac{(y_2 - y_1)^2}{4y_1 y_2}$ 8
- b) A submerged sharp-crested weir 0.8 m high stands clear across a channel having vertical sides and a width of 3 m. The depth of water in the channel of approach is 1.25 m and 10 m downstream from the weir, the depth of water is 1 m. Determine the discharge. 7

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