

FLUID MECHANICS AND HYDRAULIC MACHINES

(Code : MET-404)

Full Marks : 80

Time : 3 hours

Answer any five questions including Q. Nos. 1 & 2

Figures in the right-hand margin indicate marks

1. Answer *all* the questions in brief : 2 × 10
  - (a) Define specific gravity and state its unit.
  - (b) State Archimedi's principle.
  - (c) Write down continuity equation for one dimensional flow.
  - (d) What do you mean by slip of a pump ?
  - (e) Give one example from each of the following water turbine :
    - (i) Impulse turbine
    - (ii) Reaction turbine.
  - (f) Define Hydraulic gradient line.
  - (g) What is the function of venturimeter ?
  - (h) What is the difference between laminar and turbulent flow ?
  - (i) What is Cavitation ?
  - (j) What is Kinematic Viscosity and state its unit ?
2. Answer any *six* : 5 × 6
  - (a) Explain Absolute pressure, Gauge Pressure, Vacuum Pressure and their relationship through a plot.
  - (b) A simple U-tube manometer containing mercury, the right limb is open to atmosphere and left limb is connected to a pipe in which a fluid of specific gravity 0.8 is flowing. The center of pipe is 10 cm below the level of mercury in right limb. Find the pressure of fluid in pipe if difference of mercury level in two limbs is 18 cm.
  - (c) Determine the total pressure and position of centre of pressure on a circular plate of diameter 2 m which is placed vertically in water in such a way that the centre of the plate is 4 m below the free surface of water. Find the position of center of pressure also.
  - (d) Explain Hydraulic co-efficients.
  - (e) Write down the formula for head loss due to friction using Darcy's formula and Chezy's formula with its proper notation.

(Turn Over)

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- (f) Water is flowing through a pipe at the end of which a nozzle is fitted. The diameter of nozzle is 120 mm and head of water at the centre of nozzle is 90 m. Find the force exerted by the jet of water on a fixed vertical plate. Take co-efficient of velocity is given as 0.95.
- (g) What is a Hydraulic turbine and classify it ?
- (h) A single acting reciprocating pump running at 60 rpm delivers  $0.015 \text{ m}^3/\text{sec}$  of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine theoretical discharge of the pump, co-efficient of discharge and slip of the pump.
3. Explain the construction and working principle of a centrifugal pump with neat sketch. 10
4. An oil of sp. gr. 0.9 flowing through a venturimeter having inlet diameter 15 cm and throat diameter 8 cm. The oil-mercury differential manometer shows a reading of 22 cm. Calculate the discharge of oil through the horizontal venturimeter. Take  $c_d = 0.98$ . 10
5. A pelton wheel has a mean bucket speed of 10 m/sec with a jet of water flowing at rate of 800 lit./sec under a head of 40 meters. The bucket deflect the jet through an angle of  $160^\circ$ . Calculate the power given by water to the runner and hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. 10
6. A block of wood of specific gravity 0.8 floats in water. Determine the metacentric height of block if its size is  $4 \text{ m} \times 2 \text{ m} \times 1.6 \text{ m}$ . 10
7. Draw the layout of a hydro-electric power plant and mention its features. 10
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