

Fluid Mechanics and Machinery (313309)

MSBTE Diploma · K-Scheme · Model Question Paper — Set C

Time: 3 Hours**Max. Marks: 70****Instructions:**

1. All questions are compulsory.
2. Answer each next main question on a new page.
3. Illustrate your answers with neat sketches wherever necessary.
4. Figures to the right indicate full marks.
5. Assume suitable data, if necessary.
6. Use of Non-programmable Electronic Pocket Calculator is permissible.
7. Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Q.1 Attempt any FIVE of the following:**10**

- a) Define: (i) Vapour pressure (ii) Kinematic viscosity.
- b) The density of glycerine is 1260 kg/m^3 . Calculate its specific weight, specific gravity and specific volume.
- c) Differentiate between hydraulic gradient line and total energy line with the help of a neat sketch.
- d) Why is a draft tube used in a reaction turbine? Draw a neat sketch of a conical draft tube.
- e) Define the hydraulic coefficients C_c , C_v and C_d and state the relation between them.
- f) State any four laws of fluid friction for laminar flow.
- g) State any two uses of an air vessel in a reciprocating pump.

Q.2 Attempt any THREE of the following:**12**

- a) A circular plate 1.8 m in diameter is immersed in water so that its greatest and least depths below the free surface are 3.0 m and 1.2 m respectively. Determine the total pressure on one face of the plate and the position of the centre of pressure.
- b) Explain with a neat sketch how the pressure difference between two points in pipes is measured using a differential U-tube manometer. Derive the expression for the pressure difference.
- c) A vertical tank open to the atmosphere contains 25 cm of mercury at the bottom, 40 cm of water above it and 60 cm of oil ($S = 0.8$) at the top. Find the absolute pressure in bar (i) at the oil–water interface (ii) at the bottom of the tank. Take atmospheric pressure = 1.01325 bar.

- d) Draw a neat sketch of a Bourdon tube pressure gauge and compare it with manometers (any four points).

Q.3 Attempt any THREE of the following:

12

- A venturimeter is fitted in a pipe of 250 mm diameter carrying water at the rate of $0.06 \text{ m}^3/\text{s}$. The mercury differential manometer connected between the inlet and the throat reads 10 cm. Taking $C_d = 0.97$, find the diameter of the throat.
- Explain the phenomenon of water hammer with a neat sketch. State its effects and the methods to reduce it.
- Water flows through a pipe at the rate of $0.12 \text{ m}^3/\text{s}$. At section 1 the diameter is 300 mm, the pressure is 180 kN/m^2 and the section is 5 m above the datum. At section 2 the diameter is 150 mm and the section is 8 m above the datum. Find the pressure at section 2, neglecting losses.
- Distinguish between laminar flow and turbulent flow (any four points).

Q.4 Attempt any THREE of the following:

12

- A jet of water 75 mm in diameter having a velocity of 22 m/s strikes a fixed flat plate inclined at 35° to the axis of the jet. Find the normal force on the plate and its components along and perpendicular to the jet. Also find the force if the plate were normal to the jet.
- State any four faults in a centrifugal pump with their causes and remedies.
- Explain the construction and working of a Pelton wheel with a neat sketch.
- Explain the working of a single acting reciprocating pump with a neat sketch. State how a double acting pump differs from it.
- Discuss the factors to be considered for the selection of a hydraulic turbine.

Q.5 Attempt any TWO of the following:

12

- A pipe 3 km long and 200 mm in diameter is used for the transmission of hydraulic power. The pressure at the inlet of the pipe is 60 bar. Taking $f = 0.0075$, find the maximum power that can be transmitted, the corresponding discharge and the efficiency of transmission.
- A Pelton wheel of 2 m mean diameter works under a net head of 350 m at 360 rpm. Jet diameter = 200 mm, $C_v = 0.98$, blade angle at outlet = 15° , friction coefficient for buckets $(V_{r2}/V_{r1}) = 0.95$ and mechanical efficiency = 0.90. Determine (i) the power developed by the runner (ii) the hydraulic efficiency (iii) the specific speed.
- Compare Francis turbine and Kaplan turbine (any six points).

Q.6 Attempt any TWO of the following:

12

- A centrifugal pump has an impeller of 400 mm outer diameter and 200 mm inner diameter and runs at 1450 rpm. The vanes are set back at 30° at outlet and the velocity of flow is constant at 2.8 m/s. Water enters radially. The width at

outlet is 40 mm, the manometric head is 60 m and the overall efficiency is 72%. Find (i) the vane angle at inlet (ii) the absolute velocity of water at outlet and its direction (iii) the manometric efficiency (iv) the power required.

- b) Explain the effect of air vessels on the indicator diagram of a reciprocating pump. Draw the indicator diagram showing the combined effect of acceleration head and friction head (i) without air vessels (ii) with air vessels.
- c) Draw and explain the operating characteristic curves and the constant efficiency (Muschel) curves of hydraulic turbines.

Note: This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in