Fluid Mechanics and Machinery (313309)

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

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) Dynamic viscosity (ii) Specific weight.

b) State Pascal's law. Give two applications of it.

c) State the continuity equation and write its expression for an incompressible fluid.

d) State any four laws of fluid friction for turbulent flow.

e) State the function of a draft tube and name any two types of draft tube.

f) Define NPSH (Net Positive Suction Head) of a pump.

g) Name the most suitable turbine for the following conditions: (i) head above 250 m, small discharge (ii) head 60 m to 250 m, medium discharge (iii) low head, large discharge with adjustable runner blades (iv) low head, large discharge with fixed runner blades.

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

a) A circular plate of diameter 2.4 m is immersed vertically in water so that its centre is 3.5 m below the free surface of water. Determine the total pressure on one face of the plate and the position of the centre of pressure.

b) Explain the construction and working of a Bourdon tube pressure gauge with a neat sketch.

c) Define with one example each: (i) Steady and unsteady flow (ii) Uniform and non-uniform flow (iii) Laminar and turbulent flow (iv) Rotational and irrotational flow.

d) A simple U-tube manometer containing mercury is connected to a pipe in which oil of specific gravity 0.9 is flowing. The other limb is open to the atmosphere. The centre of the pipe is 12 cm below the level of mercury in the open limb and

the difference of mercury levels in the two limbs is 22 cm. Find the pressure of oil in the pipe.

Q.3 Attempt any THREE of the following: **12**

a) A horizontal venturimeter of size 200 mm × 100 mm is used to measure the flow of water. The differential mercury manometer connected to the inlet and throat shows a reading of 18 cm of mercury. Find the discharge of water. Take $C_d = 0.97$.

b) Explain the hydraulic gradient line (HGL) and total energy line (TEL) with a neat sketch.

c) What is water hammer in pipes? State its causes and the remedial measures to reduce it.

d) State Bernoulli's theorem. Explain it with a neat sketch and state its assumptions.

Q.4 Attempt any THREE of the following: **12**

a) A jet of water 50 mm in diameter strikes a flat vertical plate normally with a velocity of 25 m/s. Find the force exerted on the plate when (i) the plate is stationary (ii) the plate moves with a velocity of 10 m/s in the direction of the jet. Also find the work done per second and the efficiency in case (ii).

b) Draw a neat labelled layout of a hydro-electric power plant and state the function of its main components.

c) Differentiate between impulse turbine and reaction turbine (any four points).

d) Explain the construction and working of a single acting reciprocating pump with a neat sketch.

e) A pressure gauge on a pipe line reads 2.5 bar. Express this pressure as the head of (i) water (ii) oil of specific gravity 0.85 (iii) mercury. Also express it in kgf/cm² and find the absolute pressure if the atmospheric pressure is 101.325 kN/m².

Q.5 Attempt any TWO of the following: **12**

a) Find the maximum power that can be transmitted through a pipe 4 km long and 300 mm in diameter if the total head available at the inlet of the pipe is 450 m. Take f = 0.0065. Also state the efficiency of transmission at maximum power.

b) A Pelton wheel of 1.8 m mean bucket diameter runs at 360 rpm under a net head of 280 m. The jet diameter is 150 mm and the jet is deflected through 165° by the buckets. The relative velocity at outlet is reduced by 10% due to friction. Take $C_v = 0.98$ and mechanical efficiency = 90%. Find (i) the power developed by the runner (ii) the hydraulic efficiency (iii) the overall efficiency. Draw the velocity triangles.

c) Draw the indicator diagram of a single acting reciprocating pump and explain the effect of (i) acceleration head and (ii) friction head in the suction and

delivery pipes on it. Show the combined effect also.

Q.6 Attempt any TWO of the following: **12**

a) A centrifugal pump has an impeller of 600 mm outer diameter and 300 mm inner diameter and runs at 800 rpm. The vanes are set back at 30° to the outer rim. The velocity of flow is constant at 2.5 m/s and water enters the impeller radially. The width of the impeller at outlet is 50 mm and the manometric head is 40 m. Find (i) the vane angle at inlet (ii) the work done per kg of water (iii) the manometric efficiency (iv) the power required if the overall efficiency is 70%.

b) Draw and explain the performance characteristic curves of hydraulic turbines.

c) Explain the construction and working of a Francis turbine with a neat sketch.

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