Fluid Mechanics Important Questions PDF

The most important Fluid Mechanics topics are fluid properties and viscosity, hydrostatic force and buoyancy, the continuity equation, Bernoulli's equation with the venturimeter, flow through pipes with Darcy-Weisbach losses, laminar flow, boundary layers and dimensional analysis. Learn the standard derivations and practise numericals where you write units at every step.

Key takeaways

- These are practice questions based on common B.Tech syllabus topics. They are not verified past papers.
- Check your own university syllabus and official question papers before you revise.
- Each unit gives definitions, derivations and numericals with short answer outlines.
- Most numericals need only three equations: hydrostatic pressure, continuity and Bernoulli. Practise them until they are automatic.
- Friction factor conventions differ between textbooks. Say which one you use.

Before you start: about these questions

The units below follow the pattern most Indian B.Tech syllabi use for Fluid Mechanics (often called Fluid Mechanics and Fluid Machines, or Fluid Mechanics and Hydraulic Machines). Your university may split topics differently or move turbines and pumps to a separate paper. These are **practice questions based on common syllabus topics, not verified past papers**. Check your own syllabus and official papers. AKTU students can use the official AKTU old question paper page, and the Uncodemy previous year question papers hub links official sources for many other universities.

Use the scientific calculator for square roots and powers and the unit converter for pressure and flow units.

Unit 1: Fluid properties and fluid statics

Definitions and short questions

- Define density, specific weight, specific gravity and specific volume.
- State Newton's law of viscosity. Differentiate dynamic and kinematic viscosity with units.
- What are Newtonian and non-Newtonian fluids? Give examples.
- Define surface tension and capillarity. Why does mercury show capillary fall?
- State Pascal's law and the hydrostatic law.

- Define metacentre and metacentric height. What is the condition for stable equilibrium of a floating body?

Derivations

- Derive the expression for total pressure and centre of pressure on a vertical plane surface.
- Derive the expression for capillary rise, $h = 4\sigma \cos\theta/(\rho g d)$.
- Explain the experimental method of finding metacentric height.

Numericals

- Find the gauge pressure at a depth of 5 m in water. *Outline:* $p = \rho g h = 1000 \times 9.81 \times 5 =$ **49.05 kPa**.
- A vertical rectangular gate 2 m wide and 3 m deep has its top edge at the water surface. Find the total force and depth of centre of pressure. *Outline:* $F = \rho g A \bar{h} = 9810 \times 6 \times 1.5 \approx$ **88.3 kN**. Centre of pressure $= \bar{h} + I_G/(A\bar{h}) = 1.5 + (2 \times 3^3/12)/(6 \times 1.5) = 1.5 + 0.5 =$ **2 m** below the surface.
- Solve a U-tube differential manometer question for pressure difference between two pipes. *Outline:* write pressure balance at a common datum, move through each fluid column, and keep specific gravities clear.

Unit 2: Fluid kinematics

Definitions and short questions

- Differentiate steady and unsteady, uniform and non-uniform, laminar and turbulent flow.
- Define streamline, pathline and streakline. When do they coincide?
- What are stream function and velocity potential? State their properties.
- What is a flow net and where is it used?

Derivations

- Derive the continuity equation in Cartesian coordinates for three-dimensional flow.
- Show that stream lines and equipotential lines are orthogonal.

Numericals

- Water flows through a pipe that narrows from 0.2 m to 0.1 m diameter. Velocity in the large section is 2 m/s. Find discharge and velocity in the small section. *Outline:* $Q = A_1V_1 = (\pi/4 \times 0.2^2) \times 2 \approx$ **0.0628 m³/s**. $V_2 = V_1 (D_1/D_2)^2 = 2 \times 4 =$ **8 m/s**.
- Check whether a given velocity field (for example $u = 2x$, $v = -2y$) satisfies continuity and find the stream function. *Outline:* $\partial u/\partial x + \partial v/\partial y = 2 - 2 = 0$, so flow is possible. $\psi = 2xy$ (up to a constant).

Unit 3: Fluid dynamics

Definitions and short questions

- State Bernoulli's theorem and its assumptions.
- What is the difference between Euler's equation and Bernoulli's equation?
- Define coefficient of discharge, coefficient of velocity and coefficient of contraction.

- What is a pitot tube used for?

Derivations

- Derive Euler's equation of motion along a streamline and integrate it to get Bernoulli's equation.
- Derive the discharge through a venturimeter: $Q = Cd\ A1A2\ \sqrt{(2gh)}/\sqrt{(A1^2 - A2^2)}$.
- Derive the momentum equation and use it to find the force on a pipe bend.

Numerical

- A venturimeter of inlet 200 mm and throat 100 mm shows a differential head h (in metres of water). Find discharge for a given Cd. *Outline:* compute A1 and A2, substitute in the venturimeter equation, and convert mercury manometer readings to water head with $h = x(S_m/S_w - 1)$.

Unit 4: Viscous flow and flow through pipes

Definitions and short questions

- Define Reynolds number and its physical meaning. Give the usual laminar limit for pipe flow.
- What are major and minor losses?
- What are hydraulic gradient line and total energy line?
- What is water hammer?

Derivations

- Derive the Hagen-Poiseuille equation for laminar flow in a circular pipe and show that the maximum velocity is twice the average velocity.
- Derive the Darcy-Weisbach equation for head loss due to friction.
- Derive the loss of head due to sudden enlargement: $h = (V1 - V2)^2/2g$.

Numericals

- Water ($v = 1 \times 10^{-6}\ m^2/s$) flows at 2 m/s in a 0.2 m pipe. Find Reynolds number and flow type. *Outline:* $Re = VD/v = 2 \times 0.2/10^{-6} =$ **4×10^5**, so the flow is turbulent.
- Find the friction head loss in a 100 m pipe of 0.2 m diameter at 2 m/s with Darcy friction factor f = 0.02. *Outline:* $h_f = fLV^2/(2gD) = 0.02 \times 100 \times 4/(2 \times 9.81 \times 0.2) \approx$ **2.04 m**. If your textbook uses 4f in the formula, adjust the coefficient.

Unit 5: Boundary layer and dimensional analysis

Definitions and short questions

- Define boundary layer thickness, displacement thickness and momentum thickness.
- What is boundary layer separation and how can it be controlled?
- Differentiate drag and lift. What is the drag coefficient?
- State Buckingham's π theorem. Define repeating variables.
- Name the important dimensionless numbers (Reynolds, Froude, Euler, Weber, Mach) and where each is used.

Derivations and long questions

- Derive the von Kármán momentum integral equation.

- Using Buckingham's π theorem, show that drag force on a sphere is $F = \rho V^2 D^2 \varphi(Re)$.
- Explain model laws and similitude: geometric, kinematic and dynamic similarity.

Numerical

- A model of a ship is tested at 1:25 scale using Froude similarity. Find the model speed for a prototype speed of 10 m/s. *Outline:* $Vm/Vp = \sqrt{(Lm/Lp)} = 1/5$, so Vm = **2 m/s**.

How to score well in Fluid Mechanics

- **Draw the sketch.** Mark datum, sections 1 and 2, and flow direction before writing any equation.
- **State assumptions.** Steady, incompressible, frictionless flow for Bernoulli; fully developed laminar flow for Hagen-Poiseuille.
- **Watch units.** Convert mm to m and kPa to Pa early. Most errors come from area calculations.
- **Write the final answer with units and a box.** Examiners look for it.
- **Practise manometers.** They look tricky but follow one simple rule and score full marks.
- **Use diagrams in theory answers.** A labelled velocity profile or boundary layer sketch adds marks.

Frequently asked questions

Are these Fluid Mechanics questions from previous year papers?

No. They are practice questions based on common B.Tech syllabus topics. Check your own university syllabus and official papers, such as the AKTU old question paper page, to see the real pattern.

Which topics are most important in Fluid Mechanics?

Hydrostatic force, Bernoulli's equation with the venturimeter, pipe flow losses, laminar flow and dimensional analysis appear in most syllabi. Your university's paper pattern sets the final weight.

Which derivations should I learn first?

Start with Bernoulli's equation from Euler's equation, the venturimeter discharge, Hagen-Poiseuille flow, Darcy-Weisbach head loss and total pressure on a vertical plane.

Why do my friction loss answers differ from the textbook?

Some books write $h_f = fLV^2/2gD$ with the Darcy factor and others use 4f with the Fanning factor. Both give the same answer if you use the matching value of f.

Is Fluid Mechanics common to Mechanical and Civil?

Yes, both branches study it, though civil syllabi often add open channel flow and mechanical syllabi add turbines and pumps. Check your own syllabus.

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Sources and further reading

- AKTU old question papers (official)
- NPTEL courses
- AICTE (model curriculum and approvals)

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