

Total No. of Questions: 09

B.Tech. (ME) (Sem. – 4)

FLUID MECHANICS-I

M Code: 59015

Subject Code: ME-206

Paper ID: [A0810]

Time: 3 Hrs.

Max. Marks: 60

INSTRUCTIONS TO CANDIDATES:

1. **SECTION-A** is **COMPULSORY** consisting of **TEN** questions carrying **TWO** marks each.
2. **SECTION-B** contains **FIVE** questions carrying **FIVE** marks each and students have to attempt any **FOUR** questions.
3. **SECTION-C** contains **THREE** questions carrying **TEN** marks each and students have to attempt any **TWO** questions.

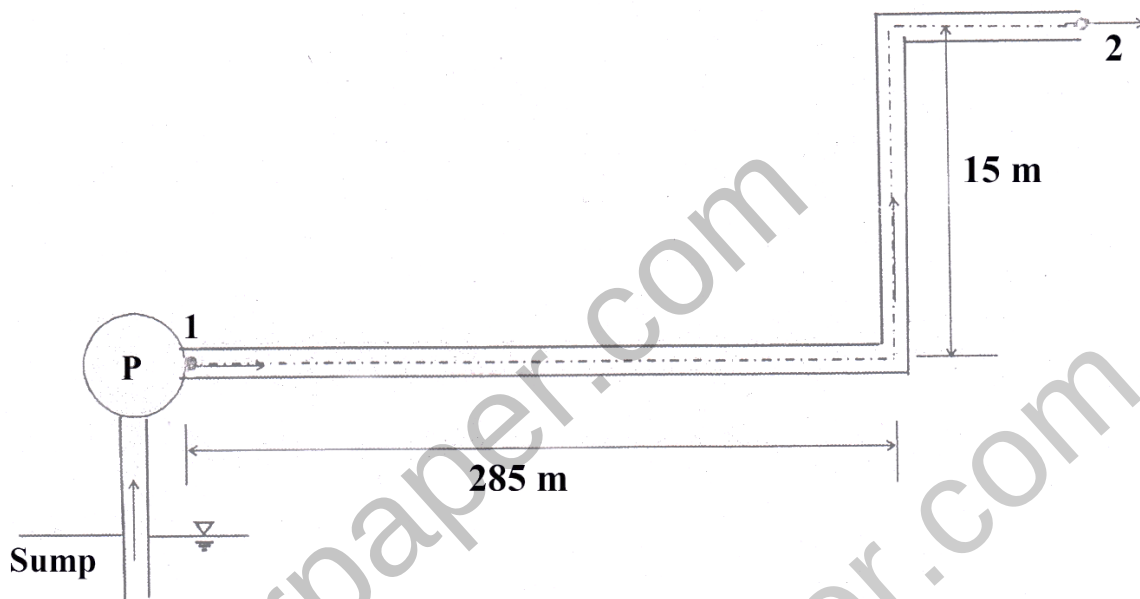
SECTION A

1. a) Explain compressibility of a fluid.
b) How is the hydrostatic force acting on a curved surface determined?
c) What is relative equilibrium? Why is a fluid in relative equilibrium free from shear stresses?
d) Differentiate steady and unsteady flows.
e) Express Euler's equation of motion in Cartesian coordinates.
f) What is kinetic energy correction factor and what is its significance?
g) What are distorted and undistorted models? What is the use of distorted models?
h) Explain the variation of friction factor for laminar and turbulent flows.
i) Define HGL and TEL with the help of an example.
j) What is a Pitot tube and how does it work?

SECTION B

2. A cylinder of radius 120 mm rotates concentrically inside a fixed hollow cylinder of 130mm radius. Both the cylinders are 300 mm long. Determine viscosity of the fluid that fills the space between the cylinders if a torque of 0.88 Nm is required to maintain an angular velocity of 2π rad/s.

3. A U-tube differential manometer is used to measure the pressure difference between two points in a pipe containing water. The distance between the gauge points is 200 mm. Determine pressure difference if (i) pipe is horizontal and the manometer reading is 250 mm and (ii) pipe is vertical and the manometer reading is 100 mm.
4. A flow is described by the stream function, $\psi = 2\sqrt{3} xy$. Locate the point at which the velocity vector has a magnitude of 4 units and makes an angle of 150° with the x-axis.
5. Water is to be pumped from a sump at the rate of $0.02 \text{ m}^3/\text{s}$ using a 150 mm diameter pipe as shown in Figure 1. If the pipe is discharging freely, determine (i) pressure developed by the pump on its delivery side and (ii) power delivered to water by the pump. Given, friction factor = 0.03 and efficiency of pump = 70%.



6. A pipeline consists of the following fittings and the values of loss coefficient as given in the table:

Type of fitting	Value of loss coefficient
Tee	1.8
Elbow	0.9
Bend	1.2
Gate valve	0.19

Determine the equivalent length of a 400 mm diameter pipe for the above fittings. Given, friction factor = 0.02.

SECTION C

7. A lawn sprinkler has two identical nozzles of diameter 12 mm each, provided at the ends of a rotating arm of a sprinkler. Both the nozzles are discharging water in the same directions and in the same horizontal plane. The left nozzle is located at a radial distance of 200 mm from the center of rotor while the other nozzle is located at a radial distance of 150 mm from the center of rotor. The velocity of flow from each nozzle is 10 m/s. Determine (i) torque required to hold the rotating arm stationary and (ii) constant speed of rotation of the arm, if it is free to rotate.
8. A cylindrical buoy diameter 1.5 m, 1.1 m high and weighing 4.45 kN is floating in sea water with its axis vertical. A load of 450 N is placed centrally on the top of buoy. Find the maximum permissible height of this load. Take specific gravity of sea water = 1.025.
9. The resisting force R of a supersonic aircraft during flight can be considered to depend upon the length of the aircraft L , velocity V , air viscosity μ , air density ρ and the bulk modulus of air K . Express a functional relationship between the variables and the resisting force.