QUESTION BANKS

FLUID MECHANICS

1st Chapter: (Properties of fluid)

2 marks questions:

1. Define fluid and write its properties.
2. Define the following terms and its units.
   a)Density b)Weight density c)Specific volume d)Specifics gravity e)Dynamic viscosity f)Kinematic viscosity
3. Define Newtonian and Non-Newtonian fluids.
4. Define surface tension and its unit.
5. Define capillarity phenomenon.
6. Convert 1kg/sec-m, dynamic viscosity in poise.
7. Define viscosity and its unit (S.I).
8. Define ideal fluid and real fluid.
9. What is the difference between Dynamic viscosity and Kinematic viscosity?
10. How does the viscosity of fluid vary with temperature?

5 marks questions:

1. One litre of crude oil weighs 9.6N. Calculate its specific weight, density and specific gravity.
2. A plate 0.025mm distant from a fixed plate moves at 60cm/sec and requires a force of 2N per unit area i.e $2N/m^2$ to maintain this speed. Determine the fluid viscosity between the plates in the poise.
3. The surface tension of water in contact with air at 20^oC is 0.0725N/m. The pressure inside a droplet of water is to be $0.02N/cm^2$ greater than the outside pressure. Calculate the diameter of the droplet of water.
4. Find the surface tension in a soap bubble of 40mm diameter when the inside pressure is $2.5N/M^2$ above the atmospheric pressure.
5. The pressure outside the droplet of water of diameter 0.04mm is $10.32N/cm^2$ (at atmospheric pressure). Calculate the pressure with the droplet if the surface tension is given as 0.0725 N/m of water.

10 marks questions:

1. Determine the intensity of shear of an oil having viscosity=1poise. The oil is used for lubricating the clearance between a shaft of diameter 10cm and its journal bearing. The clearance is 1.5mm and the shaft rotates at 150rpm.
2. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8mx0.8m and an inclined plane with angle of inclination 30^0. The weight of square plate is 300N and its slides down the inclined plane with a uniform velocity of 0.3m/s. The thickness oil film is 1.5mm.
3. Find the kinematic viscosity of an oil having density $9.81kg/m^3$.The shear stress at a point in oil is $0.2452N/m^2$ and velocity gradient at that point is 0.2 per second.
4. Calculate the capillary rise in a glass tube of 2.5mm diameter when immersed vertically in (a) water (b) mercury. Take surface tension=0.0725N/m for water and surface tension=0.52N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact=130^0
5. Find out the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2mm. Consider surface of water in contact with air as 0.073575 N/m.

2nd Chapter: (Fluid pressure and its measurement)

2 marks questions:

1. Define fluid pressure and its unit.
2. Define pressure intensity and pressure head.
3. State Pascal's law.
4. Define absolute pressure and gauge pressure.
5. What is atmospheric and vacuum pressure?
6. What is a manometer and write its classification.
7. What do you mean by single column manometers?
8. Distinguish between manometers and mechanical gauges.
9. What is the difference between U-tube differential manometer and inverted U-tube manometer?
10. Define piezometer and U-tube manometer?

5 marks questions:

1. State and prove the Pascal's law.
2. What do you mean by single column manometer? How are they used for the measurement of pressure?
3. Distinguish between manometer and mechanical gauges. What are the different types of mechanical pressure gauges?
4. Explain briefly the working principle of Bourdon tube Pressure gauge with a neat sketch.
5. A pipe contains an oil of sp.gravity 0.9. A differential manometer connected at the two points A&B shows a difference in mercury level at 15cm. Find the difference of pressure at the two points.

10 marks questions:

1. Describe the classification of pressure measurement devices.
2. An open tank contains water upto a depth of 2m and above it an oil of sp.gravity 0.9 for a depth of 1m. Find the pressure intensity (i) at the interference of the two liquids.
   (ii) At the bottom of the tank.
3. What are gauge pressure and absolute pressure at a point3m below the free surface of a liquid having a density of $1.53x10^3$ kg/m^3, if the atmospheric pressure is equivalent to 750mm mercury? The specific gravity of mercury is 13.6 and density of water is 1000kg/m^3.
4. The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp.gravity 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm.
5. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp.gravity of 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to the atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40cm and the height of fluid in the left from the centre of pipe is 15cm below.
6. A differential manometer is connected at the two points A & B of two pipes. The pipe A contains a liquid of sp.gravity =1.5 while pipe B contains a liquid of sp.gravity=0.9. The pressure at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer.

3nd Chapter: (Hydrostatics)

2 marks questions:

1. What do you understand by total pressure and centre of pressure?
2. Define hydrostatic pressure.
3. Define Buoyance metacentre and metacentric height.
4. State Archimedes' principle.
5. Define flotation.

5 marks questions:

1. Determine the total pressure and depth of centre of pressure on a plane rectangular surface of 1m wide and 3m deep when its upper edge is horizontal and
   (a) Coincides with water surface
   (b) 2m below the free water surface
2. Determine the total pressure on a circular plate of diameter 1.5m which is placed vertically in water in such a way that the centre of the plate is 3m below the free surface of water. Find the position of centre of pressure also.
3. Define the principle of flotation explain the condition of equilibrium of a floating body.

10 marks questions:

1. Derive expression for total pressure and centre of pressure on horizontal immersed bodies.
2. Derive an expression for total pressure and centre of pressure on vertical immersed bodies.
3. A rectangular plane surface is 2m wide and 3m. deep. It lies in vertical plane in water. Determine the total pressure and position of centre of pressure on the plane surface where its upper edge is horizontal and
   (a) Coincides with water surface
   (b) 2.5m below the free water surface
4. Determine the total pressure on a circular plate of diameter 1.5m. which is placed vertically in water in such a way that the centre of the plate is 3m. below the free surface of water. Find the position of centre of pressure also.

5. Find the volume of water displaced and position of centre of buoyancy for a wooden block of width 2.5m and of depth1.5m, when it floats horizontally in water. The density of wooden block is 650kg/m^3 and its length 6m.

4th Chapter: (Kinematics of flow)

2 marks questions:

1. Define the following with example :
   (a) Laminar flow (b) Turbulent flow
2. Define the equation of continuity.
3. Define the following with example:
   (a)Laminar flow (b) Turbulent flow
4. State Bernoulli's theorm.
5. Define one-dimensional and two-dimensional flow.
6. Define rotational and irrerotational flow.
7. What is the function of venturimeter and pitot tube.
8. Define Bernoulli's equation.

5 marks questions:

1. Derive continuity equation for one-dimensional flow of liquid.
2. State Bernoullis's theorm for steady flow of an incompressible fluid and derive an expression for Bernoulli's theorm from 1st principle.
3. What is the application and limitations of Bernoulli's theorm.

10 marks questions:

1. Explain the principle of venturimeter with a neat sketch and derive the expression for the rate of flow of fluid.
2. Water is flowing through a pipe having diameter 300mm. and 200mm at the bottom and upper end respectively.. The intensity of pressure at the bottom end is 24.525 N/cm^2 .and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40lit/ses.
3. The water is flowing through a pipe having diameter 20cm and 10cm. at sections 1 and 2 respectively. The rate of flow through pipe is 35lits/sec.The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure at section 1 is 39.24 N/cm^2. Find the intensity of pressure at section 2.
4. A pipe of diameter 400mm carries water at a velocity of 25m/sec. The pressure at the points A &B are given as 29.43N/cm^2. And 22.563 N/cm^2. Respectively while the datum head at A and B are 28m and 30m. Find the loss of head between A &B.
5. An oil of sp.gravity 0.8 is flowing through a venturimeter having inlet diameter 20cm. and throat diameter10cm. The oil-mercury differential manometer shows a reading of 25cm. Calculate the discharge of oil through the horizontal venturimeter. Take C_d =0.98
6. A horizontal venturimeter with inlet diameter 20cm and the throat diameter 10cm is used to measure the flow of oil of sp.gravity 0.8. The discharge of oil through venturimeter is 60lit./sec. Find the readings of the oil-mercury differential manometer. Take C_d= 0.98
7. A pitot –static tube is placed in the centre of a 300mm. pipe line has one orifice pointing upstream and other perpendicular to it. The mean velocity in the pipe is 0.80

of the central velocity. Find the discharge through the pipe if the pressure difference between the two orifices is 60mm of water. Take co-efficient of pitot tube as C_v=0.98

8. Find the velocity of flow of an oil through a pipe, when the difference of mercury level in a differential U-tube manometer connected to the two tappings of the pitot tube is 100mm. Take co-efficient of pitot tube 0.98 and sp.gravity of oil 0.8.

5^{th} Chapter: (Orifices, notches and weirs.)

2 marks questions:

1. Define orifices and what are the hydraulic co-efficients ?
2. Define the following co-efficients:
   (a) co-efficient of velocity
   (b) co-efficient of contraction
   (c) co-efficient of discharge
3. Define vena-contracta.
4. Define the terms:notch,weir,nappe, and crest.
5. What are the classification of orifice according to the shape of opening?

5 marks questions:

1. Explain the classification of orifices based on shape, size.
2. Derive the expression $C_d=C_c x C_v$
3. How are the weirs and notches classified?
4. What are the advantages of triangular notch or weir over rectangular notch.
5. What is the difference between notch and a weir?

10 marks questions:

1. Find an expression for the discharge over a rectangular weir in terms of head of water over the crest of the weir.
2. Prove that the discharge through a triangular notch or weir is given by $Q=8/15 C_d \times \tan\theta/2 \times \sqrt{2g}\, H^{3/2}$

Where h=Head of water over the notch or weir

θ = Angle of notch or weir

3. Derive an expression of flow through an orifice.
4. Determine the height of rectangular weir of length 6m to be built across a rectangular channel. The maximum depth of water on the upstream of the weir is 1.8m. and discharge is 2000 lit/sec. Take $C_d=0.6$ and neglect end contracts.
5. Find the discharge over triangular notch of angle 60^0 , when the head over the V-notch is 0.3m. Assume $C_d=0.60$
6. A rectangular channel 2m. wide has a discharge of 250lits/sec, which is measured by right angled V-notch weir. Find the position of the apex of the notch from the bed of the channel if maximum depth of water is not to exceed 1.3m.. Take $C_d=0.62$

6th Chapter: (Flow through pipes)

2 marks questions:

1. Define pipes and what is the loss of energy in pipes?
2. Define the following terms:
   (a) Hydraulic gradient line
   (b) Total energy line
3. How will you determine the loss of head due to friction in pipes by using

   (i) Darcy's formula

   (ii)Chezy's formula

5 marks questions:

1. Derive Chezy's formula for loss of head due to friction in pipes.
2. Derive Darcy formula for loss of head due to friction in pipes.

10 marks questions:

1. Find the head lost due to friction in a pipe of diameter 300mm and length 50m. through which water is flowing at a velocity of 3m/sec using

   (i) Darcy's formula

   (ii)Chezy's formula

   for which C=60, Take v for water= 0.01 stoke.

2. Find the diameter of pipe of length 2000m when the rate of flow of water through the pipe is 200lit/sec and the head lost due to friction is 4m. Take the value of C=50 in Chezy's formula.

7th Chapter: (Impact of jets)

2 marks questions:

1. Define the term impact of jets?
2. What is the condition for maximum efficiency on series of vanes?
3. Draw inlet and outlet velocity diagram of velocity of jet of moving vertical flat plate.
4. Draw inlet and outlet velocity diagram of velocity of jet of fixed vertical flat plate.

5 marks questions:

1. Derive an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of jet.
2. Derive an expression for the force exerted by a jet of water on a moving vertical
   plate in the direction of jet.

10 marks questions:

1. Derive an expression for the force exerted by a jet of water on series of vanes. Prove that maximum efficiency is when u=V/2 and the value of maximum efficiency is 50%.
2. Derive an expression for the force exerted on series of radial curved vanes and condition for maximum efficiency using velocity triangles.
3. Find the force exerted by a jet of water of diameter 75 mm on a stationary flat plate, when the jet strikes the plate normally with velocity of 20m/sec