MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Department of Civil Engineering
Question Bank - Academic Year (2021-2022)

Course Code & Course Name : 19CED07 / MECHANICS OF FLUIDS

Year/Sem/Sec : II/III

Unit-I: FLUID PROPERTIES & FLUID STATICS

Part-A (2 Marks)

1. Define the following fluid properties. State their dimensions and units: specific weight ι & specific gravity. (Nov/Dec 2008)
2. State and explain Newton's law of viscosity. (Nov/Dec 2008, Nov/Dec 2008)
3. What is dynamic viscosity? What are its units? (May/June 2009, May/June 2007)
4. Define viscosity. (Nov/Dec 2010, Nov/Dec 2011)
5. Define cohesion and adhesion. (Nov/Dec 2010)
6. What is meant by control volume of liquid? (Nov/Dec 2010)
7. What is compressibility of fluid. (Nov/Dec 2010)
8. Calculate the capillary rise in a glass tube of 1.8mm diameter when immersed vertically in water. Take surface tension of water as 0.073 N/m. (May/June 2007)
9. Differentiate between specific volume and specific weight. (Nov/Dec 2007)
10. Distinguish between real and ideal fluid. (Nov/Dec 2007)

Part-B (16 Marks)

1. A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs U. U tube is 10 cm and the free surface of mercury is in level with over the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m2, calculate the new difference in the level of mercury. Sketch the arrangement in both cases (16)
2. The diameters of a small piston and a large piston of a hydraulic jack at3cm and 10 cm respectively. A force of 80 N is applied on the small piston Find the load lifted by the large piston when: (16)
   The pistons are at the same level
   Small piston in 40 cm above the large piston.
   The density of the liquid in the jack in given as 1000 kg/m3
3. The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil (16)

film is 1.5 mm.

4. Calculate the dynamic viscosity of oil which is used for lubrication between a square plate of size 0.8 mx0.8 m and an inclined angle of inclination 300. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of the oil film is 1.5 mm.and also draw the sketch. (16)

5.(i). What is the difference between U – tube differential manometer and inverted U-tube differential manometer? (8)

(ii). 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 tension of water in contact with air as 0.073575 N/m. (8)

Unit-II : FLUID KINEMATICS & FLUID DYNAMICS

Part-A (2 Marks)

1. State pascal's law and hydrostatic law. (Nov/Dec 2009)
2. Differentiate between steady flow and unsteady flow. (May/June 2009)
3. Define stream function and write their properties. (May/June 2007, May/June 2009, Nov/Dec 2010)
4. What are the commonly used mechanical gauges? (Nov/Dec 2010)
5. What is flow net. (Nov/Dec 2010)
6. Define a rotational flow and irrotational flow. (Nov/Dec 2011)
7. Write the formula used to determine the Meta Centric Height. (May/June 2007)
8. Differentiate stream line and path line. (May/June 2007)
9. State the assumptions used in deriving Bernoulli's equation. (May/June 2007, Nov/Dec 2010)
10. Write down the types of fluid flow.

Part-B (16 Marks)

1. Water flows through a pipe AB 1.2m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter at C, the pipe branches. Branch CD is 0.8m in diameter and carries one third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. (16)
2. A horizontal Venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the discharge. (16)
   Take $C_d = 0.98$.
3. The x and y components of velocity in a 2-D incompressible flow are as follows: $u = 3x + y$ and $v = 2x – 3y$. Derive an expression for the stream function and hence show that the flow is not irrotational. Also calculate the velocity at the point (-1, 2). (16)

4. The velocity potential function is given by an expression $\varphi = y^2 - x^2 + (x^3y/3) - (xy^3/3)$. Check continuity flow. Find the velocity components in X and Y directions. (16)

5.(i) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation. (8)

(ii) A pitot – static tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6mm and static pressure head is 5m. Calculate the velocity of flow assuming the co-efficient of tube equal to 0.98. (8)

Unit-III : FLOW THROUGH PIPES

Part-A (2 Marks)

1. What is Moody's diagram? (Nov/Dec 2007, Nov/Dec 2007)
2. What is a laminar flow? Give examples. (May/June 2009)
3. State the characteristics of laminar flow. (Nov/Dec 2010)
4. What is cavitation in venturimeter?
5. Where are the Darcy weishbach and Chezy's forumalae used?
6. State the principle of momentum.
7. Define Hydraulic gradient line.
8. Define the terms: Major energy loss and minor energy loss in pipe?
9. What do you understand by (a) pipes in series (b) pipes in parallel?
10. What do you understand by the terms a) major energy losses , b) minor energy losses

Part-B (16 Marks)

1. Derive an expression for the velocity distribution for the viscous flow through a circular pope and sketch the shear stress distribution and velocity distribution across the section of the pipe. (16)
2. A pipe line, 300mm in diameter and 3200m long is used to pump up 50kg per second of an oil whose density is 950n kg/m^3.and whose Kinematic viscosity is 2.1 stokes. The center of the pipe at upper end is 40m above than at the lower end. The discharge at the upper end is atmospheric. Find the pressure at the lower end and draw the hydraulic gradient and the total energy line (16)
3. The rate of flow through a horizontal pipe is 0.25 m^3/s. the diameter of the pipe which is 200mm is suddenly enlarged to 400mm. the pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine (i). Loss of head due to sudden enlargement (ii) Pressure intensity in large pipe. (iii) Power lost due to enlargement. (16)
4. A horizontal pipeline 40m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150mm diameter is suddenly enlarged to 300mm. the height of water level in the tank is 8m above the centre of the pipe. Considering all losses of head, which occur. Determine the rate of flow. Take f = 0.01 for both sections of the pipe. (16)

5. A main pipe divides into two parallel pipes, which again forms one pipe . The length and diameter for the first parallel pipe are 2000m and 1.0m respectively, while the length and diameter of 2nd parallel pipe are 2000m and 0.8m. Find the rate of flow in each parallel pipe, if total flow in main is 3.0 m^3/s. the co-efficient of friction for each parallel pipe is same and equal to 0.005. (16)

Unit-IV : BOUNDARY LAYER

Part-A (2 Marks)

1. What is meant by laminar sub layer? (May/June 2007)
2. Define energy thickness. (Nov/Dec 2007)
3. What is meant by hydraulic gradient line. (Nov/Dec 2007)
4. Define displacement thickness. (Nov/Dec 2008)
5. Define momentum thickness of boundary layer. (May/June 2009)
6. What is hydraulic mean depth or hydraulic radius? (Nov/Dec 2010)
7. What are the methods adopted for controlling the boundary layer? (Nov/Dec 2010)
8. Why are the pipes connected in parallel? (Nov/Dec 2011).
9. Write down the examples laminar flow / viscous flow?
10. What are the characteristics of laminar flow?

Part-B (16 Marks)

1. For the laminar boundary layer,the velocity distribution is given by $u/U = 2(y/\delta) -2(y/\delta)^2$ Compute the boundary layer thickness (δ),shear stress (τ),co-efficient of drag (C_D) in terms of Reynold number. (16)
2. For the laminar boundary layer,the velocity distribution is given by $u/U = 3/2(y/\delta) -1/2 (y/\delta)^3$ Compute the boundary layer thickness (δ),shear stress (τ),co-efficient of drag (C_D) in terms of Reynold number (16)
3. Derive expressions for displacement thickness and momentum thickness. (16)
4. Find the displacement thickness and the momentum thickness for the velocity distribution in the boundary layer given by by $u/U = 2(y/\delta) -2(y/\delta)^3 + (y/\delta)^4$. (16)

5.(i) For the following velocity profiles, determine whether the flow has separated or on the verge of separate or will attach the surface: (8)

(a) $u/U = 3/2(y/\delta) -1/2(y/\delta)^3$ (b) $u/U = 2(y/\delta)^2 -(y/\delta)^3$ (c) $u/U = -2(y/\delta) +(y/\delta)^2$

(ii) What is separation of boundary layer? When it occurs? Discuss the methods for the control of boundary layer separation. (8)

Unit-V : SIMILITUDE AND MODEL STUDY

Part-A (2 Marks)

1. Define Reynolds model law. (May/June 2007)
2. What is meant by the term distorted model? (May/June 2007, May/June 2009)
3. What is meant by dimensional homogeneity? (Nov/Dec 2007, May/Jne 2009)

4. State Buckingham's pie theorem. (Nov/Dec 2007, Nov/Dec 2008, Nov/Dec 2010, Nov/Dec 2011)
5. What is meant by repeating variables? (May/June 2009)
6. What is meant by scale effect? (Nov/Dec 2010)
7. Mention at least two uses of dimensional analysis. (Nov/Dec 2011)
8. Define dimensional analysis.
9. Write the uses of dimension analysis?
10. Define model law or similarity law.

Part-B (16 Marks)

1. The resisting force of (R) of a supersonic flight can be considered as dependent upon the length of aircraft "l", velocity 'V', air viscosity 'μ', air density 'ρ', and bulk modulus of air 'k'. Express the functional relationship between these variables and the resisting force. (16)
2. A ship 150 m long moves in fresh water at 36 km/hr. A 1:100 model of this ship is to be tested in a towing basin containing a liquid of gravity 0.90. What viscosity must this liquid should have for both Reynolds and Froude model laws to be satisfied? Also find the speed which the model must be towed. μ of water = 1.13x10-3 Ns/m^2. (16)
3. Efficiency η of a fan depends on the density ρ, the dynamic viscosity of the fluid μ, the angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensional parameters. (16)
4. The spillway model is to be built to a geometrically similar scale of 1:50 across a flume of 60 cm width. The prototype is 1.5 m high and the maximum head on it is expected to be 1.5 m. What height of model and what head on the model should be used. If the flow over the model at a particular head is 12 lps, what flow per meter length of the prototype is expected? If the pressure in the model is 14 cm, what is the negative pressure in prototype? Is it practicable? (16)
5. Using Buckingham's π-theorem, show that the drag force FD of an aircraft is given by FD = ρ L2 V2 φ (Re, M) in which Re = ρ V L / μ; M = V/C; ρ = fluid mass density; L = chord length; V = velocity of aircraft; μ = fluid viscosity; C = sonic velocity = (K / ρ)1/2 where K = bulk modulus of elasticity. (16)

Course Faculty **HoD**