UKA TARSADIA UNIVERSITY

B.Tech (Automobile) (Semester 3)
030130306(2016-17)
Fluid Mechanics

Date :14/12/2021 **Time :**1:30PM- 4:30PM
Max. Marks:60

Instructions :

1. Attempt all questions.
2. Write each section in a separate answer book.
3. Make suitable assumptions wherever necessary.
4. Draw diagrams/figures whenever necessary.
5. Figures to the right indicate full marks allocated to that question.
6. Follow usual meaning of notations/abbreviations.

SECTION - 1

Q 1 A) Answer the following in brief (Any 2) **[4]**

I) Write the SI units of specific weight and specific gravity.

II) Define compressibility.

III) How does viscosity of a fluid vary with temperature?

Q 1 B) Answer the following (Any 2) **[6]**

I) A plate 0.025 mm distance from a fixed plate, moves at 60cm/s and requires a force of 2N per unit area to maintain this speed. Determine the fluid viscosity between the plates.

II) Discuss the classification of fluid with the help of schematic of shear stress verses velocity gradient.

III) What is surface tension? Derive the expression of surface tension for a liquid droplet.

IV) Determine the minimum size of glass tubing that can be used to measure water level. If the capillary rise in the tube is not to exceed 0.4 mm .take surface tension of water in contact with air as 0.075 N/m.

Q 2 Answer the following in detail. (Any 2) **[10]**

I) Prove that “The rate of change in pressure in a vertical direction is equal to weight density of the fluid at that point”.

II) Derive the equation of meta-centric height.

III) A hydraulic press has a ram of 30 cm diameter and a plunger of 4.5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500 N.

Q 3 A) Answer the following in brief (Any 2) **[4]**

I) What are the steps for selecting repeating variable in dimensional analysis?

II) Give the fundamental dimensions (MLT) for: Density, Dynamic Viscosity, Pressure force and Specific Gravity.

III) Classify various types of flow.

Q 3 B) Answer the following (Any 2) **[6]**

I) The time period (t) of a pendulum depends upon length (L) of the pendulum and acceleration due to gravity (g). Derive an expression for the time period.

II) The pressure difference in a pipe of diameter d and length l due to turbulent flow depends on velocity, viscosity,density and roughness. Using Buckingham’s - theorem, obtain an expression for pressure difference and tell the reason why this expression will not be complete form of the relating parameters.

III) A fluid flow field is given by: V= x2y i + y2zj - (2xyz + yz^2) k. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity at the point (2,1,3).

IV) In a two dimensional incompressible flow, the fluid velocity components are given by: u = x – 4y and v = -y-4x. Show that velocity potential exists and determine its form.

SECTION - 2

Q 4 A) Answer the following in brief (Any 2) **[4]**

I) Write the statement of Newton's second law of motion for fluid and mention the forces involved in it.

II) What is orifice meter?

III) Differentiate between Laminar flow and Turbulent flow.

Q 4 B) Answer the following (Any 2) **[6]**

I) Prove that co-efficient of discharge is the product of the co-efficient of velocity and co-efficient of contraction.

II) Derive the relation between maximum velocity and average velocity in laminar flow through circular pipe.

III) Water is flowing through a pipe having diameter 600 mm and 400 mm at bottom and upper end respectively. The intensity of pressure at bottom end is 350 kN/m^2 and pressure at upper end is 100 kN/m^2 determine the difference in datum head if the rate of flow through pipe is 60 litre/s.

IV) The head of water over an orifice of diameter 100 mm is 10 m. The water coming out from orifice is collected in a circular tank of diameter 1.5 m. The height of water level in this tank is 1.0 m in 25 seconds. Also the co-ordinates of a point on the jet, measured from vena-contracta are 4.3 m horizontal and 0.5 m vertical. Find $C_{d,}$ C_v and $C_{c.}$

Q 5 A) Answer the following in brief (Any 3) **[6]**

I) Sketch the boundary layer on flat plate with water flow over it.

II) When a flow is seperated? Give the methods to avoid flow seperation.

III) Define momentum thickess and write the equation giving momentum thickness for a given boundary layer.

IV) What do you mean by Laminar sub layer?

Q 5 B) Answer the following (Any 1) **[4]**

I) Calculate the displacement thickness and momentum thickness for velocity distribution in the boundary layer given by $u/U = 3(y/\delta)-(y/\delta)^2$

II) Air is flowing over a smooth plate with a velocity of 6 m/s. The length of the plate is 2 m and width 1 m. If laminar boundary
layer exits up to a value of $Re = 4 \times 10^5$, find the maximum distance from the leading edge up to which laminar boundary layer
exists.

Q 6 A) Answer the following in brief (Any 2) **[4]**

I) What is the compressible flow? Give examples for it.

II) Derive the relation between pressure and density of a compressible flow for isothermal process.

III) Obtain a corelation between pressure and density of a compressible flow for adiabatic process.

Q 6 B) Answer the following (Any 2) **[6]**

I) Derive the expression for stagnation density using the stagnation pressure equation asa basic equation.

II) Express Bernoulli's Equation for adiabatic process in compressible flow.

III) A projectile is travelling in air having pressure and temperature as 8.829 N/cm2 and -2^0C. If the Mach angle is 40^0, find the velocity of projectile. Take k=1.4 and R=287 J/kg^0C.

IV) Calculate the stagnation pressure, density at stagnation point on the noise of a plane, which is flying at 700 km/hour through still air having a pressure 7.5 N/cm^2 and temperature -10^0C. Take k=1.4 and R=287 J/kg^0C.