UKA TARSADIA UNIVERSITY

B.Tech (Mechanical) (Semester 3)
030050306(2013-14)
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 1) **[2]**

I) Calculate the density,specific weight and weight of one litre of petrol of specific gravity=0.8.

II) How is ideal fluid different from real fluid?

III) Define Cavitation.

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

I) Enlist fluid properties and explain any three in brief.

II) Calculate the capillary effect in milimeters in a glass tube of 4mm diameter,when immersed in (i)water and (ii) mercury. the temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contact air are 0.073575 N/m and 0.51N/m respectively. the angle of contact for water is zero and that for mercury is 130° .Take density of water at 20°C as equal to 998kg/m^3.

III) The surface tension of water in contact with air at 30°C is 0.0736 N/m. The pressure inside the droplet of water is to be 0.04 N/cm^2 greater than the outside pressure. Calculate the diameter of droplet of water.

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

I) Define: (i) Mass Density and, (ii) Weight density.

II) Define: Capilarity. Write the condition (range of angle of inclination of surface tension) for capillary rise.

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

I) A rectangular pontoon is 8 m long, 4 m wide and 1.5 m high. The depth of immersion of pontoon is 0.80 m in sea water. If the centre of gravity is 0.6 m above the bottom of pontoon, determine the metacentric height. The density of sea water is 1015 kg/m^3.

II) Prove that “The rate of increase of pressure in a vertical direction is equal to weight density of the fluid at that point”. (Hydrostatic law)

III) Derive the equation of total pressure and center of pressure when curved surface submerged in liquid.

Q 3 A) Answer the following in brief. (Any 1) **[2]**

I) What is meant by streamline and stream tube?

II) What is the difference between path line and streak line?

III) Explain the term, ‘dimensionally homogeneous equation’.

Q 3 B) Answer the following in detail. (Any 2) **[10]**

I) The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\ \varphi[\mu/D^2N\rho]$. Prove this by pi-theorem method.

II) A stream function is given by φ = 8x – 10y. Determine (i) velocity components and (ii) magnitude and direction of the resultant velocity at any point.

III) Distinguish between a source and a sink.

SECTION - 2

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

I) An oil of specific gravity 0.8 and viscosity 0.080 poise is flowing through a pipe of diameter 200 mm at the rate of 50 litres/s. Caclulate the head lost due to friction for 500 m length of pipe. Find the power required to maintain this oil flow.

II) A main pipe divides into two branch parallel pipes which merges into a single pipe. The length and diameter for the first parallel pipe are 1500 m and 1 m respectively while the length and diameter of 2nd parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe. If the total flow in the main is 4 m^3 /s. The co-efficient of friction for each parallel pipe is same and equal to 0.005.

III) Obtain an expression for the head loss due to sudden contraction.

Q 5 Answer the following (Any 3) **[12]**

I) Derive Euler's equation of motion for incompressible fluid.

II) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 (gauge) and with mean velocity of 2 m/s. Find the total head or total energy per unit weight of the water at a cross section, which is 5 m above the datum line.

III) Derive equation of shear stress distribution across a section in circular pipe for laminar flow.

IV) Derive the expression of coefficient of friction in terms of shear stress for turbulent flow.

Q 6 A) Answer the following in brief. (Any 1) **[2]**

I) What do you mean by 'shape factor' in boundary layer ? Write down the expression for it.

II) Which type of velocity gradient will delay boundary layer separation?

Q 6 B) Answer the following in detail. (Any 2) **[10]**

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

II) A plate of 580 mm length and 380 mm wide is immersed in a fluid of specific gravity 0.88 and kinematic viscosity 0.0001 m^2/s. The fluid is moving with a velocity of 6.2 m/s. Determine (i) boundary layer thickness and (ii) Drag force on one side of the plate.

III) Give the detailed importance of average coefficient of drag and local co-efficient of drag.