UKA TARSADIA UNIVERSITY

B.Tech (Mechanical) (Semester 3)
ME4004(2020-21)
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 Answer the following (Any 1) **[6]**

I) The time period of a pendulum depends upon the acceleration due to gravity. Derive an expression for the time period by use of principle of dimensional homogenity.

II) Find the expression for the drag force on smooth sphere of diameter D, moving with velocity of V in a fluid of density ρ and viscosity μ.

Q 2 Answer the following. **[12]**

A) Derive the equation of total pressure and centre of pressure when inclined surface submerged in liquid.

OR

A) Define: (i) Absolute pressure, (ii) Gauge pressure, (iii) Atmospheric pressure and (iv) Vacuum pressure. Also show their relationship with sketch.

B) Determine the total pressure force on an isosceles triangular plate of base 4 m and altitude 4 m which is placed vertically in an oil of specific gravity 0.9 in such a way that the base of the plate coincides with the free surface of oil. Also find the position of centre of pressure.

OR

B) Find the volume of water displaced and position of centre of buoyancy for a wooden block of width 2.5 m and of depth 1.5 m, when it floats horizontally in water. The density of the wooden block is 650 kg/m^3 and its length 6 m.

Q 3 Answer the following. **[12]**

A) A water at 25 °C is flowing in a round pipe of 10 mm diameter with 5 m/s velocity. The viscosity of water at 25 °C is 0.0091 poise. Calculate the Reynolds number and comment on the nature of the flow.

OR

A) Which one of the following is a possible case of 2D incompressible, steady flow?
(1) $u = x + y$, $v = x – y$
(2) $u = x + 2y$, $v = x^2 - y^2$

B) Explain the stream function. Derive the slope of equi-stream function line.

OR

B) Write Burnoulli's equation. Apply it for a given pipe flow with neat sketch. Explain every energy terms in it.

SECTION - 2

Q 4 Answer the following (Any 1) **[6]**

I) Drive the Bernoulli equation for (i) Isothermal process and (ii) Isentropic process.

II) An airplane can fly at a speed of 800 km/hr at a sea level where the temperature is 15 ^{0}C. If the airplane flies at the same mach number at an altitude where the temperature is -44 ^{0}C, find the speed at which the airplane is flying at that altitude.

Q 5 Answer the following. **[12]**

A) A pipe line 50 cm diameter bifurcates at a Y-junction into two branches 30 cm and 20 cm in diameter. If the rate of flow in the main pipe is 1.5 m^3/s and mean velocity of flow in 30 cm diameter pipe is 7.5 m/s, determine the rate of flow in the 20 cm diameter pipe.

OR

A) An oil of specific gravity 0.8 and viscosity 0.08 poise is flowing through a pipe of diameter 200 mm at the rate of 50 litres/s. Find the head lost due to friction for 600 m length of pipe. Find the power required to maintain this flow.

B) Derive the equation for loss of head due to sudden contraction.

OR

B) Explain the flow in parallel and series pipes.

Q 6 Answer the following in detail. (Any 2) **[12]**

I) Define: Energy thickness. Also derive the equation of energy thickness for boundary layer.

II) Explain the effect of pressure gradient on boundary layer separation.

III) Find the momentum thickness for the following velocity distribution,
$(u/U) = 1.5\ (y/\delta) - 0.5(y/\delta)^3$