Ex/PRN/T/312/2019

B.E. PRINTING ENGINEERING THIRD YEAR FIRST SEMESTER EXAM 2019

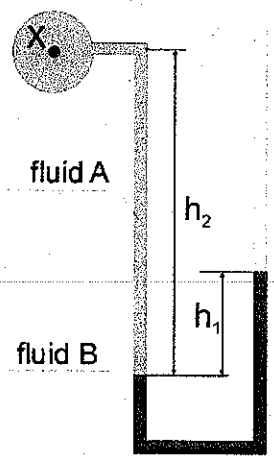
FLUID MECHANICS

Time-3 hrs. **Full Marks:** 100

Answer any **five** of the following questions:

1. Explain the relationship between shear stress and shear strain rate of different fluids. Find the excess pressure inside a cylindrical jet of water 4 mm diameter than the outside atmosphere? The surface tension of water is ***0.0736*** N/m at that temperature. Prove that $\sigma_x = \sigma_y = \sigma_z = -p$ when fluid element at rest. iii) In figure, fluid A is water and fluid B is mercury. What will be the difference in level h_1 if the pressure at X is ***140*** kN/m^2 and h_2 = 1:5 m.

[(2.5+2.5)+10+5=20]



2. Write down the differences between a) Newtonian and Non-Newtonian Fluid b) Incompressible and Compressible flow c)Steady and Unsteady flow d) Uniform and Non Uniform flow

Two fluids 1 and 2 have mass densities of p1 and p2 respectively. If p1 > p2, What will be the expression which will represent the relation between their specific volumes v1 and v2?

If the fluid has specific weight of 10N/m^3 for a volume of ***100***dm^3 on a planet which is having acceleration due to gravity ***20***m/s^2 , what will be its specific weight on a planet having acceleration due to gravity ***4***m/s^2?

For a flow in the xy plane, the y component of velocity is given by $v = y^2 - 2x + 2y$ Determine a possible x component for a steady, incompressible flow. How many possible x components are there?

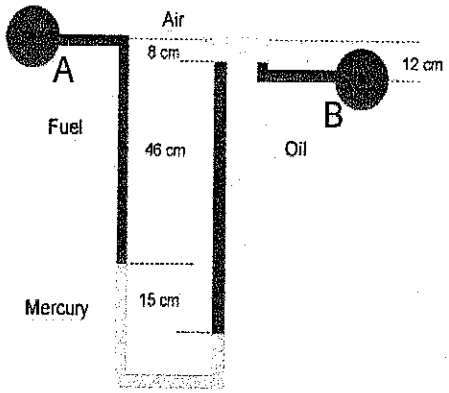
[10+4+6=20]

3.What is bulk modulus? What is Kinematic viscosity? Find the kinematic viscosity of oil having density ***1962*** g/m3. the force experienced for area of 20 m^2 is ***4.904*** kN and velocity of gradient at that point is ***0.2***/s.

A large iceberg floating in sea water is of cubical shape and its specific gravity is ***0.9*** If ***20*** cm proportion of the iceberg is above the sea surface, determine the volume of the iceberg if specific gravity of sea water is ***1.025***.

A mercury manometer is used to measure the pressure difference in the two pipelines as shown in a figure(b). Fuel (ρ_f = ***850*** kg/m^3) is flowing in A and oil (ρ_o = ***915*** kg/m^3) is flowing in B. An air pocket has become entrapped in the oil as indicated. Determine the pressure in pipe B if the pressure in A is ***105.5*** kPa.

P. T.O



A cylinder contains $0.35m^3$ of air at 50°C and 276 kN/m^2 absolute. The air is compressed to 0.081 m^3 assuming isentropic conditions, what is the pressure and what is the isothermal bulk modulus of elasticity(ratio of sp. heat $\gamma=1.4$) [(2+4)+4+6+4=20]

4. Derive a venturimeter with the suitable sketch and derive the expression for the determination of flowrate through an u tube manometer in terms of height difference in differential manometer connected to the venturimeter ; define all terms used. A venturimeter with a 6 inch throat is placed on a water line that has an 8 inch outer diameter. According to the factory manual the coefficient of discharge is 0.97.After attaching a manometer to help measure the flow rate through the pipe. The manometer measures a differential pressure of 5 inches of mercury the flow rate through the pipe. The manometer measures a differential pressure of 5 inches of mercury.What is the volumetric flow rate ? What is the velocity of the fluid if a wall thickness of 0.25 inches is used. Explain the reason behind the origin of surface tension . [10+8+2=20]

5. Short Note- i) Reynolds Number ii) Euler Number iii) Weber Number. Water flows at the rate of $0.015m^3$ / s through a 100mm diameter orifice used in 200mm pipe .What is the pressure head between the upstream section and vena contracta section; define all terms used. $C_c=0.60$, $C_v=1$ [12+8=20]

6. i)The velocity of water in a flow field is given by

$$\vec{V} = Ax^2y^2\hat{\imath} - Bxy^3\hat{\jmath}$$

where A and B are constants and having appropriate dimensions. Determine the stream function for the flow. ii) The flow field of a fluid is given by $V = xy\hat{\imath} + 2y\hat{\jmath} - (yz + z^2)\,\hat{k}$. Show that it represents a possible three-dimensional incompressible flow. iii) Derive the equation of stream function and velocity potential for a uniform flow of stream of velocity 5 m/s at a angle of 30^0 to the x-axis in a two dimensional field. Derive the conservation of mass theorem in the light of Reynolds Transport theorem and what will be the expression for steady flow. [3+3+8+6=20]

7. Derive the Bernoulli's Equation with Head loss; define all terms used. 20

8. Find the acceleration components at a point(1,1,1) for the following flow field :

$$u = 2x^2 + 3y, v = -2xy + 3y^2 + 3zy, w = -\frac{3}{2}z^2 + 2xz - 9y^2z$$

What is the difference between pathline and streamline? Derive local acceleration and temporal acceleration for steady flow [8+4+8=20]