Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH (MECHANICAL ENGINEERING)
END SEMESTER EXAMINATION – APRIL 2019
SUBJECT: FLUID MECHANICS (MME 2202)
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- ❖ Answer ALL the questions.
- ❖ Missing data may be suitably assumed.
- ❖ Draw sketches as applicable
- ❖ Assumptions made must be clearly mentioned

1A. (i) What is the unique feature and common feature among Newtonian fluids and Ideal plastic fluid?
(ii) Explain the property of the fluid that is responsible for producing vapour in carburetors and sprayers. 02

1B. A thin plate of surface area $0.6 m^2$ is pulled through a very narrow gap of 25mm at a velocity of 0.8 m/s. On one side of the plate is oil of viscosity 8.5 P and on the other side there is oil of viscosity 6 P. Determine the position of the plate in the narrow gap so that shear stress on the two sides of the plate is equal. 02

1C. State and prove the Hydrostatic law. Use usual notations and symbols. 03

1D. Gate ABC in Fig. Q (1D) is a quarter circle 2.5 m wide into the paper. Compute the horizontal and vertical hydrostatic forces on the gate and the line of action of the resultant force.

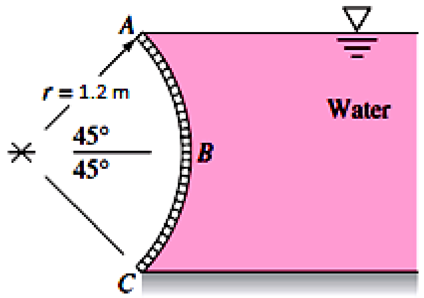

Fig. Q (1D) 03

2A. A ship 75 m long and 12 m broad has displacement of 20 MN. A weight of 350 kN is moved across the deck through a distance of 6 m. The ship is tilted through 7^o. The area moment of inertia of the ship at water-line about its fore and aft axis is 80% of area moment of inertia of the circumscribing rectangle. The center of buoyancy is 4 m below water-line. Find the metacentric height and position of center of gravity of ship. Specific weight of sea water is 10104 N/m^3. 03

2B. Fig. Q (2B) shows a closed container with a partition, containing three immiscible fluids: air, water and mercury. The uniform pressure of air in the container is 180 kPa. If the pressure gauge *A* reads 350 kPa absolute,

(i) What is the height *h* of the water?

(ii) What should the pressure gauge *B* read in kPa absolute?

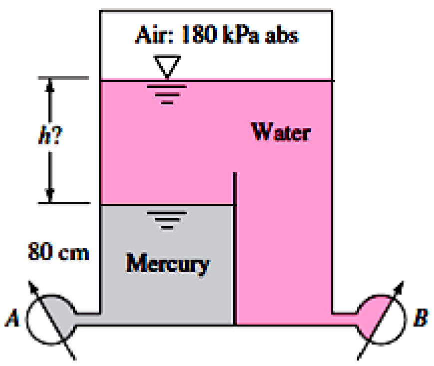

Fig. Q(2B) 02

2C. Differentiate between the following:

(i) Lagrangian approach and Eulerian approach of fluid kinematics

(ii) Local acceleration and convective acceleration 02

2D. Derive an expression to determine the actual flow rate of a fluid through a venturimeter. Use usual notations and symbols. 03

3A. A pipe of 300 mm diameter conveying 0.30 m^3/s of water has a right angled bend in a horizontal plane. Find the force components exerted by water on the bend if the pressure at inlet and outlet of the bend are 245.25 kPa and 235.44 kPa. 02

3B. A conical tube of length 3 m is fixed vertically with its smaller end upwards. The velocity of flow at the smaller end is 4 m/s while at the lower end it is 2 m/s. The pressure head at the smaller end is 2 m of liquid. The loss of head in the tube is $0.95\dfrac{(v_1 - v_2)^2}{2g}$, where v_1 is the velocity at the smaller end and v_2 at the lower end respectively. Determine the pressure head at the lower end. Flow takes place in downward direction. 03

3C. What are the salient findings of Reynold's experiment and William Froude's experiment with respect to laminar and turbulent flow? Write the functional relationship for both cases. 02

3D. Derive the Darcy-Weisbach formula for determining the head lost due to viscous friction. 03

4A. Oil of specific gravity 1.5 and viscosity 10 P flows through a horizontal pipe of 100 mm diameter. The pressure drop in the 200 m length of pipe is 300 kN/m^2. Determine (i) the average velocity, (ii) the power required to maintain the flow. 02

4B. Determine the difference in the elevations between the water surfaces in the two tanks which are connected by a horizontal pipe of diameter 300 mm and length 400 m. The rate of flow of water through the pipe is 300 litres/s. Consider all losses and take the value of coefficient of friction as 0.008. 03

4C. Write short notes on different types of similarities that we consider in model analysis. 02

4D. Using Buckingham pi theorem show that the velocity through a circular orifice is given by $V = \sqrt{2gH} \times \phi\left(\frac{D}{H}, \frac{\mu}{\rho V H}\right)$ where, H = head causing flow, D = diameter of the orifice, μ = Coefficient of viscosity, ρ = Mass density and g = acceleration due to gravity. 03

5A. Find an expression for the drag force R on a smooth sphere of diameter D, moving with uniform velocity V in a fluid of density ρ and dynamic viscosity μ using Rayleigh's method. 02

5B. Write the equations and define(i) Momentum thickness and (ii) Energy thickness 02

5C. A flat plate 1.5 m × 1.5 m moves at 50 km/hour in stationary air of density 1.15 kg/m^3. If the co-efficients of drag and lift are 0.15 and 0.75 respectively, determine:
(i) The lift force, (ii) The drag force, (iii) The power required to keep the plate in motion. 03

5D. Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer is given by $\frac{u}{U} = \frac{y}{\delta}$, where 'u' is the velocity at a distance 'y' from the plate and u = U at y = δ, where δ is the boundary layer thickness. 03

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