Code: 13A01408 **R13**

B.Tech II Year II Semester (R13) Supplementary Examinations May/June 2017

MECHANICS OF FLUIDS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Determine absolute pressure in Pascal at a depth of 6 m below the free surface of a tank of water when barometric reading is 760 mm of Hg $\left(\text{assume } \rho_{Hg} = 13600\ \text{kg/m}^3\right)$.

(b) What is the difference between gauge, absolute and vacuum pressures?

(c) In a steady fluid flow, the velocity components are $u = 3xy$; $v = -2y$, determine whether the flow is possible.

(d) What is the importance of continuity equation?

(e) Define total energy line and hydraulic gradient line.

(f) What are the differences between venturimeter and orifice meter.

(g) What boundary conditions must be satisfied by the velocity distribution in laminar boundary layer over a flat plate?

(h) Differentiate between laminar and turbulent boundary layers.

(i) What is magnus effect? Explain.

(j) Distinguish between the friction drag and the pressure drag.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Derive the expression for pressure difference in case of inverted U-tube manometer with neat sketch.

(b) The left leg of a U-tube mercury manometer is connected to a pipe-line conveying water, the level of mercury in the leg being 0.6 m below the center of pipe line and the right leg is open to atmosphere. The level of mercury in the right leg is 0.45 m above that in the left leg and the space above mercury in the right leg contains Benzene (specific gravity 0.88) to a height of 0.3 m. Find the pressure in pipe.

OR

3 (a) Derive the expression for capillary rise and fall with neat sketch

(b) If the equation of a velocity profile over a plate is $v = 2y^{2/3}$; in which v is the velocity in m/s at a distance of y meters above the plate, determine the shear stress at y = 0 m, y = 0.05 m and y = 0.075 m. The dynamic viscosity of the fluid flowing is 0.85 N.s/m^2.

UNIT – II

4 (a) In a steady fluid flow, the velocity components are $u = 2cx$; $v = -2cy$, find the equation of streamline passing through the point (2, -3).

(b) In a two-dimensional incompressible flow, the fluid velocity components are given by $u = x^2 - y^2$; $v = x^2 + y^2$, show that velocity potential exists and determine its form for stream function as well.

OR

5 (a) Derive Bernoulli's theorem and state its limitations.

(b) The diameter of a pipe bend is 30 cm at inlet and 15 cm at outlet and the flow is turned through 120° in a vertical plane. The axis at inlet is horizontal and the center of the outlet section is 1.5 m below the center of the inlet section. The total volume of fluid contained in the bend is 0.85 m^3. Neglecting friction, calculate the magnitude and direction of the force exerted on the bend by water flowing through it at 225 liters/sec when the inlet pressure is 1.4 kgf/cm^2.

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UNIT – III

6 (a) Derive an expression for finding the rate of flow through a venturimeter.

(b) A venturimeter, having a diameter of 7.5 cm at the throat and 15 cm diameter at the enlarged end, is installed in a horizontal pipeline of 15 cm in diameter carrying an oil of specific gravity 0.9. The difference of pressure head between the enlarged end and the throat recorded by a U-tube is 17.5 cm of Hg. Determine the discharge through the pipe. Assume the coefficient of discharge of the meter as 0.97.

OR

7 (a) Derive an expression for finding the major loss when a fluid flows through a pipe and also give the formulae for various minor losses.

(b) A pipe line 30 cm in diameter 1500 m long is used to connect two tanks and has a slope of 1 in 100. The water level in the first tank is 10 m above inlet of the pipe and water level in the second tank is 2 m above the outlet of the pipe. Considering only frictional losses, find the flow rate through the pipe. Also draw TEL and HGL lines. Take friction factor as 0.005.

UNIT – IV

8 (a) Explain the separation of boundary layer and its preventive methods.

(b) A thin flat plate, 0.05 m tall and 3.0 m wide, forms the leading edge of the banner towed by an aircraft at 44 m/s on a 294 K day. How far from the leading edge of the plate does the laminar portion of boundary layer extend? What is the boundary layer thickness at the downstream end of the laminar boundary layer? Find the drag force on the plate contributed by the laminar boundary layer and the corresponding drag coefficient.

OR

9 (a) What is a boundary layer? Explain its formation along a long thin plate with neat sketch.

(b) Water is flowing over a thin smooth plate of length 4.5 m and width 2.5 m at a velocity of 0.9 m/s. If the boundary layer flow changes from laminar to turbulent at a Reynold's number of 5×10^5, find: (i) The distance from the leading edge up to which the boundary layer is laminar. (ii) Thickness of the boundary layer at the transition point. (iii) The drag forces on one side of the plate. Take viscosity of water as 0.01 poise.

UNIT – V

10 (a) Describe with the help of a sketch, the variation of drag coefficient for a cylinder over a wide range of Reynold's number.

(b) A smooth wind tunnel 1.5 m long and 0.75 dia. is used for testing the model of an airplane. If the velocity of air is 70 m/s and the pressure drop in the tunnel is 0.981 kPa, determine the drag on the model. Take density of air as 1.2 kg/m^3 and viscosity as 1.854×10^4 Ns/m^2. Determine the frictional drag on an airship 92 m long, average diameter 18 m, being propelled at 120 km/hr. Take density of air as 1.3 kg/m^3 and kinematic viscosity as 1.5×10^{-5} m^2/s.

OR

11 (a) Obtain an expression for coefficient of lift for a rotating cylinder placed in a uniform flow.

(b) A thin flat plate 0.3 m wide and 0.6 m long is suspended and exposed parallel to air flowing with a velocity of 3 m/sec. Calculate drag force on both sides of the plate when the 0.3 m edge is oriented parallel to free stream. Consider flow to be laminar and assume for air, kinematic viscosity as 0.18 stokes and density as 1.2 kg/m^3.

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