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10MEB406/10ME46B

# Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
# Fluid Mechanics

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***



## PART – A

1 a. Distinguish between the following:
i) Mass density and weight density
ii) Specific volume and specific gravity
iii) Capillarity and compressibility. **(09 Marks)**

b. The pressure of a liquid is increased from 500Pa to 1300Pa producing a decrease in volume of 0.16 percent. Find the compressibility of liquid. **(04 Marks)**

c. A 150mm diameter vertical cylinder rotates concentrically inside another cylinder of 151mm. Both cylinders are 250mm length. The space between the cylinders is filled with a liquid of unknown viscosity. If a torque of 12Nm is required to rotate the inner cylinder at 100rpm. Determine the viscosity of fluid. **(07 Marks)**

2 a. Define following terms:
i) Atmospheric pressure
ii) Gauge pressure
iii) Absolute pressure. **(06 Marks)**

b. Find the difference pressure between L and M. [Ref.Fig.Q.2(b)].

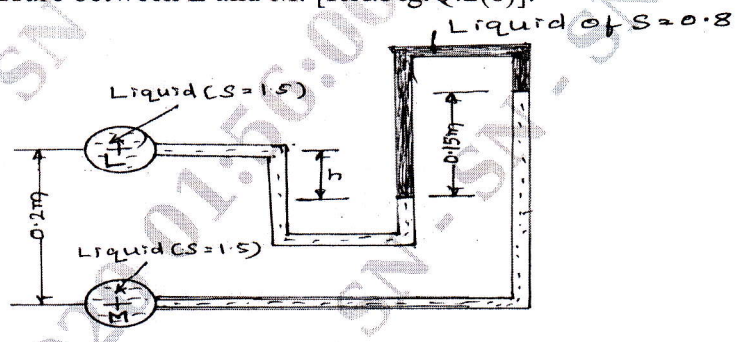


Fig.Q.2(b)

**(04 Marks)**

c. A 1 m wide and 1.5m deep rectangular plane surface lies in water in such way that its plane makes an angle of 30° with free water surface. Determine the total pressure and position of centre of pressure, when the upper edge is 0.75m below the free water surface. **(10 Marks)**

3 a. Explain stability conditions of floating bodies. **(09 Marks)**

b. In a fluid flow the velocity vector at any point is defined as $\vec{V} = 2x^3i - 5x^2yj + 4tk$. Determine the velocity at (1, 2, 3) and at unit time. **(04 Marks)**

c. The potential function for a flow is known as $\phi = 12xy - 16x$. Determine the stream function for the flow. Also calculate the value of $\Psi$ at (2, 3). **(07 Marks)**

4 a. With suitable assumptions, derive Euler's equation of motion for flow along a stream line, further reduce it to Bernoullis equation. **(10 Marks)**

b. A 400m long pipe tapers from 1.2m diameter at high end to 0.6m diameter at low end, slow of the pipe being 1 in 100. The pipe conveys a discharge of 1.25 $m^3$/sec. If the pressure at the high end is 75kPa, find the pressure at the low end. Ignore other losses. **(10 Marks)**

## PART – B

5 a. Derive an equation for discharge flowing through circular orifice. **(08 Marks)**

b. A pitot tube installed to determine the velocity of an aeroplane registers a pressure difference of 80mm of water. Taking specific weight of air as 11.97 N/m$^3$, and coefficient of pitot tube as 0.98, find the speed of the plane in km/hr. **(04 Marks)**

c. A 150mm × 75mm venturimeter placed vertically with the throat 225mm above the inlet conveys oil of specific gravity 0.78 at 29 litre per second. Calculate the difference of pressure between the inlet and the throat. Take $c_d = 0.96$. **(08 Marks)**

6 a. Explain major and minor losses for flow through pipes. **(06 Marks)**

b. A 150mm diameter horizontal pipe conveys water. If the slope of hydraulic gradient is 1 in 130, find the rate of flow. Take f = 0.008. **(04 Marks)**

c. A horizontal pipe line 40 meters long is connected to a water tank at one end and discharges freely into atmosphere at the other end. For first 25m of its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarged to 300mm. The height of the water level in the tank is 8m above the centre of the pipe, considering all the losses, determine the rate of flow. Take f = 0.01 for both sections of the pipe. **(10 Marks)**

7 a. Derive Hagen Poiseuile formula for viscous laminar flow through circular pipe. **(08 Marks)**

b. A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30mm diameter pipe. If pressure drop per meter length of pipe is 20 kN/m$^2$. Determine:

i) Mass flow rate in kg/min
ii) The shear stress at the pipe wall
iii) The Reynold's number of flow and
iv) The power required per 50m length of the pipe to maintain the flow. **(12 Marks)**

8 a. Explain the following terms:

i) Drag ii) Lift iii) Boundary layer thickness iv) Mach number v) Mach cone. **(10 Marks)**

b. A kite weighing 9.8N and having an area 1m$^2$ makes an angle of 7° to the horizontal when flying in a wind of 36 km/hr. If pull on the string attached to the kite is 49N and it is inclined to horizontal at 45°, calculate the lift and drag coefficients. Take ρ for air = 1.2 kg/m$^3$. **(10 Marks)**

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