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10ME36B/AU36B

# Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
## Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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



### PART – A

1 a. Define following terms:
i) Mass density
ii) Newtonian fluid
iii) Capillarity. **(06 Marks)**

b. Calculate the gauge pressure and absolute pressure within a droplet of water of 0.4cm diameter and a jet of water 0.4cm diameter. Assume surface tension of water as 0.073 N/m and atmospheric pressure as 101300 N/m$^2$. **(06 Marks)**

c. A flat plate 0.1m$^2$ area is pulled at 30cm/sec relative to another plate located at a distance of 0.01cm from it, the fluid separating them being water of viscosity 0.001 N-sec/m$^2$. Find the force and power required to maintain the velocity. **(08 Marks)**

2 a. Define and derive hydrostatic law. **(06 Marks)**

b. Two U-tube manometers, one upright and other inverted type are connected across a water line and on oil line as shown in Fig.Q.2(a). If $h_1$ = 5cm, then what will be reading $h_2$? **(06 Marks)**

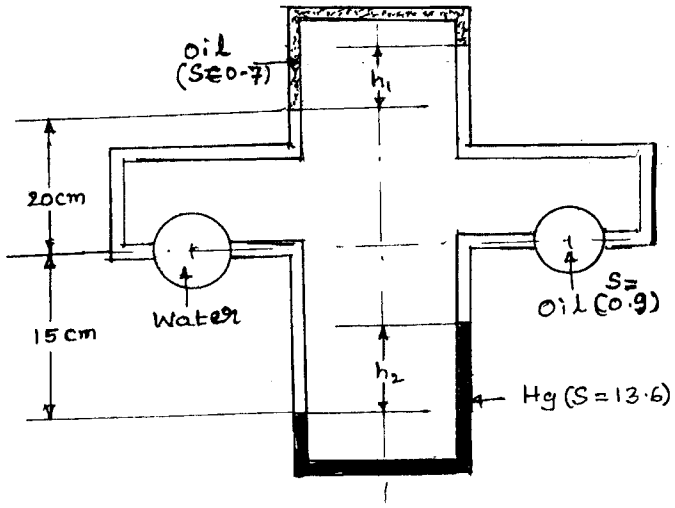


Fig.Q.2(b)

c. A circular plate of 2m in diameter is submerged in oil of special gravity 0.8, such that its greatest and least depths below the free surface are 3.5m and 2m respectively. Find the total pressure on one face of the plate and depth of centre of pressure. **(08 Marks)**

3 a. Write differences between following:
i) Stable and unstable equilibrium of floating bodies.
ii) Steady and unsteady flow.
iii) Stream line and streak line. **(09 Marks)**

b. A cylindrical belay is 2m in diameter, 2.5m long and weighs 21582N. The density of sea water is 1025 kg/m$^3$ show that the body cannot float with its axis vertical. **(05 Marks)**

c. If for a 2-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the velocity at point P(4, 5). Also determine the value of stream function $\Psi$ at point P. **(06 Marks)**

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

b. A pump has tapering pipe running full of water. The pipe is placed vertically with diameter at the base 1.2m and at the top 0.6m respectively. The pressure at the upper end is 240mm of Hg (Vaccum), while the pressure at the lower end is 15 kPa. Assume head loss to be 20% of difference in velocity head, calculate the discharge. The flow is vertically upwards and difference in elevation is 3.9m. **(10 Marks)**

## PART – B

5 a. Derive equation for actual discharge flowing through V-notch. **(06 Marks)**

b. A pitot static tube is mounted on an airoplane. The plane is flying into still air at a height of 1km, where ambient conditions are P = 0.9 bar and T = 278K. If difference of pressure reading is 0.02 bar, how fast is the plane is going? **(06 Marks)**

c. The lift force $F_L$ on an airfoil depends on the mass density $\rho$ of the medium, velocity of flow v, a characteristic length L, the viscosity $\mu$ and angle of attack $\alpha$ (alpha). Obtain an expression for the lift force. **(08 Marks)**

6 a. Derive expressions for Darcy's equation and Chezy's equation for fluid flowing through circular pipe. **(10 Marks)**

b. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m, when one end of the pipe is connected to tank and other end of pipe is open to the atmosphere. The pipe is horizontal and height of the water in the tank is 4m, above the centre of the pipe. Consider all minor losses and take f = 0.009, also draw HGL and TEL. **(10 Marks)**

7 a. Derive Hagen Poiseulle equation for loss of head due to friction in pipe of length L. **(08 Marks)**

b. A lubricating oil of viscosity 1 poise, and sp. gravity 0.9 is pumped through a 30mm diameter pipe. If the pressure drop per meter length of the pipe is 20kN/m$^2$. Determine: i) Mass flow rate; 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. Define the following terms:
i) Lift; ii) Drag; iii) Displacement thickness; iv) Energy thickness; v) Mach number. **(15 Marks)**

b. A projectile travels in air of pressure $1.01043 \times 10^5$N/m$^2$ at 10°C at a speed of 1500km/hr. Find Mach number and Mach angle. Take K = 1.4 and R = 287 J/kg K. **(05 Marks)**

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