USN | | | | | | | | | | |

10CT63

# Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
# Fluid Mechanics and Hydraulics Structures

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. Explain the Newton's laws of viscosity. Calculate the dynamic viscosity of an oil, which is used for lubrication between square plate of size 0.8m × 0.8m and inclined plate with angle of inclination 30° as shown in Fig.Q.1(a). The weight of the square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3m/s. The thickness of oil film is 1.5mm. **(08 Marks)**

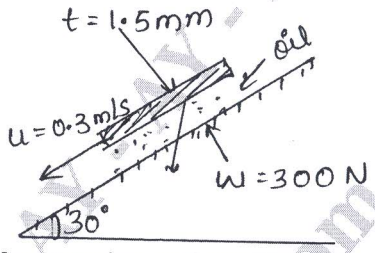


Fig.Q.1(a)

b. Explain the phenomenon of surface tension and capillarity. **(06 Marks)**

c. Calculate the capillarity effect in millimeters in a glass tube of 4mm diameter, when immersed in i) water and ii) mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero and that for mercury is 130°. Take density of water at 20°C as equal to 998 kg/m$^3$. **(06 Marks)**

2 a. What is manometer? Explain the classification of manometers. **(06 Marks)**

b. A circular opening, 3m diameter, in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate:
i) The force on the disc, and
ii) The torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4m. **(08 Marks)**

c. Differential manometer is connected at the two points A and B as shown in Fig.Q.2(c). At B air pressure is 9.81 N/cm$^2$ (abs). Find the absolute pressure at A. **(06 Marks)**

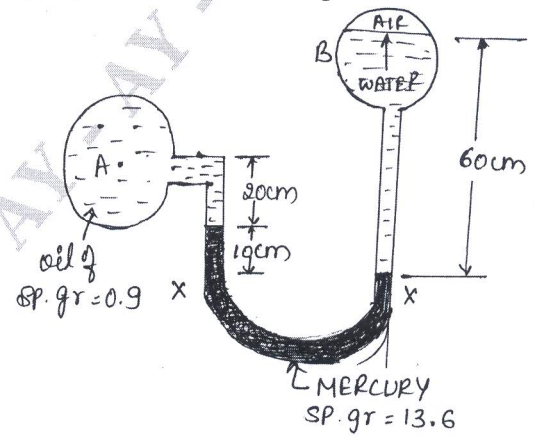


Fig.Q.2(c)

3 a. Derive Euler's equation of motion and hence obtain Bernoulli's equation from Euler's equation. **(08 Marks)**

b. Water is flowing through a pipe having diameter 300mm and 200mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm$^2$ and the pressure at the upper end is 9.81 N/cm$^2$. Determine the difference in the datum head if the rate of flow through pipe is 40 lit/s. **(06 Marks)**

c. A pipe of 300mm diameter conveying 0.30 m$^3$/s of water has a right angled bend in a horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and outlet of the bend are 24.525 N/cm$^2$ and 23.544 N/cm$^2$. **(06 Marks)**

4 a. With a neat sketch, obtain the expression for discharge over a rectangular notch. **(06 Marks)**

b. Water flows over a rectangular weir 1m wide at a depth of 150mm and afterwards passes through a triangular right angled weir. Taking $C_d$ for the rectangular and triangular weir as 0.62 and 0.59 respectively. Find the depth over the triangular weir. **(06 Marks)**

c. A horizontal venturimeter with inlet and throat diameters 30cm and 15cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and throat is 20cm of mercury. Determine the rate of flow. Take $C_d = 0.98$. **(08 Marks)**

## PART – B

5 a. Obtain the expression for force exerted by jet when jet of water strikes fixed curved plate at its centre. **(06 Marks)**

b. A 7.5cm diameter jet having a velocity of 30m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate i) When the plate is stationary ii) When the plate is moving with a velocity of 15m/s and away from the jet. **(08 Marks)**

c. A jet of water of diameter 75mm is moving with a velocity of 25m/s strikes a fixed plate in such a way that the angle between the jet on the plate is 60°. Find the force exerted by the jet on the plate i) In the direction normal to the plate ii) In the direction of the jet. **(06 Marks)**

6 a. Explain the classification of turbines based on direction of flow through runner. **(06 Marks)**

b. With a neat sketch, explain Pelton wheel turbine. **(08 Marks)**

c. A Frances turbine with an overall efficiency of 75% is required to produce 148.25kW power. It is working under head of 7.62m. The peripheral velocity = $0.26\sqrt{2gH}$ and the radial velocity of flow at inlet is $0.96\sqrt{2gH}$. The wheel runs at 150 rpm and the hydraulic losses in turbine are 22% of available energy. Assuming radial discharge, determine:
i) The guide blade angle
ii) The wheel vane angle at inlet. **(06 Marks)**

7 a. Find the discharge through a trapezoidal channel of width 8m and side slope of 1 horizontal to 3 vertical. The depth of flow of water is 2.4m and value of Chezy's constant C = 50. The slope of the bed of the channel is given 1 in 4000. **(08 Marks)**

b. Obtain the conditions for a rectangular channel section to be most economical. **(06 Marks)**

c. The rate of flow of water through a circular channel of diameter 0.6m is 150 liters/s. Find the slope of bed of the channel for maximum velocity. Take C = 60. **(06 Marks)**

8 a. With a neat sketch, explain the main parts of centrifugal pump. **(08 Marks)**

b. Explain the efficiencies of centrifugal pump. **(06 Marks)**

c. A centrifugal pump is to discharge 0.118m$^3$/s at a speed of 1450rpm against a head of 25m. The impeller diameter is 250mm, its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at outer periphery of the impeller. **(06 Marks)**

* * * * *