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15CT63

# Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
## Fluid Mechanics and Hydraulics Structures

Time: 3 hrs. Max. Marks: 80

**Note:** ***Answer FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

### Module-1

1 a. Define the following with symbols and units, (i) Specific weight (ii) Mass density **(04 Marks)**

b. Derive expression for Newton's law of viscosity and state. **(06 Marks)**

c. A differential manometer is connected at the two points A and B of two pipes as shown in Fig. Q1 (c). The pipe A contains a liquid of Sp.gr = 1.35 while pipe B contains a liquid of sp.gr = 0.85. The pressure at A and B are 1 kgf/cm$^2$ and 1.8 kgf/cm$^2$ respectively. Find the difference in mercury level in differential manometer. **(06 Marks)**

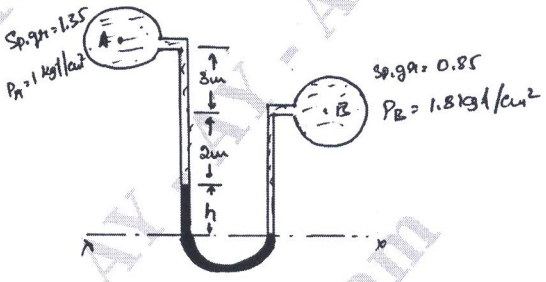


Fig. Q1 (c)

**OR**

2 a. Define the following with symbol and units : (i) Specific volume (ii) Kinematic viscosity **(04 Marks)**

b. Distinguish between:
(i) Simple manometer and differential manometer.
(ii) Absolute pressure and gauge pressure.
(iii) Newtonian and non-newtonian fluid. **(06 Marks)**

c. Calculate the specific weight, density and specific gravity of one litre of liquid which weight 9 N. **(06 Marks)**

### Module-2

3 a. Derive expression for total pressure and centre of pressure for vertical plane surface submerged in liquid. **(06 Marks)**

b. List assumption and limitations of Bernoulli's equation. **(04 Marks)**

c. A circular plate of 4 m diameter with concentric circular hole of diameter 2 m is immersed in water in such a way that its greatest and least depth below the free surface are 5 m and 2 m respectively. Determine the total pressure and position of the centre of pressure. **(06 Marks)**

**OR**

4 a. Derive Euler's equation of motion. **(06 Marks)**

b. Find the magnitude and direction of the resultant force due to water acting on a roller gate of cylindrical form of 5 m diameter, when the gate is placed on the dam in such a way that water is just going to spill. Take the length of the gate as 6 m. **(06 Marks)**

c. Water is flowing through a pipe having diameter 400 m and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 25 N/cm$^2$ and the pressure at the upper end is 10 N/cm$^2$. Determine the difference in datum head if the rate of flow through pipe is 50 lit/s. **(04 Marks)**

## Module-3

5 a. Derive equation for head loss due to friction. **(06 Marks)**

b. Derive expression for discharge over a triangular notch. **(06 Marks)**

c. The head of water over a rectangular notch is 90 cm. The discharge is 400 litres/s. Find the length of the notch, when $C_d = 0.7$. **(04 Marks)**

**OR**

6 a. Derive expression for discharge through venturimeter. **(06 Marks)**

b. The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m and 210 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 12 m. Determine the rate of flow of water if co-efficient of friction are 0.005, 0.0052 and 0.0048 respectively, consider (i) Minor losses (ii) Neglecting minor losses. **(06 Marks)**

c. An oil of sp.gr 0.75 is flowing through a venturimeter having inlet diameter 15 cm and throat diameter 9 cm. The oil-mercury differential manometer shows a reading of 20 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. **(04 Marks)**

## Module-4

7 a. Derive expression for force exerted on curved plate is moving in the direction of Jet. **(04 Marks)**

b. Derive Chezy's formula for flow through open channel. **(04 Marks)**

c. A jet of water having a velocity of 15 m/s, strikes a curved vane which is moving with a velocity of 5 m/s in the same direction as that of the jet at inlet. The vane is so shaped that the jet is deflected through 135°. The diameter of jet is 100 mm. Assuming the vane to be smooth, find (i) Force exerted by the jet on the vane, (ii) Power exerted on the vane. (iii) Efficiency of the vane. **(08 Marks)**

**OR**

8 a. Derive expression for most economical rectangular channel. **(06 Marks)**

b. Derive expression for force exerted by a Jet on a hinged plate. **(06 Marks)**

c. A trapezoidal channel has side slope of 3 horizontal to 4 vertical and slope of its bed is 1 in 2000. Determine the optimum dimensions of the channel, if it is to carry water at 0.5 $m^3/s$. Take Chezy's constant as 80. **(04 Marks)**

## Module-5

9 a. Derive expression for workdone and efficiency for Pelton wheel. **(08 Marks)**

b. The Pelton wheel is to be designed for the following specifications: Shaft power=12000 kW; Head = 350 m; Speed = 780 rpm; Overall efficiency = 85%; Jet Diameter is not to exceed are – Sixth of the wheel diameter. Determine : (i) The wheel diameter (ii) Diameter of Jet. Take $K_{u_1} = 0.985$ and $K_{u_1} = 0.45$ **(04 Marks)**

c. A three stage centrifugal pump has impeller 40 cm in diameter and 2 cm wide at outlet. The vanes are curved back at the outlet at 45° and reduce the circumferential area by 10%. The manometric efficiency is 90% and the overall efficiency is 80%. Determine the head generated by the pump when running at 1000 rpm delivering 50 litres per second. **(04 Marks)**

**OR**

10 a. Derive expression for minimum speed required to start a centrifugal pump. **(06 Marks)**

b. A centrifugal pump with 1.2 m diameter runs at 200 rpm and pumps 1880 litres/s, the average lift being 6 m. The angle which the vanes make at exit with the tangent to the impeller is 26° and the radial velocity of flow is 2.5 m/s. Determine the manometric efficiency and the least speed to start pumping against a head of 6 m, the inner diameter of the impeller is 0.6 m. **(06 Marks)**

c. Explain the following: (i) Caring (ii) Guide mechanism (iii) Runner (iv) Draft tube **(04 Marks)**

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