Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech

PCME 4201

Third Semsester Back Examination – 2014

FLUID MECHANICS AND HYDRAULIC MACHINES

BRANCH(S) : CIVIL, MECH, MINERAL, MINING

QUESTION CODE : L 338

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) Explain the terms Dynamic viscocity and kinematic viscocity. Give their dimensions and significance.

(b) Define Newtonian and non-Newtonian fluid and show the characteristics.

(c) Calculate the specific weight density and specific gravity of two liters of liquid which weight 15N.

(d) State Pascals's Law and show through demonstration.

(e) Explain Hydrostatic Law and its significance for fluid dynamics.

(f) A rectangular slvice gate is situated on the vertical wall of a lock. The vertical side of the slvice is 'd' meters in length and depth of centroid of the area is 'p' m below the water surface. Prove that the depth of pressure is equal to

$$p + \frac{d^2}{12p}$$

(g) Explain the conditions of equilibrium of a floating body and a sub-merged body and give the diagrams.

(h) A block of wood of specific gravity 0.8 floats in water. Determine the meta-centric of the block if its size is 3 m × 2 m × 1 m.

P.T.O.

(i) Differentiate between forced vertex and free vertex flow and differentiate between rotational flow and irrotational flow. Give one example of each.

(j) Differentiate between stream function and velocity potential function and also differentiation between stream line and streak line.

2. (a) Find the pressure intensity of air in the chamber as shown in the figure. 5

(b) A semicircular plate 1.25 m in diameter is placed vertically in a liquid of specific weight 10 KN/m^3 with its diameter on the free liquid surface. Find the total pressure on the plate and the depth of pressure. 5

3. (a) Find the total pressure and depth of centre of pressure for the vertical square lamina as shown in the figure. 4

(b) A tank contains water up to height of 0.75 m above the base. An immiscible liquid of sp. Gravity 0.8 is filled on the top of water upto 1.5 m height. Calculate 6

(i) total pressure on one side of the tank.

(ii) the position of the centre of pressure for one side of the tank, which is 2.5m wide.

(iii) Draw the pressure diagram.

4. (a) A body has a cylindrical upper portion of 4m diameter and 2 m deep. The lower portion is curved one which displaces a volume of 0.9m^3 of water. The center of buoyance of curved portion is at a distance of 2.1 m below the top of the cylinder. The centre of gravity of whole body is 1.5 m below the top of the cylinder. The total displacement of water is 4.5 tonnes. Find the meta-centric height of the body. 5

(b) A venturimeter is installed in a 300mm diameter horizontal pipe line. The throat pipe rates is 1/3 water flows through the installation. The pressure in the pipe line is 13.783N/cm^2 (gauge0 and vacuum in the throat is 37.5 cm of mercury. Neglecting head loss in the venturimeter, determine the rate of flow in the pipe line. 3

(c) Differentiate between momentum equation and impulse momentum equation. 2

5. (a) A 30 mm diameter orifice is provided in the vertical side of a tank in which the head of water over the centre of the orifice is 1.5 m. The tank is supported from knife edges provided at 1.4m above the centre of the orifice. The discharge from orifice is found to be 2.35 lit/sec. A weight of 58.8N is required on the horizontal lever at a distance of 0.3m from the knife edges to balance the tank in the vertical position. Determine all the coefficients of the orifices. 4

(b) In a two dimensional flow the x and y directional velocities u and v are given by $\frac{x}{x^2+y^2}$, $v = \frac{y}{x^2+y^2}$ show that the flow is steady and check whether the flow is irrotational. 3

(c) Give that $u = x^2 - y^2$ and $v = -2xy$, determine the stream function and potential function for the flow. 3

6. (a) What is cavitation ? How does it affect the performance of hydraulic machines ? 5

(b) In an inward flow reaction turbine the diameter at the inlet and outlet are 1.2 m and 0.7m. The hydraulic efficiency is 92%, when the head is 40 m. The velocity of flow at outlet is 2m/sec. The discharge at the outlet is radial. The vane angle at outlet is 15°. Flow width is 0.1 m at the inlet and outlet. Determine 5

(i) the guide blade angle

(ii) speed of turbine

(iii) Guide blade angle and blade inlet angle

(iv) the degree of reaction.

7. (a) What do you understand by characteristic curves of a pump ? What is the significance of the characteristic curves ? 3

(b) A centrifugal pump having outer diameter equal to two times the inner diameter and sunning at 1200 rpm works against a total head of 75 cm. The velocity of flow through the impeller is constant and is equal to 3m/sec. The vanes are set back at angle of 30° at outlet. If the outer diameter of the impeller is 600 mm and width at outlet is 50 mm. Determine 7

(i) vane angle at inlet

(ii) work done per second by the impeller

(iii) manometric efficiency.

8. (a) Define slip, percentage of slip and negative slip of a reciprocating pump and how it occurs. 4

(b) The cylinder of single acting reciprocating pump is 125 mm in diameter and 250 mm in stroke. The pump is running at 40 rpm and discharge water to a height of 15m. The diameter and length of the delivery pipe are 100 mm and 30 mm respectively. If a large air vessel is fitted in the delivery pipe at a distance of 1.5 m from the centre of the pump, find the pressure head in the cylinder, at the beginning of the stroke and in the middle of the delivery stroke. Take friction factor = 0.01. 6