CBCS SCHEME

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

21CV42

Fourth Semester B.E. Degree Examination, June/July 2024
Fluid Mechanics and Hydraulics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following fluid properties:
i) Density
ii) Specific weight
iii) Specific volume
iv) Specific gravity. **(04 Marks)**

b. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m × 0.8m and an inclined plane with angle of inclination 30° as shown in Fig.Q.1(b). 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)**

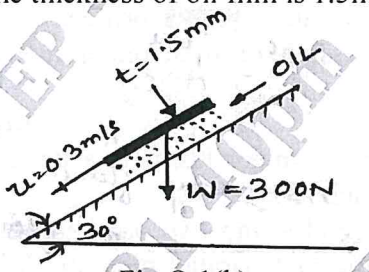

Fig.Q.1(b)

c. What are the gauge pressure and absolute pressure at a point 3m below the free surface of a liquid having a density of $1.53 \times 10^3 kg/m^3$ if the atmospheric pressure is equivalent to 750mm of mercury? The specific gravity of mercury is 13.6 and density of water = $1000kg/m^3$. **(08 Marks)**

OR

2 a. State and prove the Pascal's law. **(06 Marks)**

b. Derive an expression for total pressure and centre of pressure on an inclined plane surface submerged in the liquid. **(08 Marks)**

c. A circular plate of 3m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on the face of the plate and position of centre of pressure. **(06 Marks)**

Module-2

3 a. Derive continuity equation is Cartesian co-ordinates for a fluid in 3 dimensions. **(08 Marks)**

b. Distinguish between:
i) Steady and unsteady flow
ii) Uniform and non-uniform flow
iii) Laminar and turbulent flow. **(06 Marks)**

c. A 30cm diameter pipe, conveying water, branches into two pipes of diameters 20cm and 15cm respectively. If the average velocity in the 30cm diameter pipe is 2.5m/s, find the discharge in this pipe. Also determine the velocity in 15cm pipe if the average velocity in 20cm diameter pipe is 2m/s. **(06 Marks)**

OR

4 a. Derive the equation for discharge through venturimeter. **(08 Marks)**

b. The water is flowing through a pipe having diameters 20cm and 10cm at section (1) and (2) respectively. The rate of flow through pipe is 35 litres/s. The section (1) is 6m above datum and section (2) is 4m above datum. If the pressure at section (1) is 39.24N/cm^2, find the intensity of pressure at section (2). **(06 Marks)**

c. An orifice meter with orifice diameter 15cm is inserted in a pipe of 30cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50cm of mercury. Find the rate of flow of oil specific gravity 0.9 when the coefficient of discharge of the orifice meter = 0.64. **(06 Marks)**

Module-3

5 a. Give classification of orifices and mouth pieces. **(06 Marks)**

b. Water discharge at the rate of 98.2 litres/s through a 120mm diameter vertical sharp edged orifice placed under a constant head of 10 meters. A point on the jet measured from the vena contracta of the jet has co-ordinates 4.5 meters horizontal and 0.54 meters vertical. Find the coefficient C_v, C_c and C_d of the orifice. **(06 Marks)**

c. Derive an expression for discharge through a v-notch. **(08 Marks)**

OR

6 a. Explain major and minor losses in a flow. Give an expression for head loss due to sudden expansion in pipe line. **(08 Marks)**

b. A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000m and 1m respectively, while the length and diameter of 2nd parallel pipe are 2000m and 0.8m. Find the rate of flow in each parallel pipe, if total flow in the main is 3m^3/s. The co-efficient of friction for each parallel pipe is same and equal to 0.005 **(06 Marks)**

c. Explain the phenomenon of water Hammer. List the factors upon which it depends. **(06 Marks)**

Module-4

7 a. Derive Chezy's equation for uniform rate of flow in a channel. Hence write Manning's equation. **(08 Marks)**

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

c. Derive the conditions for the most economical rectangular channel. **(06 Marks)**

OR

8 a. Define hydraulic jump. List the applications of hydraulic jump. **(06 Marks)**

b. The discharge of water through a rectangular channel of width 8m, is 15m^3/s. When depth of flow of water is 1.2m. Calculate:

i) Specific energy of the flowing water.

ii) Critical depth and critical velocity.

iii) Value of minimum specific energy. **(06 Marks)**

c. Derive an expression for GVF in an open channel flow. **(08 Marks)**

Module-5

9 a. Derive an expression for force exerted by jet on moving curved vane in the direction of jet. **(08 Marks)**

b. Explain the neat sketch, the components of a pelton wheel (impulse) turbine. **(06 Marks)**

c. A jet of water of diameter 75mm moving with a velocity of 2.5m/s strikes a fixed plate in such a way that the angle between the jet and plate is 60°. Find the force exerted by the jet on the plate

i) In the direction normal to the plate and

ii) In the direction of the jet. **(06 Marks)**

OR

10 a. Explain with various components of a centrifugal pump. **(08 Marks)**

b. The internal and external diameters of the impeller of a centrifugal pump are 200mm and 400mm respectively. The pump is running at 1200 r.p.m. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. **(06 Marks)**

c. Write a note of multistage centrifugal pumps. **(06 Marks)**

* * * * *