CBCS SCHEME

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18CV33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following terms: (i) Ideal fluids and Real fluids.
(ii) Surface tension and capillarity. **(06 Marks)**

b. State Newton's law of viscosity. Derive an expression for the same. **(06 Marks)**

c. The space between the two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine the dynamice viscosity of the oil in poise. Also find the kinematic viscosity of the oil in stokes, if the specific gravity of the is 0.95. **(08 Marks)**

OR

2 a. Explain with neat sketches the differential manometer and simple manometer. **(06 Marks)**

b. Calculate the gauge pressure and absolute pressure at a point 3 m below the free surface of a liquid having a density of 1.53×10^3 kg/m^3, if the atomospheric pressure is equivalent to 750 mm of mercury. **(06 Marks)**

c. Petrol of specific gravity 0.8 flows upwards through a vertical pipe. A and B are two points in the pipe, B being 0.3 m higher than A, connections are led from A and B to a U tube containing mercury. If the difference of pressure between A and B is 0.18 kgf/cm^2. Find the difference in the mercury level in the differential manometer. **(08 Marks)**

Module-2

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

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

c. In a two dimensional flow $\phi = 3xy$ and $\psi = \frac{3}{2}\left(y^2 - x^2\right)$. Determine the velocity components at the points (1, 3) and (3, 3). Also find the discharge passing between the streamlines passing through the points given above. **(06 Marks)**

OR

4 a. Define : (i) Uniform flow and Non uniform flow.
(ii) Steady and Unsteady flow.
(iii) Velocity potential and stream function. **(06 Marks)**

b. A vertical gate closes a horizontal tunnel 3 m high and 3 m wide running full with water. The pressure at the bottom of the gate is 196.2 kN/m^2. Determine the total pressure on the gate and position of the centre of pressure. **(08 Marks)**

c. Show that streamlines and equipotential lines form a set of perpendicular lines. **(06 Marks)**

Module-3

5 a. Obtain an expression for Euler's equation of motion along a stream line and deduce it to Bernoulli's equation. **(08 Marks)**

b. Define impulse momentum equation and give its applications. **(04 Marks)**

c. A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. If the axis of the pipe turns through 45°. Find the magnitude and direction of the resultant force at the bend. **(08 Marks)**

OR

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

b. A venturimeter is to be fitted in a pipe of 0.25 m diameter where the pressure head is 7.6 m of flowing liquid and the maximum flow is 8.1 m^3/minute. Find the diameter of the throat of the venturimeter. Take $C_d = 0.96$. **(06 Marks)**

c. A pipeline carrying oil of specific gravity of 0.87 changes in diameter from 200 mm at a point A to 500 mm diameter at point B which is 4 m higher. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 l/s. Determine the loss of head and direction of flow. **(06 Marks)**

Module-4

7 a. Define the hydraulic coefficients (C_C, C_d, C_V) of an orifice and obtain the relation between them. **(06 Marks)**

b. Explain the classification of orifice and mouthpiece based on their shape, size, sharpness and discharge. **(06 Marks)**

c. Water flows through a triangular right angled weir first and then over a rectangular weir of 1 m width. The C_d values of triangular and rectangular weir are 0.6 and 0.7 respectively. If the depth of water over the triangular weir is 360 mm, find the depth of water over the rectangular weir. **(08 Marks)**

OR

8 a. Explain Cipolletti notch. What is the advantage of Cipolletti notch over trapezoidal notch. **(06 Marks)**

b. Water discharge at the rate of 98.2 litre/sec through a 120 mm diameter vertical sharp edged orifice placed under a constant head of 10 m. A point on the jet measured from the venacontracta of the jet has co-ordinate (4.5, 0.54). Find the coefficients C_C, C_v, C_d of the orifice. **(08 Marks)**

c. Derive an expression for discharge through a V-notch. **(06 Marks)**

Module-5

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

b. Three pipes of lengths 800 m, 500 m and 400 m and of diameters 500 mm, 400 mm and 300 mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of the single pipe. **(06 Marks)**

c. What is the maximum permissible velocity in a cast iron pipeline 10 mm diameter and 15 mm thick which can be suddenly stopped by a valve at the outlet end of the pipe without letting the rise of pressure in the pipe to exceed 1.545×10^3 kN/m^2.

Take E for cast iron = 123.606×10^9 N/m^2, K for water = 206.01×10^7 N/m^2. Neglect effect of Poisson's ratio. **(06 Marks)**

OR

10 a. Define the term compound pipe and equivalent pipe. Derive the expression for diameter of equivalent pipes. **(06 Marks)**

b. Explain Hardy cross method used in pipe networks. **(06 Marks)**

c. The population of a city is 8,00,000 and it is to be supplied with water from a reservoir 6.4 km away. Water is to be supplied at the rate of 140 litres per head per day and half the supply is to be delivered in 8 hours. The full supply level of the reservoir is RL 180.00 and its lowest water level is RL 105.00. The delivery end of the main is at RL 22.50 and the head required there is 12 m. Find the diameter of the pipe. Take f = 0.04. **(08 Marks)**

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