CBCS Scheme

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15CV33

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State Newton's law of viscosity and derive the expression. **(04 Marks)**

b. Derive an expression for pressure inside a liquid droplet. **(04 Marks)**

c. Petrol of specific gravity 0.8 flows up through a vertical pipe. A and B are the two points in the pipe, B being 0.3m higher than A. A and B are connected to a u-tube differential manometer containing mercury. If the pressure difference between A and B is 18kPa, find the mercury difference in manometer. **(08 Marks)**

OR

2 a. Distinguish between: i) Simple manometer and differential manometer; ii) Absolute pressure and gauge pressure; iii) Newtonian and non-Newtonian fluids. **(06 Marks)**

b. At a certain point in a fluid the shear stress is 0.216 Pa and the velocity gradient is 0.216/s. If specific gravity of fluid is 0.9, what is the kinematic viscosity? **(04 Marks)**

c. A cube of 0.3m sides and weight 30N slides down an inclined plane sloped at 30° to the horizontal. The plane is covered by an oil of $\mu = 2.3 \times 10^{-3}$ Pas with 0.03mm thickness. Determine the velocity with which the cube slides down. **(06 Marks)**

Module-2

3 a. Derive an expression for total pressure and center of pressure on a vertically immersed plane surface. **(08 Marks)**

b. In a 2D incompressible flow the velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine it. Also find the corresponding stream function. **(08 Marks)**

OR

4 a. A vertical gate closes a circular tunnel of 5m diameter running full of water. The pressure at the bottom of the gate is 1MPa. Determine the hydrostatic pressure force and position of CP on the gate. **(08 Marks)**

b. Explain:
i) Steady and unsteady flows
ii) Streamline and path line
iii) Flownet
iv) Rotational and irrotational flow. **(08 Marks)**

Module-3

5 a. Derive the Bernoulli's equation of motion along the stream tube. **(08 Marks)**

b. A horizontal venturimeter 200mm × 100mm is used to measure the flow of water in a pipe. The pressure at inlet is 17.658N/cm^2 and vacuum pressure at throat is 30cm of mercury. Find the flow rate through the venturimeter if $C_d = 0.98$. **(08 Marks)**

OR

6 a. A cylindrical vessel open at the top is 1m long and 150mm in diameter. It contains water upto a height of 0.8m. The vessel is rotated at 300rpm. Find the depth of parabola formed at the free surface. Also find the maximum speed at which the vessel is to be rotated so that no water spills. **(08 Marks)**

b. A pipe line carrying oil of specific gravity 0.8 changes in diameter from 300mm diameter at position A to 500mm diameter at B which is 5m higher than A. If the pressure at A and B are respectively $20N/cm^2$ and $15N/cm^2$ and discharge is 150 lps, determine the loss of head and direction of flow. **(08 Marks)**

Module-4

7 a. Prove that the discharge over a triangular notch is $Q = \frac{8}{15} C_d \sqrt{2g} \tan \frac{\theta}{2} H^{5/2}$. **(08 Marks)**

b. Define C_v, C_c and C_d for an orifice. **(03 Marks)**

c. Explain types of nappe. **(05 Marks)**

OR

8 a. Water is flowing in a rectangular channel 1m wide and 0.75m deep. Find the discharge over a rectangular weir of 0.6m crest length. The head over the crest is 200mm, $C_d = 0.62$. Take velocity of approach into consideration and neglect end contraction. **(08 Marks)**

b. Differentiate between: i) Notch and weir; ii) Orifice and mouthpiece. **(04 Marks)**

c. A jet of water issuing from a 25cm diameter orifice under a constant head of 1.5m moves 0.915m vertically before it strikes ground at a distance of 2.288m measured horizontally from the vena-contracta. The discharge was found to be 102 lpm. Calculate C_d, C_v, C_c. **(04 Marks)**

Module-5

9 a. Derive Darcy's equation for head loss through a pipe. **(08 Marks)**

b. Water flowing through a rigid pipe of diameter 500mm with 1.5m/s is suddenly brought to rest. Find the instantaneous pressure rise if $K_{water} = 2GPa$. **(02 Marks)**

c. A compound pipe system consists of 1800m of 0.5m diameter, 1200m of 0.4m diameter and 600m of 0.3m diameter connected in series. Convert the system to,

i) An equivalent length of 0.4m diameter.

ii) An equivalent pipe of 3600m length. **(06 Marks)**

OR

10 a. Derive an expression for instantaneous rise in pressure in an elastic pipe due to sudden closure of a valve. **(08 Marks)**

b. Explain:

i) Hardy-cross method.

ii) Head loss due to sudden expansion. **(08 Marks)**

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