CBCS SCHEME

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18CV33

Third Semester B.E. Degree Examination, July/August 2022
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What is Capillarity? Derive an expression for capillary rise of water in a glass tube. **(06 Marks)**

b. A cube of 0.3m sides and weight 50N slides down an inclined plane sloped at 30° to the horizontal. The plane is covered by an oil of $\mu = 2.3$ Pa-s with 0.03mm thickness. Compute the velocity with which the cube slides down. **(06 Marks)**

c. An inverted U – tube differential manometer is connected to two points of pipes A & B through which water is flowing. The vertical distance between the centres of these pipes is 30cm with B below A. Oil (S = 0.8) is used in manometer. The level of manometer liquid in the two limbs is 35cm above the centres of respective pipes. Determine the difference of pressure between the pipes. **(08 Marks)**

OR

2 a. Distinguish between : i) Ideal fluids and Real fluids
ii) Manometers and Pressure gauges iii) Surface tension and Capillarity. **(06 Marks)**

b. State and prove Pascal's law. **(06 Marks)**

c. An oil of viscosity 5 Poise is used for lubrication between a shaft and sleeve. The diameter of shaft is 50cm and it rotates at 200 rpm. Thickness of lubrication is 1mm. Calculate the power lost in overcoming the friction for a sleeve length of 100mm. **(08 Marks)**

Module-2

3 a. Define Velocity potential function and Stream function. Hence obtain Cauchy – Riemann equation. **(08 Marks)**

b. Calculate the force F required to hold the hinged door shown in Fig. Q3(b) in closed position. The door is 0.6m square. Air pressure above water surface is 30 kPa. **(12 Marks)**

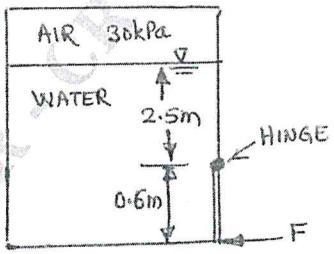

Fig. Q3(b)

OR

4 a. Derive an expression for total pressure and position of center of pressure on a vertically immersed plane surface. Show that center of pressure lies below CG. **(10 Marks)**

b. For the two – dimensional flow defined by u = x – 4y and v = – y – 4x. Obtain stream function and velocity potential function. **(10 Marks)**

Module-3

5 a. Define Impulse Momentum equation and give its applications. **(04 Marks)**

b. Derive an expression for discharge through a horizontal venturimeter. **(08 Marks)**

c. A pipeline carrying oil of specific gravity 0.8 changes in diameter from 300mm at A to 500mm at B which is 5m above A. The rate of flow is 200 ℓps and pressure at A and B is respectively $20N/cm^2$ and $15N/cm^2$. Determine the head loss and direction of flow. **(08 Marks)**

OR

6 a. Derive an Euler's equation of motion along a stream line and obtain Bernoulli's equation. List assumptions. **(10 Marks)**

b. A horizontal pipe of 300mm diameter is bent by 135°. If 250 ℓps of water is flowing through the pipe with a pressure of 400kPa, compute the magnitude and direction of force exerted on the bend. **(10 Marks)**

Module-4

7 a. Derive an expression for discharge through a small orifice. **(08 Marks)**

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

c. Water is flowing in a rectangular channel 1m wide and 0.75m deep water. Find the discharge over a rectangular weir of 0.6m crest length with 200mm head over crest. Take $C_d = 0.65$. Consider velocity of approach and neglect end contraction. **(08 Marks)**

OR

8 a. Explain types of nappe, with neat sketches. **(06 Marks)**

b. What is Cipoletti notch? What is its advantages? Explain with expression. **(08 Marks)**

c. Compute the hydraulic coefficients of an orifice of 25mm diameter discharging under a constant head of 1.5m. The coordinates of jet from vena – contracta are (2.288m , 0.915m). The discharge measured is 102 ℓpm. **(06 Marks)**

Module-5

9 a. Derive Darcy – Weisbach equation for friction loss through a pipe. **(08 Marks)**

b. Explain pipes in series and pipes in parallel. **(06 Marks)**

c. A hydraulic pipeline 3km long and 500mm diameter is used to convey water at 1.5m/s velocity. Determine the magnitude of instantaneous pressure induced if the outflow valve is closed in i) 20 sec ii) 3.5 sec. Consider the pipe as rigid and take $K_{water} = 2GPa$. **(06 Marks)**

OR

10 a. Derive an expression for an instantaneous pressure induced in a pipe due to sudden closure of valve when pipe is rigid. **(06 Marks)**

b. Explain Hardy Cross method. **(06 Marks)**

c. A compound pipe in series consists of 1800m long of 0.5m diameter, 1200m long of 0.4m diameter and 600m long of 0.3m diameter connected between two tanks with difference in water levels of 100m. Determine the flow rate in the pipe neglecting minor losses. Also compute the diameter of equivalent pipe to be connected between the two tanks.

Take $f = 0.04$ in $h_f = \frac{fLV^2}{ZgD}$. **(08 Marks)**

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