CBCS SCHEME

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18MR46

Fourth Semester B.E. Degree Examination, June/July 2024
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. Define : i) Density ii) Specific weight iii) Specific volume iv) Viscosity v) Specific gravity vi) Surface tension. **(06 Marks)**

b. Define capillarity. Derive an expression for capillary rise. **(06 Marks)**

c. A 15cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10cm. Both cylinders are 25cm height. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder of 100rpm, determine the viscosity of fluid. **(08 Marks)**

OR

2 a. State and derive an equation for hydrostatic law. **(06 Marks)**

b. Derive an equation for total pressure and centre of pressure in vertical plane surface submerged in liquid. **(08 Marks)**

c. The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the lift limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. **(06 Marks)**

Module-2

3 a. Derive the continuity equation in three dimensions. **(10 Marks)**

b. A 30 cm diameter pipe, conveying water, branches into two pipes of diameters of 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in the pipe. Also determine the velocity in 15cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. **(10 Marks)**

OR

4 a. Derive Euler's equation of motion and Bernoulli's equation. **(10 Marks)**

b. A non uniform part of pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2. If the diameters at the upper and lower ends are 15 cm and 10cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

Module-3

5 a. Derive an expression for flow through orifice meter. **(10 Marks)**

b. A venturimeter is used for measurement of discharge of water in a horizontal pipe line. If the ratio of upstream pipe diameter to that of throat is 2 : 1, upstream diameters is 300 mm, the different of pressure between the throat and upstream is equal to 3 m head of water and loss of head through meter is one eighth of the throat velocity head, calculate the discharge in the pipe. **(10 Marks)**

OR

6 a. Define : i) Reynold's number ii) Froude's number iii) Euler's number iv) Weber's humber v) Mach's number. **(10 Marks)**

b. The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft ℓ, velocity V, air velocity μ, air density ρ and bulk modulus of air K. Express the functions relationship between these variables and the resisting force. **(10 Marks)**

Module-4

7 a. Drive Darcy Weisbach equation for loss of head due to friction in pipes. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is $0.25 m^3/s$. The diameter of the pipe which is 200mm is suddenly enlarged to 400mm. The pressure intensity in the smaller pipe is $11.772 N/cm^2$. Determine :

i) Loss of head due to sudden enlargement
ii) Pressure intensity in the large pipe
iii) Power lost due to enlargement. **(10 Marks)**

OR

8 a. Derive Hagen Poiseuille equation. **(10 Marks)**

b. A fluid viscosity $0.7 Ns/m^2$ and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as $196.2 N/m^2$, find :

i) The pressure gradient
ii) The average velocity
iii) Reynold number of the flow. **(10 Marks)**

Module-5

9 a. Derive an equation for lift and drag. **(10 Marks)**

b. A jet plans which weighs 29.43 kN and having a wing area of 20 m^2 files at a velocity of 950 km/hour, when the engine delivers 7357.5 kW power, 65% of the power is used to overcome the drag resistance of the wing. Calculate the co-efficient of lift and drag for the wing. The density of atmospheric air is $1.21 kg/m^3$. **(10 Marks)**

OR

10 a. Define :

i) Laminar boundary layer
ii) Turbulent boundary layer
iii) Displacement thickness
iv) Boundary layer thickness. **(08 Marks)**

b. Explain Mach number. **(06 Marks)**

c. An airplane is flying at a height of 15km where the departure is –50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg k, find the speed of the plane. **(06 Marks)**

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