CBCS SCHEME

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18MR46

Fourth Semester B.E. Degree Examination, Feb./Mar. 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. Define the following fluid properties.
i) Density
ii) Weight density
iii) Specific volume
iv) Specific gravity of a fluid. **(08 Marks)**

b. State Newton's law of viscosity. **(04 Marks)**

c. The dynamic viscosity of an oil, used for lubrication between a shift and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm. **(08 Marks)**

OR

2 a. State and prove the Pascal's law. **(08 Marks)**

b. A hydraulic press has a ram of 20cm diameter and a plunger of 3cm diameter. It is used for lifting a weight of 30kN. Find the force required at the plunger. **(08 Marks)**

c. A differential manometer is connected at the two points A and B shows a difference in mercury level as 15cm in a pipe containing an oil of specific gravity 0.9. Find the difference of pressure at the two points. **(04 Marks)**

Module-2

3 a. Define the terms buoyancy and centre of buoyancy. **(04 Marks)**

b. Derive continuity equation in 3D Cartesian co-ordinates : **(08 Marks)**

c. If for a two-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$, determine the velocity at the point P(4, 5). Determine also the value of stream function ψ at the point P. **(08 Marks)**

OR

4 a. Derive Euler's equation of motion and deduce it to 'Bernoulli's equation of motion. **(12 Marks)**

b. A non-uniform part of a pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20N/cm^2 and 12.5N/cm^2. If the diameters at the upper and lower ends are 15cm and 10cm respectively, determine the quantity of water flowing per second. **(08 Marks)**

Module-3

5 a. Write a note on:
i) Venturimeter
ii) Orifice meter
iii) V – notch
iv) Rectangular notches. **(12 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 17.658N/cm^2 and the vacuum pressure at the throat is 30cm of mercury, find the discharge of water through venturimeter, take $C_d = 0.98$. **(08 Marks)**

OR

6 a. Define Similitude? Write the types of Similarities. **(06 Marks)**

b. Define the following non dimensionless number
   i) Reynold's number
   ii) Mach number
   iii) Euler's number. **(06 Marks)**

c. Using Buckingham's π - theorem, show that the validity through a circular orifice is given by $V = \sqrt{2gH}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(08 Marks)**

Module-4

7 a. Derive Darcy – Weisbach equation for loss of head due to frication in pipes. **(10 Marks)**

b. An oil of specific gravity 0.9 and viscosity 0.06 Poise is flowing through a pipe of diameter 200mm at the rate of 60 ℓ/s. Find the head lost due to friction for a 500m length of pipe. Find the power required to maintain the flow. **(10 Marks)**

OR

8 a. Derive Hagen – Poiseuille equation for laminar flow through circular pipe. **(12 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine :
   i) The maximum velocity
   ii) The pressure dropper unit length
   iii) The shear stress at the walls of the plates if the average velocity is 0.2m/s. the viscosity of water at 15°C is given as 0.01 poise. **(08 Marks)**

Module-5

9 a. Derive an expression Drag and lift. **(10 Marks)**

b. A truck having a projected area of $6.5m^2$ travelling at 70km/hr has a total resistance of 2000N of this 20% is due to rolling friction and 10% is due to surface friction. The rest is due to form drag. Calculate the co-efficient of form drag. Take density of air = $1.25kg/m^3$. **(10 Marks)**

OR

10 a. Derive an expression for velocity of sound wave in a fluid. **(10 Marks)**

b. Define the following :
   i) Subsonic flow
   ii) Sonic flow
   iii) Super – sonic flow. **(06 Marks)**

c. Find the speed of the sound wave in air at sea-level where the pressure and temperature are $10.1043N/cm^2$ (abs) and 15°C respectively. Take R = 287J/kg K and K = 1.4. **(04 Marks)**

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