CBCS SCHEME

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15AU42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021

Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following properties of the fluid:
- i) Relative density
- ii) Surface tension
- iii) Capillarity
- iv) Vapour pressure. **(08 Marks)**

b. The space between two parallel plates is filled with oil. Each plate is 60cm. The thickness of the film is maintained at 12.5mm. If the upper plate requires 98.1N to maintain a speed of 2.5m/s, determine:
- i) The dynamic viscosity of oil in poise
- ii) The kinematic viscosity of oil in stokes, if the specific gravity of oil is 0.95. **(08 Marks)**

OR

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

b. A square plate 5m side hangs in water with one of its corner. The centroid of the area is at a depth of 10m from the water surface. Find the total pressure on the plate and the position of centre of pressure. **(08 Marks)**

Module-2

3 a. Describe with appropriate sketch various conditions of equilibrium for a floating body. **(08 Marks)**

b. A solid cylinder 2m in diameter and 2m high is floating in water with its axis vertical. If the specific gravity of the cylinder is 0.65, find its metacentric height. State whether the equilibrium is stable or not. **(08 Marks)**

OR

4 a. Define:
- i) Uniform and Non-uniform flow
- ii) Laminar and Turbulent flow with relevant sketch and equations, if any. **(08 Marks)**

b. The velocity potential in a 2-d flow field for an incompressible fluid is given by $\phi = x(2y-1)$. Determine velocity at point x = 3 and y = 4. Also determine stream function ψ at that point. **(08 Marks)**

Module-3

5 a. Starting from fundamentals derive a general Euler equation of motion for both compressible and incompressible flow for steady state conditions. **(08 Marks)**

b. A waterline used for supplying water has diameter 0.35m and 0.25m at the bottom and upper end respectively. The pressure intensity at the bottom end is 25kPa while at the upper end, it is 10kPa. Determine the difference in datum head for a flow rate of 60 litres per second. **(08 Marks)**

OR

6 a. With a neat sketch, explain the working of a Pitot tube and derive an expression to determine the actual velocity of a stream. **(09 Marks)**

b. An orifice metre consists of 0.1m diameter orifice in a 300mm diameter pipe having a coefficient of 0.65. The pipe delivers oil of relative density 0.9. The pressure difference on the two sides of the orifice plate is measured by a differential manometer. The difference in level of manometer reading is 70cm of mercury. Find the rate of discharge. **(07 Marks)**

Module-4

7 a. What do you understand by similarity or similitude? Explain different types. **(10 Marks)**

b. Using Rayleigh's method show that the resistance R to the motion of a sphere of diameter D falling through a viscous fluid of viscosity μ and density ρ at a flow velocity V is given by

$$R = \rho D^2 V^2 \phi\left(\frac{\mu}{DV\rho}\right)$$ **(06 Marks)**

OR

8 a. Write suitable equations/relations to estimate the following minor losses in pipe:

i) Sudden enlargement
ii) Sudden contraction
iii) At the pipe entrance
iv) Due to obstruction. **(04 Marks)**

b. A rectangular open channel has a width of 4.5m and a slope of 1 vertical to 600 horizontal. Find the mean velocity of flow and discharge when the depth of water is 1.2m and Chezy constant C = 49. **(08 Marks)**

c. Explain Hydraulic gradient line. **(04 Marks)**

Module-5

9 a. Define Reynold's number. Explain its significance. **(04 Marks)**

b. An oil having a viscosity of 0.096Ns/m^2 and a specific gravity of 1.59 flows through a horizontal pipe of 5cm diameter with a pressure drop of 0.06 kg/cm^2/m length of the pipe. Determine:

i) The rate of flow in kg/m
ii) The shear stress at the pipe wall
iii) The total drag for 100m length of pipe
iv) Power required for the 100m length of pipe to maintain the flow. **(12 Marks)**

OR

10 a. Define drag coefficient and lift coefficient and write expressions for the same. **(06 Marks)**

b. Define Mach number and write its significance. **(04 Marks)**

c. A projectile moves at 40.2 kmph through still air at 30°C and 1 bar abs. Determine:

i) The Mach number
ii) The Mach angle

For air take $\gamma = 1.4$ and $R = 287$J/kg K. **(06 Marks)**

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