CBCS SCHEME

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17AE/AS35

Third Semester B.E. Degree Examination, June/July 2023
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Surface Tension and Capilarity. Obtain an expression for Surface Tension. **(10 Marks)**

b. The diameters of a small piston and a large piston of a hydraulic jack are 3cm and 10cm respectively. A force of 80N is applied on the small piston. Calculate the load lifted by the large piston when : i) The pistons are at the same level.
ii) Small piston is 40cm above the large piston.
The density of water is 1000 kg/m^3. **(10 Marks)**

OR

2 a. Explain Pascal's law and Hydrostatic law. **(10 Marks)**

b. A rectangular pontoon 10m long, 7m broad and 2.5m deep weighs 686.7kN. It carries on its upper deck on empty boiler of 5m diameter weighing 588.6kN. The centre of gravity of the boiler and the pontoon are at their respective centres along a vertical line. Calculate the meat – centric height. Weight density of sea water is 10.104kN/m^3. **(10 Marks)**

Module-2

3 a. Define Fluid Kinematics. Explain the types of fluid flows. **(10 Marks)**

b. The stream function for a 2 – D flow is given by $\Psi = 2xy$, calculate the velocity at the point P(2, 3) also find the velocity potential function. **(10 Marks)**

OR

4 a. Obtain an expression for continuity equation in three dimensional flow. **(10 Marks)**

b. Explain Source and Sink flows and obtain and expression for doubled flow of stream function. **(10 Marks)**

Module-3

5 a. Write Euler's equation of motion along a stream line and integrate it to obtain Bernoulli's equation. State the assumptions made. **(10 Marks)**

b. Find the discharge of water flowing through a pipe 30cm diameter placed in an inclined position where a venturimeter is inserted , having a throat diameter of 15cm. The difference of pressure between the main and throat is measured by a liquid of sp.gr 0.6 in an inverted u – tube which gives a reading of 30cm. The loss of head between the main and throat is 0.2 times the kinematic head of the pipe. **(10 Marks)**

OR

6 a. Explain the principle of orifice meter with a neat sketch. Derive an expression for rate of fluid flowing through pipe. **(10 Marks)**

b. Using Buckingham's π – theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gh}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho v H}\right]$, where H is the head causing flow , D is the diameter of orifice , μ = coefficient of viscosity , ρ is the mass density and g is acceleration due to gravity. **(10 Marks)**

Module-4

7 a. Derive an expression for Drag and Lift. **(10 Marks)**

b. A flat plate $1.5 \times 1.5m^2$ moves at 50km/hr in a stationary air of density 1.15 kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively. Determine i) The lift force ii) The drag force iii) The resultant force and iv) The power required to keep the plate in motion. **(10 Marks)**

OR

8 a. Derive an expression for Von – Karman Momentum Integral equation. **(12 Marks)**

b. Derive an expression for displacement thickness. **(08 Marks)**

Module-5

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

b. Obtain an expression for Bernoulli's equation of Isothermal and Adiabatic process. **(10 Marks)**

OR

10 a. Explain the propagation of pressure waves in a compressible fluid. **(10 Marks)**

b. Find the Mach number when an aeroplane is flying at 1100km/hr through still air having a pressure of 7N/cm^2 and temperature -5°C. Wind velocity may be taken at zero. Take R = 287 J/kg K. Calculate the Pressure , Temperature and Density of air at stagnation point on the nose of the plane. Take r = 1.4. **(10 Marks)**

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