CBCS SCHEME - Make-Up Exam

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BAE/BAS303

# Third Semester B.E./B.Tech. Degree Examination, June/July 2025
## Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. M : Marks , L: Bloom's level , C: Course outcomes.*

| | | Module – 1 | M | L | C |
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| Q.1 | a. | Define the following fluid properties with units:<br>i) Density<br>ii) Weight density<br>iii) Viscosity<br>iv) Bulk modulus<br>v) Capillarity | 10 | L1 | CO1 |
| | b. | A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. Both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12 Nm is required to rotate the inner cylinder at 100 rpm. Determine the viscosity of the fluid. | 10 | L2 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | A pressure gauge consists of two cylindrical bulbs B and C each of 10 sq cm cross sectional area which are connected by a u-tube with vertical limbs each of 0.25 sq cm cross sectional area. A red liquid of specific gravity 0.9 is filled into C and clear water is filled into B, the surface of separation being in the limb attached to C. Find the displacement of the surface of separation when the pressure of surface in C is greater than that in B by an amount equal to 1 cm head of water. | 10 | L2 | CO1 |
| | b. | Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water. | 10 | L2 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | Derive continuity equation in integral form for a finite control volume fixed in space for a fluid. | 10 | L3 | CO2 |
| | b. | Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C the pipe branches. Branch CD is 0.8 m in diameter and carries one third of flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB the velocity in BC, the velocity in CD and the diameter of CE. | 10 | L2 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Derive the energy equation in differential form for the finite control volume. | 10 | L3 | CO2 |
| | b. | Derive the differential form momentum equation for a finite control volume. | 10 | L3 | CO2 |

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| **Module – 3** | | | | | |
| Q.5 | a. | A horizontal ventirumeter with inlet and throat diameter of 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and throat is 20 cm of mercury. Determine the rate of flow. Take $C_d = 0.98$. | 10 | L2 | CO3 |
| | b. | Derive the Bernoullis equation for ideal and real fluids. | 10 | L3 | CO3 |
| **OR** | | | | | |
| Q.6 | a. | Describe the procedure for solving problems by Buckingham's $\pi$-theorem in dimensional analysis. | 10 | L3 | CO3 |
| | b. | A partially submerged body is towed in water. The resistance R to its motion depends on the density $\rho$, the viscosity $\gamma$ of water, length $l$ of the body, velocity V of the body and the acceleration due to gravity 'g'. Show that the resistance to the motion can be expressed in the form. $R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{\rho V L}\right)\left(\frac{Lg}{V^2}\right)\right]$ | 10 | L3 | CO3 |
| **Module – 4** | | | | | |
| Q.7 | a. | Define boundary layer, explain laminar boundary layer, turbulent boundary layer and laminar sub layer with neat sketch. | 10 | L2 | CO4 |
| | b. | Find the displacement thickness, momentum thickness, energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{v} = \frac{y}{\delta}$, when u is the velocity at a distance y from the plate and u = U at y = $\delta$ where $\delta$ = boundary layer thickness. Also calculate the value of $\frac{\delta^*}{\theta}$. | 10 | L3 | CO4 |
| **OR** | | | | | |
| Q.8 | a. | Derive the expression for drag and lift. | 8 | L3 | CO4 |
| | b. | Derive the expression for Kutta Joukowsky Theorem. | 12 | L3 | CO4 |
| **Module – 5** | | | | | |
| Q.9 | a. | Derive the Bernoulli's equation for isothermal process and Adiabatic process. | 12 | L3 | CO5 |
| | b. | Describe the velocity of sound in a fluid. | 8 | L1 | CO5 |
| **OR** | | | | | |
| Q.10 | a. | Calculate the stagnation pressure, temperature and at density at the stagnation point on the nose of the plane, which is flying at 800 km/have through still air having a pressure 8 N/cm$^2$ and temperature -10°C. Take R = 287 J/kg K and K = 1.4. | 10 | L3 | CO5 |
| | b. | Derive the area velocity relationship for compressible flow. | 10 | L3 | CO5 |

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