***U.S.N*** | | | | | | | | | | |

# P.E.S. College of Engineering, Mandya - 571 401

***(An Autonomous Institution affiliated to VTU, Belagavi)***

## Third Semester, B.E. - Automobile Engineering

## Semester End Examination; March/April - 2022

## Fluid Mechanics

*Time: 3 hrs* *Max. Marks: 100*

**Course Outcome**

*The Students will be able to:*

*CO1: Understand and Explain various properties of fluids, Fluid - statics, kinematics & Dynamics and the basic concepts of Fluid mechanics*

*CO2: Apply, Interpret and describe about laminar flow, compressible flow, Energy Losses in Flow through pipes and dimensional analysis about various primary & secondary units.*

*CO3: Derive Equations for fluids properties, Fluid - statics, kinematics & Dynamics and their applications.*

*CO4: Analyze/Compare, solve engineering problems involving fluid flow pertaining to fluids properties, Fluid - statics, kinematics & Dynamics and their applications.*

*CO5: Analyze and solve engineering problems pertaining fluid flow losses, dimensional analysis techniques and practical applications of fluid mechanics in compressible flow.*

***Note:*** ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*

***II) PART - B****: Answer any* ***Two*** *sub questions (from a, b, c) for Maximum of* ***18 marks*** *from each unit.*

| Q. No. | | Questions | Marks | BLs | COs | POs |
|---|---|---|---|---|---|---|
| | | **I : PART - A** | **10** | | | |
| I | a. | State Newton's law of viscosity. | 2 | L1 | CO1 | PO1 |
| | b. | What is pressure head? | 2 | L1 | CO2 | PO1 |
| | c. | What is the condition for stable equilibrium for floating body? | 2 | L3 | CO3 | PO1 |
| | d. | Write the Bernoulli's equation for real fluid. | 2 | L2 | CO4 | PO1 |
| | e. | Explain terminal velocity of a body. | 2 | L2 | CO5 | PO1 |
| | | **II : PART - B** | **90** | | | |
| | | **UNIT - I** | **18** | | | |
| 1 | a. | State and prove Hydrostatic law using rectangular parallel piped element. | 12 | L2 | CO1 | PO1 |
| | b. | A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the lift from the centre of pipe is 15 cm below. | 12 | L3 | CO1 | PO2 |
| | c. | Distinguish between absolute pressure, Gauge pressure and vacuum pressure. | 6 | L2 | CO1 | PO1 |

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**UNIT - II** **18**

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|---|---|---|---|---|---|
| 2 a. | A circular plate 1.5 m diameter is submerged in water with its greatest and least depths below the surface being 2 m and 0.75 m respectively. Determine;<br>i) The total pressure on the face of the plate<br>ii) The position of the centre of pressure | 12 | L3 | CO2 | PO2 |
| b. | Determine the meta centric height by analytical method. | 12 | L3 | CO2 | PO1 |
| c. | Define;<br>i) Total pressure<br>ii) Centre of pressure | 6 | L1 | CO2 | PO1 |

**UNIT - III** **18**

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|---|---|---|---|---|---|
| 3 a. | Define the equation of continuity. Obtain an expression for the continuity equation for a three-dimensional flow. | 12 | L2 | CO3 | PO1 |
| b. | A pipe line carrying oil of specific gravity 0.9 changes in diameter from 0.2 m at a position A to 0.4 m diameter at a position B, which is 3.5 m at a higher level. If the pressure at A and B are 98,100 N/m$^2$ and 58,860 N/m$^2$ respectively and the discharge is 0.2 m$^3$. Determine the loss of head and direction of flow. | 12 | L3 | CO3 | PO2 |
| c. | With neat sketch, explain pitot tube to measure the velocity of a flowing liquid. | 6 | L2 | CO3 | PO1 |

**UNIT - IV** **18**

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| 4 a. | An Oil with density 800 kg/m$^3$ and viscosity 0.16 N-s/m$^2$ flows through a 20 cm diameter pipe. The loss of head due to fluid friction over a 100 m length of pipe is 1.3 m of oil. Determine;<br>i) The average velocity of the flow ii) The volumetric flow rate<br>iii) The wall shear stress iv) The Darcy's friction factor | 12 | L3 | CO4 | PO2 |
| b. | Show that the velocity of sound wave in compressible fluid is given by, $C = \sqrt{E/s}$ | 12 | L2 | CO4 | PO1 |
| c. | Explain the terms mach number mach cone and mach angle. | 6 | L2 | CO4 | PO2 |

**UNIT - V** **18**

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|---|---|---|---|---|---|
| 5 a. | Two reservoirs are connected by a pipeline of diameter 30 cm and length 600 m. If the difference of water surface in the reservoir is 8 m, find the rate of flow. Take Darcy's friction factor f = 0.03. Consider only the low due to fluid friction. | 12 | L3 | CO5 | PO2 |

Contd... 3

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|---|---|---|---|---|---|
| b. | Drag force $F_D$ on a high speed aircraft depends on the velocity of flight V. The characteristic geometrical dimension of the aircraft $L_1$, the density S, the viscosity μ and isentropic bulk modulus of elasticity Es of the ambient air. Using Buckinghari's Π theorem. Find out the independent dimensionless quantities, which describe the phenomenon drag on the aircraft. | 12 | L3 | CO5 | PO2 |
| c. | What is hydraulic gradient line and total energy line? | 6 | L1 | CO5 | PO1 |

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