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# B.M.S. College of Engineering, Bengaluru-560019

**Autonomous Institute Affiliated to VTU**

## December 2023 Supplementary Examinations

**Programme: B.E.** **Semester: III**
**Branch: Aerospace Engineering** **Duration: 3 hrs.**
**Course Code: 22AS3PCFMS** **Max Marks: 100**
**Course: Fluid Mechanics Systems**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Scientific calculator and steam data handbook are allowed to use.





### UNIT - I

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|---|---|---|---|---|
| 1 | a) | Elucidate an expression for Hydrastatic Law with considering a fluid element. | **06** |
| | b) | Deduce a relation for the total pressure and depth of centre of pressure from free surface of liquid of a vertical plane surface submerged in the liquid. | **08** |
| | c) | A solid cylinder of diameter 4m has a height of 4m. Find the metacentric height of the cylinder if the specific gravity of the material of cylinder is 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. | **06** |

**OR**

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|---|---|---|---|---|
| 2 | a) | Enumerate an expression for metacentric height of a floating body by an analytical method. | **12** |
| | b) | A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp.gr 0.8and having vacuum pressure is flowing. The other end of manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the 2 limbs is 40cm and height of fluid in the left from the centre of pipe is 15cm below. | **08** |

### UNIT – II

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|---|---|---|---|---|
| 3 | a) | Assuming an elemental Cartesian fixed control volume, derive an expression for 3D continuity equation which can be applicable for steady, unsteady, compressible & incompressible flow. | **7** |
| | b) | Enumerate the flowing terms with neat sketches. | **6** |

i. Streak lines
ii. Stream lines
iii. Path lines.

c) The stream function for a two-dimensional flow is given by $\Psi = 2xy$. Calculate the velocity at the point P(2,3). Find the velocity potential function $\Phi$. **7**

**UNIT - III**

4 a) Derive Euler's equation of motion & compute Bernoulli's equation from Euler's equation of motion. **07**

b) The water is flowing through a taper pipe of length 100m having diameter 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62N/cm$^2$. **06**

c) Deduce an expression for the discharge over a rectangular weir in terms of head of water over the crest of weir. **07**

**UNIT - IV**

5 a) Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of pipe. **08**

b) Compute an expression for Darcy's to determine the loss of head due to friction in pipe **06**

c) An oil of viscosity 0.1 Ns/m2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and of length 300m. The rate of flow of fluid flow of fluid through the pipe is 3.5 liters/s. Find the pressure drop in length of 300m and also shear stress at the pipe wall. **06**

**UNIT - V**

6 a) The efficiency 'η' of a fan depends on density 'ρ', dynamic viscosity 'μ' of the fluid, angular velocity 'ω', diameter 'D' of the rotor and the discharge 'Q'. Express efficiency 'η' in terms of dimensionless parameters using Buckingham's Pi-theorem. Use 'D', 'ω' and 'ρ' are repeating variables. **10**

b) Outline the basic laws of similarities and elucidate the basic laws of similitude analysis to make sure that the results obtained from an experiment can correctly be transferred to real fluid flow. **10**

**OR**

7 a) Define displacement thickness. Derive an expression for displacement thickness. **10**

b) Enumerate the expression for lift and drag force on a body moving through a fluid. **10**

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