

**Indian Maritime University**  
**(A Central University, Govt of India)**  
**End Semester Examinations – June 2024**  
**Programme Name: B Tech (ME)**  
**Semester: IV**  
**Subject Code: UG11T3405**  
**Subject Name: FLUID MECHANICS I**

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Date: 05.06.2024

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

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General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.

**Section A**

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. For a Newtonian fluid
  - (a) Shear stress is proportional to shear strain
  - (b) Rate of shear stress is proportional to shear strain
  - (c) Shear stress is proportional to rate of shear strain
  - (d) Rate of shear stress is proportional to rate of shear strain
  
2. In a static fluid
  - (a) resistance to shear stress is small
  - (b) fluid pressure is zero
  - (c) linear deformation is small
  - (d) only normal stresses can exist
  
3. Rain drops are spherical because of
  - (a) viscosity
  - (b) air resistance
  - (c) surface tension forces
  - (d) atmospheric pressure
  
4. The center of gravity of the volume of the liquid displaced by an immersed body is called
  - (a) meta-center
  - (b) center of pressure
  - (c) center of buoyancy
  - (d) center of gravity

5. In a steady, ideal flow of an incompressible fluid, total energy at any point of the fluid is always constant. This theorem is known as
- (a) Euler's theorem
  - (b) Navier-Stokes theorem
  - (c) Reynold's theorem
  - (d) Bernoulli's theorem
6. Viscous forces are not present in
- (a) rotational flow
  - (b) irrotational flow
  - (c) laminar flow
  - d. none of the options
7. Friction factor for laminar flow is given by, ( $Re$  is Reynolds Number)
- (a)  $Re / 64$
  - (b)  $64 / Re$
  - (c)  $Re / 16$
  - (d)  $16 / Re$
8. The continuity equation is connected with
- (a) viscous fluids
  - (b) compressibility of fluids
  - (c) conservation of mass
  - (d) steady/unsteady flow
9. The pressure at a point in a fluid will not be same in all the directions when the fluid is
- (a) viscous
  - (b) viscous and static
  - (c) inviscous and moving
  - (d) viscous and moving.
10. Consider the velocity distribution of fluid laminar flow through a pipe. What is the ratio of maximum velocity to average velocity?
- (a) 1
  - (b) 1.5
  - (c) 2
  - (d) 3.14

## Section B

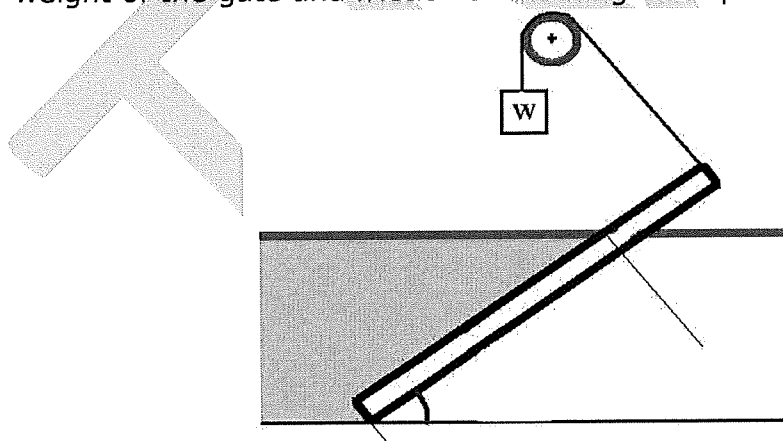
Five Questions of 02 Marks each

11. What is Pascal law?
12. Define Total pressure and Center of pressure.
13. State Bernoulli's theorem for steady flow of an incompressible fluid.
14. What are the different energy losses in pipes?
15. What is a vortex flow?

## Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. Derive an expression for Bernoulli's equation from first principle.
17. A rectangular gate 5m x 2m is hinged at its base and inclined at  $60^\circ$  to the horizontal as shown in figure. To keep the gate in a stable position, a counter weight  $W$  of 49050 N is attached at the upper end of the gate. Find the depth of water at which the gate begins to fall. Neglect the weight of the gate and friction at the hinge and pulley.



18. Derive the expression for the force exerted by a jet on the stationary inclined flat plate. A nozzle of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet at 5 m/s. Find the force on plate and the efficiency of jet.

19. For a shaft mounted in a journal bearing deduce the expression for power required to overcome the viscous resistance. An oil of viscosity  $0.02 \text{ Pa}\cdot\text{s}$  is flowing between two stationary parallel plates  $1 \text{ m}$  wide maintained  $1 \text{ cm}$  apart. The velocity midway between the plates is  $2 \text{ m/s}$ . Calculate pressure gradient along flow, the average velocity and the discharge.
20. Derive the expression for the loss of head due to sudden expansion in pipe line.
21. For flow through pipes in case of laminar flow, derive the relation between coefficient of friction and Reynolds number.
22. In case of forced vortex what is the relation between the rise of liquid level at the ends and fall of liquid level at axis of rotation. A closed cylinder of diameter  $200 \text{ mm}$  and height  $150 \text{ mm}$  is completely filled with water. Calculate the total pressure force exerted by water on the top and bottom of the cylinder, if it is rotated about its vertical axis at  $200 \text{ rpm}$ .