

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations – December 2024
Programme Name: B Tech [ME]
Semester: 3
Subject Code: UG11T4303
Subject Name: FLUID MECHANICS

Date: 11.12.2024

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions

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

Section A

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

- 1) If the Reynolds number is more than 4000 then the flow in the pipe is
 - a) A turbulent flow
 - b) A laminar flow
 - c) Either of the above
 - d) None of the above

- 2) A fluid in which shear stress is not directly proportional to the rate of shear strain or the velocity gradient is known as
 - a) Ideal fluid
 - b) Newtonian fluid
 - c) Non-Newtonian fluid
 - d) Ideal plastic

- 3) The continuity equation refers to the conservation of
 - a) Mass
 - b) Force
 - c) Momentum
 - d) Energy

- 4) The property of the liquid, which opposes the motion of one layer of liquid over another adjacent layer of liquid, is called

- a) Surface tension
- b) Cohesion
- c) Viscosity
- d) Capillarity

5. Which of the following best describes vacuum pressure?

- a. Pressure that is higher than atmospheric pressure.
- b. The absolute pressure in a system measured from zero pressure.
- c. Pressure that is lower than atmospheric pressure.
- d. Pressure measured in relation to a perfect vacuum.

6. What is the condition related to the minimum speed for starting a centrifugal pump?

- a. The pump will start delivering water as soon as the impeller begins rotating at any speed.
- b. The pump must reach a minimum speed where the pressure rise equals or exceeds the manometric head (H_m) to start delivering water.
- c. The impeller must reach maximum speed to start the pump.
- d. The pump starts delivering water only after a specified period of operation, regardless of speed.

7. What does Pascal's Law state?

- a. Pressure applied to a confined fluid is transmitted undiminished in all directions.
- b. The pressure in a fluid decreases with depth.
- c. Fluids exert pressure only in the direction of applied force.
- d. Pressure in a fluid is inversely proportional to its density.

8. Which of the following represents a major head loss in a fluid flow system?

- a. Losses associated with bends
- b. Losses associated with fittings
- c. Losses due to sudden expansion of pipe
- d. Losses due to friction

9. What is the primary purpose of priming a centrifugal pump?

- a. To increase the fluid velocity in the pump.
- b. To adjust the pressure of the fluid entering the pump.
- c. To lubricate the moving parts of the pump.
- d. To remove air from the pump and suction line to ensure proper flow.

10. Which valve is used to ensure that fluid flows only in one direction?

- a. Gate valve
- b. Ball valve
- c. Check valve
- d. Globe valve

Section B

Five Questions of 02 Marks each

11. Differentiate between ideal and real fluids
12. Explain the Newton's law of viscosity
13. Name the various Hydraulic Coefficients and describe them.
14. Define Reynolds number and classify fluid flow based on Reynolds number
15. Explain about Cavitation in Centrifugal Pumps

Section C

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

16. A horizontal pipeline 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150 mm in diameter and its diameter is suddenly enlarged to 300 mm. The height of the water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take $f = 0.01$ for both sections of the pipe. (10 marks)

17. The outer diameter of an impeller of a centrifugal pump is 400 mm and outlet width is 50 mm. The pump is running at 800 rpm and is working against a total head of 15 m. The vane angle at the outlet is 40° and manometric efficiency is 75%. Determine:

- i) Velocity of flow at outlet
- ii) velocity of water leaving the vane
- iii) angle made by the absolute velocity at outlet with the direction of motion at outlet, and
- iv) discharge (10 marks)

18. A rectangular plate of dimension $2\text{m} \times 3\text{m}$ is placed vertically in the oil bath such that the 3 m side is parallel to the free surface of the liquid. Calculate the hydrostatic force or total pressure and the Centre of pressure, if the top of the rectangular plate is 2.5 m below the free surface. Specific gravity of oil = 0.8 (3+7 marks)

19. A hydraulic press has a diameter ratio between the two pistons is 8:1. The diameter of the larger piston is 600 mm and it is required to support a mass of 3500 kg. The press is filled with a hydraulic fluid of sp. gravity 0.8. Calculate the force required on the smaller piston to provide the required force: a) When the two pistons are at the same level. B) When the smaller piston is 2.6 m below the larger piston. (4+6 marks)

20. A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the

direction of the jet. The jet is deflected through an angle of 165° . Assuming the plate smooth find:

- i) Force exerted on the plate in the direction of the jet
- ii) Power of the jet, and
- iii) Efficiency of the jet

21. Explain the Manometric and Volumetric efficiency, and Mechanical and Overall efficiency of a centrifugal pump. (10 marks)

22. Describe fluid flow of Cooling Seawater System onboard marine vessels using suitable diagram

