

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023****Subject Code:3141906****Date:11-07-2023****Subject Name:Fluid Mechanics and Hydraulics Machines****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

**MARKS**

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|------------|---|-----------|
| <b>Q.1</b> | <b>(a)</b> Define the following fluid properties:   | <b>03</b> |
|            | 1. Kinematic viscosity  |           |
|            | 2. Vapour pressure  |           |
|            | 3. The bulk modulus of compressibility  |           |
|            | <b>(b)</b> Define cohesion and adhesion characteristics of the fluid.   | <b>04</b> |
|            | When detergent is mixed with water, which characteristic of water is affected? How?   |           |
|            | <b>(c)</b> List out forces acting on the fluid in motion. Discuss assumptions made in Bernoulli's equation. Also, List out the limitations of Bernoulli's equation.   | <b>07</b> |
| <b>Q.2</b> | <b>(a)</b> Define:  | <b>03</b> |
|            | 1. Stream line  |           |
|            | 2. Streak line  |           |
|            | 3. Path line  |           |
|            | <b>(b)</b> Write a statement of Pascal's law and hydrostatic law.   | <b>04</b> |
|            | <b>(c)</b> Explain Raynolds experiment with proper diagrams. Distinguish between Laminar and Turbulent flow.  | <b>07</b> |
|            | <b>OR</b>   |           |
|            | <b>(c)</b> A shaft of 100 mm diameter moves in a sleeve of length 350 mm at a speed of 0.4 m/s under the application of 250 N force in the direction of its motion. If the clearance between the shaft and sleeve is 0.08 mm, determine the dynamic viscosity of the lubricating oil filled in a clearance gap. | <b>07</b> |
|            | If the applied force is increased to 750 N, what will be the speed of the sleeve?   |           |
| <b>Q.3</b> | <b>(a)</b> Explain the condition of stability for floating and submerged body.  | <b>03</b> |
|            | <b>(b)</b> Define –   | <b>04</b> |
|            | 1. Buoyant force  |           |
|            | 2. Center of buoyancy   |           |
|            | 3. Metacenter   |           |
|            | 4. Metacentric height   |           |
|            | <b>(c)</b> A wooden block having a horizontal cross section 600 mm × 600 mm and height $h$ . If floats vertically in water. Determine maximum height of the block so that it can remain in stable condition. Consider specific gravity of wood as 0.6.  | <b>07</b> |
|            | <b>OR</b>   |           |
| <b>Q.3</b> | <b>(a)</b> Define and explain circulation? What is the importance of concept of circulation?  | <b>03</b> |
|            | <b>(b)</b> Sketch the velocity distribution and shear stress distribution across a section of the pipe for laminar flow.  | <b>04</b> |
|            | <b>(c)</b> Check whether the flow of liquid given by $u = 5x$ and $v = -5y$ is (i) Continuous (ii) Rotational   | <b>07</b> |

- Q.4 (a)** Write a short note on Kinetic energy correction factor. **03**  
**(b)** What is similitude? Define Geometric, Kinematic and Dynamic similarity. **04**  
**(c)** Discharge  $Q$  of a centrifugal pump can be assumed to be dependent on density of liquid  $\rho$ , viscosity of liquid  $\mu$ , pressure  $p$ , impeller diameter  $D$  and speed  $N$  in RPM. **07**  
Using Buckingham  $\pi$ -theorem, show that:

$$Q = ND^3 \phi \left[ \frac{gH}{N^2 D^2}, \frac{\nu}{ND} \right]$$

**OR**

- Q.4 (a)** If the surface tension at air and water interface is 0.0735 N/m, what is the pressure difference between inside and outside of an air bobble of diameter 0.01 mm? **03**  
**(b)** Write down difference between impulse and reaction Water turbines. **04**  
**(c)** Explain components and constructional features of Francis Turbines with neat schematic diagrams. **07**

- Q.5 (a)** Explain cavitation for hydraulic turbines. **03**  
**(b)** List out and explain heads in a centrifugal pump. **04**  
**(c)** A jet of water of diameter 7 cm strikes a curved plate at its center with velocity of 15 m/s. The curved plate is moving with a velocity of 7 m/s in the direction of the jet and it is deflected through an angle of  $165^\circ$ . Assuming the plate to be smooth. Determine: (i) Force exerted on plate in the direction of jet, (ii) Power of jet, and (iii) Efficiency of jet. **07**

**OR**

- Q.5 (a)** Define following terms for centrifugal pump: **03**  
1. Manometric Efficiency  
2. Volumetric Efficiency  
3. Mechanical Efficiency  
**(b)** List out and explain losses in a centrifugal pump. **04**  
**(c)** Explain hydraulic press with schematic diagram, advantages, disadvantages and applications. **07**

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