

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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|--|--------------|
| Q.1 (a) Define the following fluid properties: | 03 |
| 1. Kinematic viscosity | |
| 2. Vapour pressure | |
| 3. The bulk modulus of compressibility | |
| (b) Define cohesion and adhesion characteristics of the fluid. | 04 |
| When detergent is mixed with water, which characteristic of water is affected?
How? | |
| (c) 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. | 07 |
|
Q.2 (a) Define: | 03 |
| 1. Stream line | |
| 2. Streak line | |
| 3. Path line | |
| (b) Write a statement of Pascal's law and hydrostatic law. | 04 |
| (c) Explain Raynolds experiment with proper diagrams. Distinguish between Laminar and Turbulent flow. | 07 |
| OR | |
| (c) 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.
If the applied force is increased to 750 N, what will be the speed of the sleeve? | 07 |
|
Q.3 (a) Explain the condition of stability for floating and submerged body. | 03 |
| (b) Define – | 04 |
| 1. Buoyant force | |
| 2. Center of buoyancy | |
| 3. Metacenter | |
| 4. Metacentric height | |
| (c) 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. | 07 |
| OR | |
| Q.3 (a) Define and explain circulation? What is the importance of concept of circulation? | 03 |
| (b) Sketch the velocity distribution and shear stress distribution across a section of the pipe for laminar flow. | 04 |
| (c) Check whether the flow of liquid given by $u = 5x$ and $v = -5y$ is (i) Continuous (ii) Rotational | 07 |

- 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 ρ , viscosity of liquid μ , pressure p , impeller diameter D and speed N in RPM. **07**
Using Buckingham π -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° . 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**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2024****Subject Code:3141906****Date:18-07-2024****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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|------|------------|---|-----------|
| | Q.1 | (a) Define the following fluid properties: | 03 |
| | | 1. Dynamic viscosity | |
| | | 2. Specific gravity | |
| | | 3. Specific weight | |
| | (b) | Justify that “Intensity of pressure at any point in a fluid at rest is same in all direction”. | 04 |
| | (c) | Describe capillarity phenomenon. Derive an expression for capillary fall and capillary rise of a liquid. | 07 |
|
 | Q.2 | (a) Differentiate: | 03 |
| | | 1. Uniform and non-uniform flow | |
| | | 2. Steady and unsteady flow | |
| | (b) | Write a difference between “absolute pressure” and “gauge pressure”. | 04 |
| | (c) | State and explain – “Hydrostatic law” for pressure variation. | 07 |
| | | OR | |
| | (c) | A thin square plate 0.3 m × 0.3 m is placed horizontally in the middle of a gap of height 2.5 cm. This gap is filled with oil of viscosity 0.2 Pa·s and the plate is pulled at constant velocity of 0.2 m/s. Find the total force on the plate. | 07 |
|
 | Q.3 | (a) Define the terms “buoyancy” and “centre of buoyancy”. | 03 |
| | (b) | A rectangular block of size 3 m long × 1.5 m wide × 1 m high floats in water such that its depth of immersion is 0.8 m. What is the weight of block? Determine metacentric height and comment on outcome. | 04 |
| | (c) | Show that the distance between the metacentre (M) and centre of buoyancy (B) is expressed by $BM = \frac{I}{V}$. | 07 |
| | | OR | |
| | Q.3 | (a) Explain the terms rotation and vorticity. | 03 |
| | (b) | Obtain an expression for continuity equation for a three-dimensional flow. | 04 |
| | (c) | If the velocity components are given by, | 07 |
| | | $u = 8 + 4xy + t^2, \quad v = -(xy + 20t), \quad w = 5x + y$ | |
| | | Determine velocity and acceleration of particle at (2,1,1) and $t = 1$ sec. | |
|
 | Q.4 | (a) State Buckingham’s π -theorem. How repeating variables are selected in dimensional analysis? | 03 |
| | (b) | State Model (similarity) laws. Where they are used? Explain Euler’s modal law. | 04 |

- (c) Using Buckingham's π -theorem, show that the velocity through a circular orifice is given by - **07**

$$V = \sqrt{2gH} \phi \left[\frac{D}{H}, \frac{\mu}{\rho V H} \right]$$

Where, H = Head causing flow, D = Diameter of the orifice, V = flow velocity, μ = Coefficient of viscosity, ρ = Mass density and g = Acceleration due to gravity.

OR

- Q.4** (a) Explain the advantages of Kaplan turbine over Francis turbine **03**
(b) Classify Hydraulic turbines on the basis of various criteria. **04**
(c) A jet of water of diameter 8 cm strikes a flat plate normally with a velocity of 20 m/s. The plate is moving with a velocity 12 m/s in the direction of the jet and away from the jet. Find: the force exerted by the jet on the plate, work done by the jet on the plate per second. **07**

- Q.5** (a) Determine the head lost due to friction in a pipe. Diameter and length of pipe is 250 mm and 60 m, respectively. Velocity of flowing water inside pipe = 2.5 m/s, Chezy's constant = 60. Use Chezy's formula, $V = C\sqrt{mi}$ **03**
(b) What is pump? How pumps are classified? **04**
(c) What is Hagen-Poiseuille's formula? Derive an expression for Hagen-Poiseuille's formula. **07**

OR

- Q.5** (a) Explain the application and working of "Draft tube". **03**
(b) List out and explain losses in a centrifugal pump. **04**
(c) Write a note on hydraulic crane. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3141906**Date:27-06-2022****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
Q.1	(a) Define Following Fluid Properties: (i) Specific Gravity (ii) Compressibility (iii) Vapour Pressure	03
	(b) Classify fluids on the basis of general equation of Viscosity. Plot Shear stress versus deformation rate curve for each type of fluid.	04
	(c) Differentiate between following fluid flows with examples: (i) Uniform and Non Uniform flow (ii) Steady and Unsteady flow (iii) Compressible and Incompressible flow (iv) Laminar and Turbulent flow (v) Rotational and Irrotational flow	07
Q.2	(a) Define Metacentric height. List the Equilibrium conditions for a floating body.	03
	(b) Explain streamline, Pathline and Streakline with the help of neat diagrams. What is a streamtube?	04
	(c) A 120 mm diameter disc rotates on a table separated by an oil film of 1.8 mm thickness. Find the viscosity of oil if the torque required to rotate the disc at 60 rpm is 0.00072 Nm. Assume the velocity gradient in the oil film to be linear.	07
OR		
	(c) An isosceles triangular plate of base 5 mm and height 5 mm is immersed vertically in an oil of specific gravity 0.8. The base of the plate is 1 m below the free liquid surface, determine: (i) The total pressure (ii) The centre of Pressure.	07
Q.3	(a) List the assumptions in Bernoulli's theorem. List different forces that act on a fluid during flow.	03
	(b) Explain : (i) Hydraulic Gradient line (ii) Total energy line (iii) Geometric similarity (iv) Water hammer	04
	(c) A pipe of 150 mm diameter is attached to a 100 mm diameter pipe by means of a flange in such a way that they are in same horizontal axis. If rate of flow is 2 m ³ /min and manometer shows the pressure difference reading as 80 mm, then find: (i) The loss of head due to contraction (ii) The coefficient of contraction	07
OR		
Q.3	(a) Define Velocity potential function and stream function. Explain the relation between Potential line and stream line.	03
	(b) Describe the steps involved in Buckingham π -theorem with the help of an example.	04
	(c) Glycerine of specific gravity 1.28 and viscosity 8.07 poise flows between two large parallel flat plates 1.5 cm apart. The rate of flow	07

is 4.4 m^3 per hour per metre width of the plates. Determine: (i) Maximum velocity (ii) Maximum shear stress (iii) Pressure gradient (iv) Reynolds number.

- Q.4** (a) Classify Hydraulic turbines on the basis of various criteria. **03**
 (b) Explain the application and working of “Draft tube”. **04**
 (c) Determine the output power, speed, specific head and vane angle at exit of a Francis turbine using the following data: Head = 75 m, Hydraulic efficiency = 92 %, Overall efficiency = 86 %, runner diameters = 1 m and 0.5 m, runner width = 15 cm and guide blade angle = 18° . Assume that the runner vanes are set normal to the periphery at the inlet. **07**
- OR**
- Q.4** (a) With the help of neat diagram, Explain the working of Kaplan turbine. **03**
 (b) Explain Cavitation in Hydraulic turbines. List the steps to protect the turbines against cavitation. **04**
 (c) Describe the requirements of a good Governor. Explain Governing of Impulse turbine in detail. **07**
- Q.5** (a) Explain priming in centrifugal pumps. **03**
 (b) Describe following with respect to a centrifugal pump : (i) Manometric efficiency (ii) Mechanical efficiency (iii) Volumetric efficiency (iv) Overall efficiency **04**
 (c) Estimate the maximum height at which a centrifugal pump with following data can be located above the sump water level: Capacity = $0.08 \text{ m}^3/\text{s}$, diameter of suction pipe = 20 cm, loss of head in suction pipe = 12 times the velocity head in pipe, manometric head = 15 m, vapor pressure of water = 80 kPa (vac). **07**
- OR**
- Q.5** (a) List the selection criteria for pump. **03**
 (b) Plot and explain the characteristic curves for centrifugal pump. **04**
 (c) With the help of neat diagram, explain the construction and working of Hydraulic accumulator. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV EXAMINATION – SUMMER 2025****Subject Code:3141906****Date:12-05-2025****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
Q.1	(a) Define (i) fluid (ii) specific gravity (iii) compressibility	03
	(b) Define cavitation. How does it affect the performance of hydraulic machines?	04
	(c) Explain construction and working of simple hydraulic accumulator with neat sketch and derive equation of its capacity.	07
Q.2	(a) Explain the concept of hydrostatic paradox.	03
	(b) Define Metacentric height. Explain the Equilibrium conditions for a floating body.	04
	(c) A rectangular plane surface is 1m wide and 1.5m deep, having circular hole of 0.5m diameter at the centre. The upper edge and lower edge are below free surface being 1m and 2m respectively. Calculate the magnitude, direction and location of the force acting upon one side of the plate due to water pressure.	07
OR		
	(c) A cylinder block weighs 22 kN having diameter of 2m and height 2.5m is to float in sea water ($S=1.025$). Show that it does not float vertically.	07
Q.3	(a) Define Velocity potential function and stream function. Explain the relation between Potential line and stream line.	03
	(b) State and prove Pascal's law.	04
	(c) Explain construction and working of venturimeter and deduce expression of discharge through it.	07
OR		
Q.3	(a) Explain hydraulic similitude in model analysis	03
	(b) Define centre of pressure. Obtain expression for centre of pressure for vertical plane surface submerged in liquid.	04
	(c) Using Buckingham's π - theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH} \phi \left[\frac{D}{H}, \frac{\mu}{\rho V H} \right]$ Where H- head causing flow, D- diameter of the orifice, μ - viscosity , ρ -mass density of fluid	07
Q.4	(a) Give applications of Moody diagram.	03
	(b) Prove that maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow.	04
	(c) Two sharp ended pipes of diameters 60mm and 120mm and each of length 200m are connected in parallel between two reservoirs.	07

The difference in water surface levels in two reservoirs is 15m. If the friction factor for each pipe is 0.3, calculate (i) rate of flow of each pipe (ii) diameter of a single pipe 200m long which would give the same flow rate if it were substitute for a original two pipes.

OR

- Q.4** (a) Define priming. Why priming is necessary in centrifugal pump? **03**
(b) Explain Eulerian method to study the motion of fluid particles. **04**
(c) Derive the equation of force exerted and work done by the jet when jet strikes tangentially at one of the tips on moving curved blades **07**

- Q.5** (a) Give functions of splitter, breaking jet and spear used in pelton wheel turbine. **03**
(b) Derive the equation of power absorbed in overcoming the viscous resistance in journal bearing. **04**
(c) An inward flow reaction turbine has a degree of reaction 0.6. The peripheral velocity of the blade at entry is 10 m/s and velocity of flow is constant at 2.2 m/s. The rotor diameter at entry is twice that at exit. Neglecting frictional loses, find the blade angle at entry and exit. Water leaves the rotor without whirl sketch the shape and arrangement of the blades. **07**

OR

- Q.5** (a) Give classification of pumps. **03**
(b) Define draft tube. State functions served by draft tube. **04**
(c) Derive the equation of minimum starting speed for a centrifugal pump. **07**
