Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–IV (NEW) EXAMINATION – WINTER 2020

Subject Code:3141906 Date:11/02/2021

Subject Name:Fluid Mechanics and Hydraulics Machines

Time:02:30 PM TO 04:30 PM Total Marks:56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	If the surface tension at the soap-air interface is 0.09 N/m, calculate the internal pressure in a soap bubble of 28 mm diameter.	**03**
	(b)	Explain the terms: Compressibility and Bulk Modulus.	**04**
	(c)	State and prove Pascals's Law.	**07**
Q.2	**(a)**	Briefly discuss Eulerian and Lagrangian approach for description of fluid flow.	**03**
	(b)	Discuss types of equilibrium of floating bodies.	**04**
	(c)	Given that u = xy, v = 2yz. Examine whether these velocity components represent two or three-dimensional incompressible flow; if three-dimensional, determine the third component.	**07**
Q.3	**(a)**	Define and explain briefly the following: (i) Velocity potential; (ii) Stream function.	**03**
	(b)	Explain hydraulic similitude in model analysis.	**04**
	(c)	Deduce the expression of discharge through Orificemeter.	**07**
Q.4	**(a)**	What are the characteristics of a laminar flow?	**03**
	(b)	Explain construction and working of Rotameter.	**04**
	(c)	A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If the co-efficient of discharge is 0.98, determine the rate of flow.	**07**
Q.5	**(a)**	Explain water hammer and its effects.	**03**
	(b)	What is cavitation? How does it affect the performance of hydraulic machines?	**04**
	(c)	Explain governing system of any one hydraulic turbine.	**07**
Q.6	**(a)**	What do you mean by major and minor losses in a pipe flow?	**03**
	(b)	Describe Reynold's experiment.	**04**
	(c)	The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft l, velocity υ, air viscosity μ, air density ρ, and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using dimensional analysis.	**07**
Q.7	**(a)**	Find the discharge over a triangular notch of angle 60^0 when the head over the triangular notch is 0.2 m. Assume $C_d = 0.6$.	**03**
	(b)	Give classification of pumps.	**04**
	(c)	With neat sketch explain construction and working of hydraulic press.	**07**

Q.8	**(a)**	A jet of water 80 mm diameter and having a velocity of 20 m/s impinges at the centre of hemispherical vane. The linear velocity of vane is 10 m/s in the direction of jet. Find the force exerted on the vane.	**03**
	(b)	Discus characteristic curves of centrifugal pump.	**04**
	(c)	With neat sketch explain construction and working of hydraulic accumulator.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2021

Subject Code:3141906 Date:01/01/2022

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.**

Q.1	**(a)**	If the surface tension at air water interface is 0.069 N/m, What is the pressure difference between inside and outside of an air bubble of diameter 0.009 mm?	**03**
	(b)	Explain hydraulic similitude in model analysis.	**04**
	(c)	Derive Bernoulli's equation stating all assumptions.	**07**
Q.2	**(a)**	Discuss types of equilibrium of floating body.	**03**
	(b)	State and prove Pascal's law.	**04**
	(c)	Derive an expression for continuity for 3 D flow and reduce it for steady incompressible 2 D flow in cartesian coordinate system.	**07**
		OR	
	(c)	An annular plate 2m external diameter and 1m internal diameter with its greatest and least depths below the surface being 1.5 m and 0.75 m respectively. Calculate the magnitude, direction and location of the force acting upon one side of the plate due to water pressure.	**07**
Q.3	**(a)**	Discuss Eulerian and Lagrangian approach for description of fluid flow.	**03**
	(b)	Explain the terms: Surface tension and Compressibility.	**04**
	(c)	Explain governing of Impulse turbines.	**07**
		OR	
Q.3	**(a)**	Enlist the characteristics of a Laminar flow.	**03**
	(b)	Explain the concept of hydraulic gradient and total energy lines.	**04**
	(c)	Deduce the expression of discharge through Venturimeter with usual notations.	**07**
Q.4	**(a)**	Explain major and minor losses in a pipe flow.	**03**
	(b)	Define cavitation. How does it affect the performance of hydraulic machines?	**04**
	(c)	Deduce the expression of discharge through V notch.	**07**
		OR	
Q.4	**(a)**	Explain the function of draft tube in the case of reaction turbines.	**03**
	(b)	A Pelton wheel generates 8000 kW under a net head of 130 m at a speed of 200 r.p.m. Assuming the mechanical efficiency 75 percent and hydraulic efficiency 87 percent, determine required discharge.	**04**
	(c)	With neat sketch explain construction and working of hydraulic press.	**07**

Q.5	**(a)**	Explain phenomenon of water hammer and its effects.	**03**
	(b)	Define and explain briefly the following: (i) Velocity potential; (ii) Stream function.	**04**
	(c)	Write a short note on hydraulic intensifier.	**07**

OR

Q.5	**(a)**	A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m^3/s. If the overall efficiency is 90 per cent, determine : (i) Power generated; (ii) Specific speed of the turbine; (iii) Type of turbine.	**03**
	(b)	Discus characteristic curves of centrifugal pump.	**04**
	(c)	With neat sketch explain construction and working of hydraulic accumulator.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV EXAMINATION – SUMMER 2020

Subject Code: 3141906 Date:27/10/2020

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.**

			Marks
Q.1	**(a)**	Explain hypothesis of continuum.	**03**
	(b)	State and prove Pascal's law.	**04**
	(c)	Derive Euler's equation of motion. State assumptions made. How will you obtain Bernoulli's equation from Euler's equation?	**07**
Q.2	**(a)**	How repeating variables selected for dimensionless analysis?	**03**
	(b)	With neat sketch explain the conditions of equilibrium for floating body.	**04**
	(c)	Define uniform flow. Obtain stream and velocity potential function when flow is parallel to x-axis. Also plot uniform flow (parallel to x axis).	**07**
		OR	
	(c)	Derive from first principles, the conditions for ir-rotational flow. Prove that for potential flow, both the stream function and velocity potential function satisfy the Laplace equation.	**07**
Q.3	**(a)**	Differentiate between stream and streak line.	**03**
	(b)	Define centre of pressure. Obtain expression for centre of pressure for vertical plane surface submerged in liquid.	**04**
	(c)	The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 lps. The pipe has slope of 1 in 30. Find the pressure at the lower end if pressure at the higher level is 19.62 N/cm^2.	**07**
		OR	
Q.3	**(a)**	The stream function for two dimensional flow is given by $\psi = 2xy$. Find velocity potential function φ.	**03**
	(b)	Define and explain the terms: HGL, TEL	**04**
	(c)	State Buckingham's π – theorem. 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 discharge Q. Express η in terms of dimensionless parameters.	**07**
Q.4	**(a)**	Derive the expression of force in x and y direction when jet striking symmetrical curved vane tangentially at one tip and leaving other end.	**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)	Derive Darcy – Weisbach equation.	**07**

OR

Q.4	**(a)**	Define priming. Why priming is necessary in centrifugal pump?	**03**
	(b)	Classify hydraulic turbines with examples based on following criteria: i. Energy at inlet ii. Direction of flow through runner iii. Head at the inlet of turbine iv. Specific speed of turbine	**04**
	(c)	A Pelton wheel is to be designed for the following specifications: Shaft power = 11.772 kW, Head = 380 m, Speed = 750 rpm, Overall efficiency = 86%, Jet diameter is not to exceed one-sixth of the wheel diameter. Determine: i. The wheel diameter ii. The number of jets required iii. Diameter of the jet. iv.	**07**
Q.5	**(a)**	Explain the advantages of Kaplan turbine over Fransis turbine.	**03**
	(b)	Define cavitation. State necessary precautions against cavitation in pump.	**04**
	(c)	Why governing of turbine is required? Explain governing of Pelton wheel with neat sketch.	**07**

OR

Q.5	**(a)**	Describe working of hydraulic accumulator with neat sketch.	**03**
	(b)	Write short note on NPSH.	**04**
	(c)	Explain briefly different losses and efficiencies associated with centrifugal pump.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2021

Subject Code:3141906 Date:04/09/2021

Subject Name:Fluid Mechanics and Hydraulics Machines

Time:02:30 PM TO 05:00 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)**	Discuss hypothesis of continuum.	**03**
	(b)	Describe metacentric height and explain the position of the metacenter relative to the center of buoyancy.	**04**
	(c)	Discuss continuity equation in 3 dimensions.	**07**
Q.2	**(a)**	Discuss circulation and vorticity.	**03**
	(b)	Explain general equation for the variation of pressure due to gravity from a point to point in a static fluid.	**04**
	(c)	Explain Hagen Poiseuille formula for viscous flow.	**07**
		OR	
	(c)	Discuss characteristic curves of Hydraulic turbines with neat sketch.	**07**
Q.3	**(a)**	Explain dimensional analysis in brief.	**03**
	(b)	Discuss various types of fluid flows.	**04**
	(c)	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 discharge Q. Express η in terms of dimensionless parameters.	**07**
		OR	
Q.3	**(a)**	Explain Reynold's equipment with neat sketch.	**03**
	(b)	Explain torque converter.	**04**
	(c)	A jet of water having a velocity of 35 m/sec impinges on a series of vanes moving with a velocity of 20 m/sec. The jet makes an angle of 30° to the direction of motion of vanes when entering and leaves at an angle of 120 °. Draw velocity triangles and calculate: (a) The angles of vanes tips so water enters and leaves without shock (b) The work done per unit weight of water entering the vanes. (c) The efficiency	**07**
Q.4	**(a)**	Discuss geometric similarity, dynamic similarity and kinematic similarity.	**03**
	(b)	Explain journal bearing with the equation of power absorbed in friction.	**04**
	(c)	An inward flow reaction turbine has external and internal diameters as 1 m and 0.6 m respectively. The hydraulic efficiency of the turbine is 90% when the head on the turbine is 36 m. The velocity of flow at outlet is 2.5 m/sec and discharge at outlet is radial. If the vane angle at outlet is 15° and width of the wheel is 100 mm at inlet and outlet. Determine 1. The guide blade angle	**07**

2. Speed of the turbine
3. Vane angle of the runner at inlet
4. Volume flow rate of the turbine
5. Power developed

OR

Q.4 **(a)** Explain Hydraulic accumulator with neat sketch. **03**

(b) Discuss Bernoulli's theorem with necessary assumptions. **04**

(c) A Kaplan turbine working under a head of 20 m develops 11772 Kw shaft power. The outer diameter of the runner is 3.5 m and hub diameter 1.75 m. The guide blade angle at the extreme edge of the runner is 35 °. The hydraulic and overall efficiency of the turbines are 88% and 84% respectively. If the velocity of whirl is zero at outlet, determine: **07**

1. Runner vane angles at inlet and outlet of the runner
2. Speed of the turbine

Q.5 **(a)** Types of notches & weirs **03**

(b) What is water hammer? Discuss its causes of occurrence. **04**

(c) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/sec. The vanes are set back at an angle of 40 ° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine **07**

1. Vane angle at inlet
2. Work done by the impeller on the water per second
3. Manometric efficiency

OR

Q.5 **(a)** Explain stream lines and path lines. **03**

(b) Explain characteristic curves of centrifugal pump with neat sketch. **04**

(c) Explain governing of hydraulic turbines with neat sketch. **07**

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Seat No.: _____ Enrolment No._____

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 mm, Hydraulic efficiency = 92 %, Overall efficiency = 86 %, runner diameters = 1 m and 0.5 m, runner width = 15 cm and guide blade angle = 18^o. 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 m^3/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**

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