Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2017

Subject Code: 2141906 **Date: 17/11/2017**

Subject Name: Fluid Mechanics

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.**

Q.1	**(a)**	Define terms: Viscosity, Specific gravity, Surface tension	**03**
	(b)	Explain the working of bellows pressure gauges with schematic diagram.	**04**
	(c)	Prove that the pressure is exerted equally in all direction at any point in a liquid at rest.	**07**
Q.2	**(a)**	A rectangular plane surface 2 m wide and 3 m high immerged in water, it plan is making an angle 45^0 with the free surface of water. The upper edge of rectangular plate is 1.5 m below the free surface. Calculate the position of center of pressure.	**03**
	(b)	Determine the metacentric height of a floating vessel if the angle of tilt Θ caused by moving load P placed over the center of the floating body.	**04**
	(c)	A solid cylinder of diameter 4 meters has a height 3 meters. Find the meta centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6.	**07**
		OR	
	(c)	Explain pressure diagram for inclined and submerge surface.	**07**
Q.3	**(a)**	Define the terms: Streamline, Streak line, Uniform flow	**03**
	(b)	What is the irrotational velocity field associated with the potential $\phi = 3x^2 - 3x + 3y^2 + 16t^2 + 12zt$. Does the flow field satisfy the incompressible continuity equation?	**04**
	(c)	Derive an expression for the discharge through a venturimeter and compare it with orifice meter for measurement of flow through pipes.	**07**
		OR	
Q.3	**(a)**	State the momentum correction factor and list the momentum correction factor for different flow in pipes.	**03**
	(b)	Derive an expression for discharge over rectangular notch.	**04**
	(c)	A rectangular air duct of 1.5 m^2 cross sectional area at section 1 which is gradually reduced to 0.75 m^2 area at section 2. The velocity of flow at section 1 is 12m/s and pressure is 30 kN/m^2. If the duct is bent by 45^0, find the magnitude and direction of the force required to hold the duct in position. Take density of air is 1.15 kg/m^3.	**07**
Q.4	**(a)**	A fluid flow is given by $V = 18x^3i - 20x^2yj$. State the flow is rotational or irrotational.	**03**
	(b)	Distinguish between free vortex flow and forced vortex flow.	**04**
	(c)	State the dimensional homogeneity. Prove that the following equations are homogeneous equation. i. Q =AV ii. $T = 2\pi\sqrt{L/g}$ iii. $V = \sqrt{2gH}$	**07**

OR

Q.4	**(a)**	Prove the velocity of a sound wave in a compressible fluid is given by $C = \sqrt{\gamma RT}$.	**03**
	(b)	Calculate the loss of head and power required to maintain the flow in a horizontal circular pipe of 40 mm diameter and 750 m long when water flow at a rate of 30 liters/minute. Take Darcy's friction factor is 0.032.	**04**
	(c)	Using Buckingham's π- theorem, show 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 the discharge Q.	**07**
Q.5	**(a)**	State the different observations in Reynold experiment for various states of flow.	**03**
	(b)	A shaft of 100 mm diameter rotates at 60 rpm in a 200 mm long bearing. Taking the two surfaces are uniformly separated by a distance of 0.5 mm and taking linear velocity distribution in the lubricating oil having dynamic viscosity of 4 centipoises, find the power absorbed in the bearing.	**04**
	(c)	Prove the friction head losses is equal to one third of total head at inlet for maximum power transmission through pipe.	**07**

OR

Q.5	**(a)**	Determine the head lost due to friction in a pipe using Chezy's formula. Diameter and length of pipe = 250 mm and 60 m Velocity of water flowing in pipe = 2.5 m/s Chezy's constant = 60	**03**
	(b)	Explain capillary tube viscometer.	**04**
	(c)	Prove that the average velocity is half of the maximum velocity in circular pipe with steady laminar flow.	**07**

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