Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV EXAMINATION – SUMMER 2020

Subject Code: 2141906 **Date:29/10/2020**

Subject Name: FLUID MECHANICS

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.**

Q.1	**(a)**	Define the term continuum as applied to the mechanism of flow. Is the continuum model valid in upper atmosphere?	**03**
	(b)	State and prove the Pascal's law and give some examples where this principle is applied.	**04**
	(c)	Explain the term total pressure action on a plane surface in a fluid at any angle. Obtain an expression for this, and also for the corresponding depth of the centre of pressure.	**07**
Q.2	**(a)**	Derive Bernoulli's equation from momentum equation.	**03**
	(b)	Calculate the capillary effect in mm in a glass tube of 4 mm diameter, when immersed in (1) water and (2) mercury. The temperature of the liquid is 20 ^{o}C and the value of the surface tension of water and mercury at 20 ^{o}C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero and for mercury is 130 degree. Take density of water 998 kg/m^3.	**04**
	(c)	State and explain stability criteria of submerged and floating bodies.	**07**
		OR	
	(c)	A cylinder 2 m in diameter x 3 m in length and supported as shown in figure-1 retains water on one side. If the cylinder weighs 150 kN, make calculations for the vertical reactions at A and the horizontal reactions at B. Ignore the frictional effects.	**07**
Q.3	**(a)**	Explain absolute, gauge and vacuum pressure.	**03**
	(b)	Sketch and describe a pitot-static probe and explain how it is used to measure the fluid flow through a pipeline.	**04**
	(c)	Give brief description of classification of fluid flows.	**07**
		OR	
Q.3	**(a)**	Explain the difference between a simple and differential manometer.	**03**
	(b)	Explain the principle of dimensional homogeneity. Is dimensionally homogeneous equation applicable in all systems of units?	**04**
	(c)	Prove that for a steady laminar flow between two fixed parallel plates, the velocity distribution across a section is parabolic and that the average velocity is 2/3rd of the maximum velocity.	**07**
Q.4	**(a)**	Explain surface tension with some examples.	**03**
	(b)	Obtain Darcy-Weisbach formula for head loss due to friction	**04**
	(c)	The velocity components in a two-dimensional incompressible flow field are expressed as $u = \frac{y^3}{3} + 2x - x^2 y$ *and* $v = xy^2 - 2y - \frac{x^3}{3}$. Determine the velocity and acceleration at point P(x=1m , y=3m)	**07**
		OR	
Q.4	**(a)**	What is meant by turbulence? How does it affect the flow properties?	**03**
	(b)	Derive Euler's equation of motion along a stream line.	**04**

(c) The water in a tank is pressurized by air, and the pressure is measured by a multifluid manometer as shown in Figure-2. The tank is located on a mountain at an altitude of 1400 m where the atmospheric pressure is 85.6 kPa. Determine the air pressure in the tank if h1 =0.1 m, h2 =0.2 m, and h3=0.35 m. Take the densities of water, oil, and mercury to be 1000 kg/m^3, 850 kg/m^3, and 13,600 kg/m^3, respectively. **07**

Q.5 **(a)** Explain why air flowing at low velocities can be considered incompressible? **03**

(b) The efficiency η of a fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and discharge Q. Express η in terms of dimensionless parameters. **04**

(c) Explain the terms: Mach number, Mach cone, Mach line and Mach angle in the context of compressible flow. **07**

OR

Q.5 **(a)** Explain the term Vorticity. **03**

(b) Derive the equation for momentum thickness **04**

$$\theta = \int_o^{\delta} \frac{u}{U_0}\left(1-\frac{u}{U_0}\right)dy$$

(c) A pipe carrying oil (Sp. Gr. 0.8) changes in diameter from 300 mm at position 1 to 600 mm diameter at point 2 which is 5 metres at a higher level. If the pressure at positions 1 and 2 are 100 kN/m^2 and 60 kN/m^2 respectively and discharge is 300 litres/sec. Determine : (i) loss of head (ii) direction of flow. **07**

Figure 1

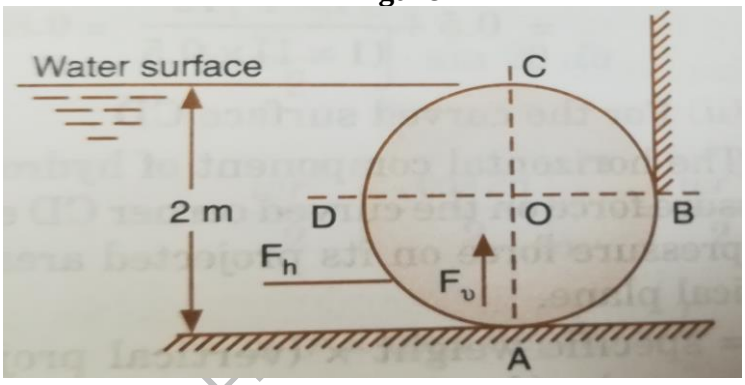
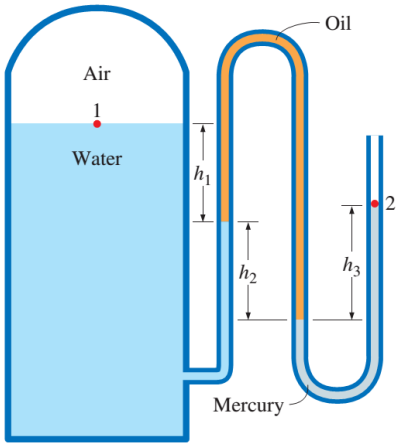


Figure 2



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