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.**

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|---|---|---|---|
| **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**

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|---|---|---|---|
| **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 $\pi$- theorem, show the efficiency $\eta$ of a fan depends on density $\rho$, dynamic viscosity $\mu$ of the fluid, angular velocity $\omega$, 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**

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| **Q.5** | **(a)** | Determine the head lost due to friction in a pipe using Chezy's formula.<br>Diameter and length of pipe = 250 mm and 60 m<br>Velocity of water flowing in pipe = 2.5 m/s<br>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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