Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**B.E. Sem-III Regular / Remedial Examination December 2010**

**Subject code: 130101** **Subject Name: Fluid Mechanics**

**Date: 16 /12 /2010** **Time: 10.30 am – 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 following terms: **07**

(I) Density (II) Weight density
(III) Specific volume (IV) Viscosity
(V) Kinematic viscosity (VI) Surface tension
(VII) Capillarity

**(b)** Derive continuity equation in 3 dimensional co-ordinate system. **07**

**Q.2** **(a)** Derive expression for Bernoulli's theorem for stream line flow. Also write assumption for the same. **07**

**(b)** What do you mean by gauge pressure, vacuum pressure and absolute pressure? Explain the working principle of U-tube differential manometer with neat sketch. **07**

**OR**

**(b)** A horizontal venturimeter of 200 mm X 100 mm is used to measure the discharge of an oil of specific gravity 0.85. A mercury manometer is used for the purpose. If the discharged is 100 litres per second and if the coefficient of discharge of the venturimeter is 0.97, find the difference of mercury level in between two limbs of manometer. **07**

**Q.3** **(a)** Define the following terms: **04**

(I) Total pressure (II) Centre of pressure
(III) Force of buoyancy (IV) Metacentre

**(b)** Derive the expression for total pressure and centre of pressure for a vertical plate submerged in the liquid with usual notations. **05**

**(c)** A solid cylinder of diameter 4 m has a height of 4 m. Find the metacentric height of the cylinder if the specific gravity of the material of cylinder is 0.7 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. **05**

**OR**

**Q.3** **(a)** Define the following dimensionless numbers: **04**

(I) Reynold's No. (II) Froude No. (III) Euler's No. (IV) Mach No.

**(b)** The pressure difference $\Delta p$ in a pipe of diameter D and length L due to turbulent flow depends on velocity V, viscosity $\mu$, density $\rho$ and roughness k. Using Buckingham's $\pi$-theorem obtain an expression for $\Delta p$. **07**

**(c)** Explain briefly : **03**

(I) Steady flow and unsteady flow
(II) Uniform flow and non uniform flow
(III) Laminar and turbulent flow

**Q.4** **(a)** With usual notations derive the expression for the discharge through a triangular notch. **05**

**(b)** Velocity components of a fluid flow are given as **05**
$u = (6xy^2 + t)$, $v = (3yz + t^2 + 5)$, $w = (z + 3ty)$, where x, y, z are given in meters and time t in seconds. Determine velocity vector at point P (4, 1, 2) at time t = 4 seconds. Also determine the magnitude of velocity and acceleration of the flow for given location and time.

**(c)** Explain the following in brief : **04**

(I) Stream function ( $\psi$ )
(II) Velocity potential function ( $\emptyset$ )
(III) Circulation ( $\Gamma$ )
(IV) Flow net

**OR**

**Q.4** **(a)** Derive the expression for shear stress and velocity distribution for the flow of viscous fluid through circular pipe with usual notations. **07**

**(b)** Two parallel plates 80 mm apart have laminar flow of oil between them with maximum velocity of flow is 1.5 m/s. Calculate : **07**
(I) Discharge per meter width (II) Shear stress at the plate (III) The difference in the pressure between two points 20 meter apart. (IV) Velocity gradient at the plates.
(V) Velocity at 20 mm from the plate.
Assume viscosity of oil 24.5 poise.

**Q.5** **(a)** Prove that velocity of sound wave in a compressible fluid is given by $C = \sqrt{(k/\rho)}$ **07**
Where k= Bulk modulus of fluid and $\rho$ = Density of fluid.

**(b)** Certain mass of air is passing through a horizontal pipe with a velocity of 350 m/s, at a section with corresponding pressure of 80 $KN/m^2$ absolute and temperature 45ºC. There is a change in diameter of the pipe at a section and pressure at this section is 128 $KN/m^2$, absolute. Find the velocity of air stream if the flow is adiabatic. **07**

**OR**

**Q.5** **(a)** What do you understand by the terms major energy loss and minor energy losses in pipe? Derive Darcy-Weisbach equation with usual notations. **07**

**(b)** State and prove Pascal's law for static fluid. **04**

**(c)** Explain the condition of stability for a submerged body. **03**

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