

**GUJARAT TECHNOLOGICAL UNIVERSITY****B.E. Sem-III Remedial Examination March 2010****Subject code: 130101****Date: 11 /03 /2010****Subject Name: Fluid Mechanics****Time: 11.00 am – 01.30 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) What do you understand by continuum concept of a fluid? **03**
- (b) Prove that “Intensity of pressure at any point in a fluid at rest is same in all direction” **04**
- (c) Using Buckingham’s  $\pi$ -theorem, show that the lift  $F_L$  on airfoil can be expressed as  $F_L = \rho V^2 d^2 \Phi[(\rho V d / \mu), \alpha]$ . **07**  
 Where,  $\rho$ = mass density  $V$ = velocity of flow,  $d$ =characteristic depth  
 $\mu$ =co-efficient of viscosity and  $\alpha$ =angle of incidence
- Q.2**
- (a) Write a short note on Kinetic energy correction factor. **03**
- (b) State Model (similarity) laws. Where they are used ? Explain Euler’s model law **04**
- (c) Derive an expression for velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across the section of a pipe. **07**

**OR**

- (c) A body has the cylindrical upper portion of 4m diameter and 2.4m deep. **07**  
 The lower portion, which is curved, displaces a volume of 800 litres of water and its centre of buoyancy is situated 2.6m below the top of the cylinder. The centre of gravity of the whole body is 1.6m below the top of the cylinder and the total displacement of water is 52 kN. Find the metacentric height of the body.
- Q.3**
- (a) Define: - (i) path line (ii) stream line (iii) stream tube **03**
- (b) Explain Zone of action, Zone of silence, Mach angle and Mach-cone with the help of diagram **04**
- (c) A U-tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 12cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m<sup>2</sup>. Calculate the new difference in the level of mercury. **07**

**OR**

- Q.3**
- (a) With the help of diagram, explain relationship between mass flow rate and pressure ratio for compressible flow. **03**
- (b) Define the capillarity and derive an expression for capillary rise  $h = 4\sigma / \rho g d$  where,  $h$ = rise of water,  $\sigma$ =surface tension of liquid,  $\rho$ =density of liquid and  $d$ = diameter of droplet **04**
- (c) Derive Darcy-Weisbach equation for the co-efficient of friction in pipes. **07**

- Q.4** (a) State the characteristics of Laminar flow and Turbulent flow **04**  
 (b) Derive an expression for the measurement of velocity of flow at any point in a pipe or channel by Pitot tube. **04**  
 (c) At a depth of 9 km in the ocean, the pressure is  $9.5 \times 10^4 \text{ kN/m}^2$ . The specific weight of the ocean water at the surface is  $10.2 \text{ kN/m}^3$  and its average Bulk modulus is  $2.4 \times 10^6 \text{ kN/m}^2$ . **06**  
 Determine: - (i) The change in specific volume,  
 (ii) The specific volume at 9 km depth and  
 (iii) The specific weight at 9 km depth
- OR**
- Q.4** (a) Prove that the velocity at the outlet of nozzle for maximum flow rate equals sonic velocity **04**  
 (b) Derive an expression of stream function and velocity potential function for vortex flow. **04**  
 (c) Explain force on a curved surface due to hydrostatic pressure. Derive an expression of resulting horizontal, vertical and resultant force on a curved surface immersed in a liquid **06**
- Q.5** (a) Define and explain circulation. What is the importance of concept of circulation? **03**  
 (b) Write short note on Say bolt viscometer. **04**  
 (c) The water is flowing through a taper pipe of length 100 m having diameter 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 litres/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is  $19.62 \times 10^4 \text{ N/m}^2$  & lower end is 10 m above datum. **07**
- OR**
- Q.5** (a) State Buckingham's  $\pi$ -theorem. How the repeating variables are selected in dimensional analysis? **03**  
 (b) Explain Flow-net and state the importance of flow net **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**

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