

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-III Examination-Dec.-2011

Subject code: 130101**Date: 17/12/2011****Subject Name: Fluid Mechanics****Time: 2.30 pm -5.00 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)** Answer the following **07**
(i) Define capillarity and develop a formula for capillary rise of a liquid between two concentric glass tubes with usual notations.
(ii) State and explain Newton's law of viscosity.
- (b)** A disc of 100 mm diameter rotates on a table separated by an oil film of 2 mm thickness. Find the torque required to rotate the disc at 60 rpm, if the dynamic viscosity of oil is 0.05 poise. Assume the velocity gradient in oil film to be linear. **07**
- Q.2 (a)** Answer the following. **07**
(i) State Pascal's law and hydrostatic law.
(ii) Prove that the centre of pressure for any immersed surface always lies below its centroid.
- (b)** A square plate of diagonal 2m is immersed in a liquid with its diagonal vertical and upper corner is 0.5m below the free surface of the liquid. The specific gravity of the liquid is 1.4. **07**
Find,
(i) The force exerted by liquid on the plate.
(ii) The position of its centre of pressure
- OR**
- (b)** A solid cylinder 2.5m in diameter and 2.5m high is floating in water with its axis vertical. If the specific gravity of cylinder material is 0.7, **07**
Find metacentric height. Also state whether the equilibrium is stable or unstable.
- Q.3 (a)** Answer the following. **07**
(i) Define stream function and velocity potential function.
(ii) Derive Euler's equation of motion along a stream line for an ideal fluid and integrate it to get the Bernoulli's equation.
- (b)** Explain the construction and working of a Venturimeter and also derive an expression for the discharge through it. **07**
- OR**
- Q.3 (a)** Answer the following **07**
(i) Distinguish between forced vortex and free vortex flow.
(ii) Define continuously equation and derive an expression for a three dimensional flow.
- (b)** Compare a triangular notch with a rectangular notch for measuring discharges and derive an expression for the discharge through a triangular notch. **07**

- Q.4 (a)** Answer the following **07**
 (i) State the characteristics of a viscous flow.
 (ii) Derive an expression of the velocity distribution for the viscous through a circular pipe. Also sketch the distribution of velocity and shear stress across the section of a pipe.
- (b)** Derive an expression for the velocity of sound wave in a compressible fluid in terms of change of pressure and change of density. **07**
- OR**
- Q.4 (a)** Derive an expression for power absorbed in overcoming viscous resistance in case of a journal bearing. **07**
(b) State Bernoulli's theorem for compressible fluid flow and derive an expression for the same when the process is adiabatic **07**
- Q.5 (a)** What is velocity defect? Derive an expression for the velocity defect for turbulent flow in pipes. **07**
(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 and discharge Q . Express efficiency η in terms of dimensionless parameters by using Buckingham's- π theorem. **07**
- OR**
- Q.5 (a)** Answer the following: **07**
 (i) State the various dimensionless numbers with their significance in fluid flow situations.
 (ii) Derive an expression for shear stress on the basis of 'Prandtl mixing length theory'
- (b)** A pipe of 1.4m in diameter is required to transport an oil of specific gravity 0.8 and dynamic viscosity 0.04 poise at the rate of 2500 litres per second. Test were conducted on a 150mm diameter pipe using water at 20°C. The viscosity of water at 20°C is 0.01 poise. Find the rate of flow in the model. **07**
