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**ET-201(A)**

# B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) B.Tech. (Aero space Engineering)

02591

## Term-End Examination

## December, 2010

## ET-201(A) : MECHANICS OF FLUIDS

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** Anwer ***any seven*** questions. Use of calculator is permitted.

**1.** (a) The velocity distribution for flow over a flat plate is given by : **2x5=10**

$$u=\frac{3}{2}y - y^{3/2},$$

where u is the point velocity in meter per second at a distance y meter above the plate. Determine the shear stress at $y = 9$cm.

Assume dynamic viscosity as 8 poise.

(b) A tank contains a liquid of specific gravity 0.8. Find the absolute pressure and gauge pressure at a point which is 2m below the free surface of the liquid. The atmospheric pressure head is equivalent to 760 mm of mercury.

2. (a) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the volocity in 15 cm pipe, if the average velocity in 20 cm diameter pipe is 2 m/s. **2x5=10**

(b) The velocity vector in a fluid flow is given by

$$V = 2x^3 \hat{i} - 5x^2y \hat{j} + 4t\hat{k},$$

find the velocity and acceleration of a fluid particle at (1, 2, 3) at time t = 1

3. (a) If for a two-dimensional potential flow, the velocity potential is given by : **2x5=10**

$$\phi = 4x(3y - 4),$$

determine the velocity at the point (2, 3).

Determine also the value of stream function $\psi$ at the point (2, 3).

(b) For the steady incompressible flow, are the following values of u and v possible?

(i) $u = 4xy + y^2,$

$v = 6xy + 3x$

and

(ii) $u = 2x^2 + y^2,\ v = -4xy.$

4. (a) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principles and state the assumptions made for such a derivation. **2x5=10**

(b) A pipe, through which water is flowing is having diameters 40 cm and 20 cm at the cross-sections 1 and 2 respectively. The velocity of water at section 1 is given 5.0 m/s. Find the velocity head at the sections 1 and 2 and also rate of discharge.

5. (a) Define the terms: viscosity, kinematic viscosity, velocity gradient, and pressure gradient. **2x5=10**

(b) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow.

6. (a) Describe Reynolds experiment to demonstrate the two types of flow. **2x5=10**

(b) Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. Also prove that maximum velocity is equal to one and a half times the average velocity.

7. (a) Determine. **2x5=10**

(i) The pressure gradient,

(ii) The shear stress at the two horizontal plates.

(iii) The Discharge per metre width for laminar flow of oil with a maximum velocity of 2 m/s between two plates which are 150 m apart. Given $\mu = 2.5$ Ns/m$^2$.

(b) Derive an expression for the loss of head due to friction in pipes.

8. (a) What do you mean by Prandtl mixing length theory? Find an expression for shear stress due to prandtl. **2x5=10**

(b) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 litres/sec.

9. (a) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity $\omega$, speed of advance V, diameter D, dynamic viscosity $\mu$, mass density $\rho$, elasticity of the fluid which can be denoted by the speed of sound in the medium C.

(b) Define the terms : **2x5=10**
boundary layer, boundary layer thickness, drag, lift, and momentum thickness.

10. Write short notes on *any four* of the following : **4x2½=10**

(a) Bulk Modulus.

(b) Meta centre.

(c) Froude number.

(d) turbulent flow.

(e) gauge pressure.

(f) water hammer.

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