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ET-201(A)

B.Tech. Civil (Construction Management) /
B.Tech. Civil (Water Resources Engineering) /
B.Tech. (Aerospace Engineering)

Term-End Examination

01475

June, 2014

ET-201 (A) : MECHANICS OF FLUIDS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **seven** questions. All question carry equal marks. Use of scientific calculator is permitted.*

1. (a) Examine the stability of a cube of side 'L' when it floats in water. The specific gravity of the cube material is 0·8. 5

   (b) A 25 cm diameter pipe carries oil of sp. gr. 0·9 at a velocity of 3 m/s. At another section the diameter is 20 cm. Find the velocity at this section and also mass rate of flow of oil. 5

2. (a) Explain properties of stream function and velocity potential. 4

   (b) A thin walled cubic tank with top open has 500 mm long side. It is full of oil of sp. gr. 0·88. It is uniformly accelerated up a slope of 1 in 4 to the horizontal. Calculate the volume of oil left in the tank after the spill. 6

3. (a) Explain flow net and how it can be plotted by graphical method. *4*

(b) A flow field of a fluid is given by $\vec{V} = x^2y\ \vec{i} + y^2z\ \vec{j} - (2xyz + yz^2)\ \vec{k}$. Prove that it is a case of possible steady incompressible flow. Calculate the velocity at the point (2, 2, 3). *6*

4. (a) Explain momentum equation. Determine jet force on a plane surface by using it. *4*

(b) An aeroplane is travelling at 450 km/hr through still air. The density of air is 12 N/m^3. It discharges 1100 m^3/s of air through 2·25 m diameter propellers. Determine

(i) theoretical efficiency

(ii) pressure difference across the propellers

(iii) thrust

(iv) theoretical power required *6*

5. (a) A jet of water emerges from a nozzle having 1 cm diameter at a velocity of 15 m/s. The jet is found to break into spray at a distance of 15 cm from the nozzle. The surface tension of fluid is 50 dynes/cm. Another fluid with a mass density $\rho_2 = 0{\cdot}9\ \rho_1$ and kinematic viscosity $\nu_2 = 1{\cdot}1\ \nu_1$ and the surface tension 75 dynes/cm, issues from a geometrically similar nozzle. If the two nozzle flows are kinematically similar, determine the scale factors for length, velocity, force and time. *7*

(b) Explain following dimensionless numbers : Reynolds' Number, Euler's Number and Mach's Number. *3*

6. (a) Explain Rayleigh's method of dimensional analysis. Using this method, derive expression for the time period of a simple pendulum of length 'L'. *4*

(b) The head loss in flow through a 8 cm diameter orifice under a certain head is 20 cm of water and velocity of water in jet 7 m/s. If the coefficient of discharge is 0·61, determine

(i) head on the orifice

(ii) diameter of the jet, and

(iii) C_v.

Derive the formulae used. *6*

7. (a) Explain jet propulsion as applied to jet engines. Determine expression of efficiency. *3*

(b) In a slider bearing, the spacings at entry and exit are 6 mm and 4 mm respectively. The length 'L' is 100 cm. Find the location and the magnitude of maximum pressure on the bearing surface. The ambient pressure is $p_0 = 0$ and $\mu = 2{\cdot}0$ kg/m.s. The velocity of travel of the bearing surface is 2 m/s. *7*

8. (a) Explain why head loss in diverging transition is more than that in converging transition. *4*

(b) A sphere of diameter 2·5 cm has relative density equal to 2·65. It is freely falling in an oil tank. The density of oil is 898 kg/m^3 and kinematic viscosity is $1{\cdot}58 \times 10^{-4}$ m^2/s. Compute the fall velocity of the sphere and the drag force. *6*

9. Write short notes on any ***five*** of the following : *5×2=10*

(a) Comparison between path line and streak line

(b) Venturimeter

(c) Couette flow

(d) Difference between laminar and turbulent flow

(e) Form drag and friction drag

(f) Kinetic theory of gases

(g) Capillarity