D 4024

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Third Semester

(Regulation 2004)

Civil Engineering

CE 1202 — MECHANICS OF FLUIDS

(Common to B.E. Part Time Second Semester Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is Specific weight and Specific gravity of a fluid?

2. Write the units and dimensions for dynamic viscosity and kinematic viscosity. of a fluid.

3. Define Buoyancy and Centre of pressure

4. What are the possible classification of fluid flow?

5. Differentiate Laminar flow and Turbulent flow.

6. What is Impulse momentum Equation.

7. Sketch the formation of boundary layer in flow over a flat plate with respect to Reynolds number.

8. Draw the hydraulic grade line and total energy line.

9. Define Reynolds number and Mach number.

10. What are the types of similarities?

PART B — (5 × 16 = 80 marks)

11. (a) A rectangular plate of size 25 cm X 50 cm and weighing 245.3 N slides down a 30° inclined surface at a uniform velocity of 2 m/s. If the uniform 2 mm gap between the plate and the inclined surface is filled with oil, determine the viscosity of the oil. (16)

Or

(b) At a depth of 2 km in the ocean the pressure is 82404 kN/m². Assume the specific weight at the surface as 10055 N/m³ and that the average bulk modulus of elasticity is 2.354×10^9 N/m² for that pressure range. Determine the change in specific volume between that at surface and 2 km depth and also determine the specific weight at that depth. (16)

12. (a) (i) Define stream line, path line and streak line. (6)

(ii) The velocity potential function (ϕ) is given by an expression $\phi = xy^3/3 - x^3y/3 + x^2 - y^2$. Find the velocity components in x and y direction, also check for a possible case of flow. (10)

Or

(b) (i) Calculate the pressure exerted due to a column of 0.5 m of water, an oil of specific gravity 0.9 and express in terms of cm mercury of specific gravity 13.6. (6)

(ii) Derive continuity equation from principle of conservation of mass. (10)

13. (a) Derive from basic principle the Euler's Equations of motion in Cartesian co-ordinate system and deduce the equation to Bernoulli's theorem for steady irrotational flow. (16)

Or

(b) A Venturimeter is inclined at 60 degree to the vertical and its 150 mm diameter throat is 1.2 m from entrance along its length. It is fitted to a pipe of diameter 300 mm diameter pipe. The pipe conveys gasoline of specific gravity 0.82 and flowing 0.215 m³/s upwards. Pressure gauge inserted at entrance and throat show the pressures of 0.141 N/mm² and 0.077 N/mm² respectively. Determine the coefficient of discharge of the Venturimeter. Also determine the reading in mm of differential mercury column, if instead of pressure gauges the entrance and the throat of Venturimeter are connected to the limbs of a U tube mercury manometer. (16)

14. (a) A compound piping system consists of 1800 m length with 0.5 m diameter, 1200 m length with of 0.40 m diameter and 600 m length with of 0.3 m diameter, pipes connected in series. Convert the system to

(i) an equivalent length of 0.4 m diameter pipe and (8)

(ii) an equivalent size of pipe of 3600 m length. (8)

Or

(b) In the boundary layer over the face of the spillway, the velocity distribution is observed to have the following form $u/U = (y/\delta)^{0.22}$

The free stream velocity U at a certain section is observed to be 30 m/s and a boundary layer thickness of 60 mm is also estimated at the section.

The discharge (water of density 1000 kg/m³) passing over the spillway is 6 m³/s per m length of the spillway. Calculate

(i) Displacement and energy thickness. (12)

(ii) The loss of energy upon the section under consideration. (4)

5\. (a) (i) Define Buckingham π Theorem. (3)

(ii) Model of an air duct operating with water produces a pressure drop of 10 kN/m² over 10 m length. If the scale ratio is 1/50. Density of water is 1000 kg/m³ and density of air is 1.2 kg/m³. Viscosity of water is 0.001 Ns/m² and viscosity of air is 0.00002 Ns/m². Estimate corresponding drop in a 20 m long air duct. (13)

Or

(b) Check for the following equations are dimensionally homogeneous

(i) $F = \gamma Q(U_1 - U_2)/g - (P_1 A_1 - P_2 A_2)$. (2)

(ii) Total Energy per unit mass $= V^2/2 + gz + P/\rho$. (2)

(iii) The pressure drop in an aero-plane model of size 1/10 of its proto type is 80 N/cm². The model is tested in water. Find the corresponding pressure drop in the proto type. Take density of air and water are 1.24 kg/m³ and 1000 kg/m³. The viscosity of air and water are 0.000018 Ns/m² and 0.001 Ns/m² respectively. (12)

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