C 130

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Third Semester

Civil Engineering

CE 1202 — MECHANICS OF FLUIDS

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Newton's law of viscosity and write the relationship between shear stress and velocity gradient.

2. Write the units and dimensions for surface tension of a fluid.

3. State Pascal's law and write hydrostatic equation.

4. What are the mechanical gauges used for pressure measurements?

5. Distinguish between Laminar and Turbulent flow.

6. State Impulse Momentum Equation.

7. What are the classifications of boundary layer related with Reynolds number?

8. Differentiate between pipes in series and pipes in parallel.

9. What is dimensional homogenity and write any one sample equation.

10. What is distorted model?

PART B — (5 × 16 = 80 marks)

11. (i) Differentiate between absolute pressure and gauge pressure and give suitable sample conversion. (4)

(ii) During the flow of a fluid following the law $\tau = \mu(\partial u/\partial y)^{(1/3)}$, it is observed that the velocity distribution within the fluid film is given by $u/U_{max} = 2(y/h) - (y/h)^3/3$ where h is the film thickness and U_{max} is maximum velocity. The viscosity is 0.5 Ns/m². Calculate the shear stress at a solid surface, when h = 1 cm, U_{max} = 0.2 m/s. (12)

12. (a) (i) Calculate the pressure in N/m² due to a column of 0.3 m of water, 0.3 m of oil of specific gravity 0.9 and also 0.3 m of mercury of specific gravity 13.6. (6)

(ii) Derive continuity equation for three dimensional flow in x, y and z co–ordinate system. (10)

Or

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

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

13. (a) Derive from basic principle Hagen Poiseuille equation for laminar flow through pipe line. (16)

Or

(b) (i) List out flow measuring devices used in flow through pipe line. (4)

(ii) A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If the coefficient of discharge is 0.98. Determine the rate of flow through venturimeter. (12)

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

(i) displacement and energy thickness. (12)

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

Or

(b) (i) What is equivalent pipe and write the equation to determine the equivalent diameter for the equivalent pipe? (5)

(ii) A piping system consists of three pipes arranged in series, the length of the pipes are 1200 m, 750 m and 600 m. Diameters are 750 mm, 600 mm and 450 mm respectively. Transform the system to an equivalent 450 mm diameter pipe, also determine an equivalent diameter for the pipe 2550 m long. (11)

15. (a) (i) Define dynamic similarity with suitable example. (4)

(ii) The pressure drop in an aero–plane model of size 1/10 of its proto type is 80 N/cm^2. 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/m^3 and 1000 kg/m^3. The viscosity of air and water are 0.000018 Ns/m^2 and 0.001 Ns/m^2 respectively. (12)

Or

(b) Using Buckingham π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2}gH\ f(D/H, \mu/(\rho V H))$. Where H is head causing flow, d is diameter of orifice, μ is coefficient of viscosity, ρ is mass density and g is acceleration due to gravity. (16)
