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Question Paper Code : 42244

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Third Semester
Civil Engineering
CE 2202 – MECHANICS OF FLUIDS
(Regulations 2008)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. A body requires a force of 100 N to accelerate it at a rate of 0.20 m/s^2. Determine the mass of the body in kilograms and in slugs.
2. Brief the concept of continuum.
3. What is metacentric height ? How it is calculated ?
4. State the physical significance of the stream function.
5. What is moody's chart ? Give its use.
6. List the assumption made in the derivation of Hagen-poiseuille equation.
7. What is the key use of boundary layer theory ?
8. Differentiate pipes in series and pipes in parallel in terms of pressure, discharge and losses.
9. Define similitude.
10. What do you mean by distorted models ?

PART – B **(5×16=80 Marks)**

11. a) i) A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. Both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder at 100 r.p.m., determine the viscosity of the fluid.

ii) Air is introduced through a nozzle into a tank of water of form a stream of bubbles. If the bubbles are intended to have a diameter of 2 mm, calculate by how much the pressure of air at the nozzle must exceed that of surrounding water. Assume $\sigma=72.7\times10^{-3}$N/m.

(OR)

b) i) A plate, 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2 N per unit area i.e. 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates.

ii) 10 m^3 of mercury weighs 136×10^4 N. Calculate its specific weight mass density, specific volume and specific gravity.

12. a) i) A hydraulic press has a ram of 30 cm diameter and a plunger of 4.5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500 N.

ii) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.

(OR)

b) i) A rectangular sluice gate is situated on the vertical wall of a lock. The vertical side of the sluice is 'd' metres in length and depth of centroid of the area is 'p' m below the water surface. Prove that the depth of pressure is equal to $\left(p+\frac{d^2}{12p}\right)$.

ii) The velocity potential function (ϕ) is given by an expression

$$\phi=\frac{xy^3}{3}-x^2+\frac{x^3y}{3}+y^2 .$$

1) Find the velocity components in x and y direction.
2) Show that ϕ represents a possible case of flow.

13. a) i) The wind in a hurricane reaches 200 km/h. Estimate the force of the wind on a window facing the wind in a high-rise building if the window measures 1m by 2m. Use the density of the air to be 1.2 kg/m^3.

ii) A 10-cm-diameter hose maintained at a pressure of 1600 kPa provides water from a tanker to a fire. There is a nozzle on the end of the hose that reduces the diameter to 2.5 cm. Estimate the force that the water exerts on the nozzle. The losses can be neglected in a short nozzle.

(OR)

b) i) Fuel oil of sp.gr. 0.95 flow through a 30 cm diameter by 10 cm diameter venturi meter. The pressures of fluid at inlet and throat sections are 1.45 bars (gauge) and 30 cm of mercury (vac) respectively. The head lost in the venturi meter is equal to 3 percent of the differential head of the meter. Determine the discharge of the fluid.

ii) An oil of viscosity 10 poise flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Find the rate of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^3. The width of the plates is 200 mm.

14. a) An oil of sp. gr. 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/s. Find the head lost due to friction and power required to maintain the flow for a length of 1000 m. Take v = 29 stokes.

(OR)

b) A smooth, flat plate 3 m wide and 30 m long is towed through still water at 20°C with a speed of 6 m/s. Determine the drag on one side of the plate and the drag on the first 3m of the plate.
Assume $v = 1.007 \times 10^{-6}$ m^2/s and $\rho = 998.2$ kg/m^3.

15. a) Using Buckingham's π–theorem, shown that the discharge Q consumed by an oil ring is given by

$$Q = Nd^3\phi\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2d^3}, \frac{w}{\rho N^2d}\right].$$

where d is the internal diameter of the ring, N is rotational speed, ρ is density, μ is viscosity, σ is surface tension and w is the specific weight of oil.

(OR)

b) The characteristics of the spillway are to be studied by means of a geometrically similar model constructed to the scale ratio of 1 : 10.

i) If the maximum rate of flow in the prototype is 28.3 cumecs, what will be the corresponding flow in model.

ii) If the measured velocity in the model at a point on the spillway is 2.4 m/s, what will be the corresponding velocity in prototype ?

iii) If the hydraulic jump at the foot of the model is 50 mm high, what will be the height of jump in prototype ?

iv) If the energy dissipated per second in the model is 3.5 N m, what energy is dissipated per second in the prototype ?
