Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 80195

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Civil Engineering

CE 6303 — MECHANICS OF FLUIDS

(Common to Environmental Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define specific volume and specific gravity.

2. Define surface tension and capillarity.

3. What are the types of fluid flow?

4. What are the assumptions made in deriving Bernoulli's equation?

5. What is Hagen Poiseuille's formula?

6. What are the factors influencing the frictional loss in pipe flow?

7. Define boundary layer thickness.

8. Give the classification of boundary layer flow based on the Reynolds number.

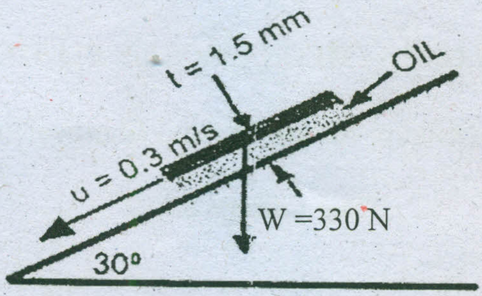
9. State Buckingham's π - theorem.

10. Define Similitude.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive an expression for the capillary rise of a liquid having surface tension σ and contact angle θ between two vertical parallel plates at a distance W apart. If the plates are of glass, what will be the capillary raise of water? Assume $\sigma = 0.0773$ N/m, $\theta = 0°$ take W = 1 mm. (7)

(ii) Calculate the dynamic viscosity of oil which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with angle of inclination 30°. The weight of the square plate is 330 N and it slide down the inclined plane with uniform velocity of 0.3 m/s The thickness of the oil film is 1.5 mm. (6)



Or

(b) If the velocity distribution of a fluid over a plate is given by $u = ay^2 + by + c$ with the vertex 0.2 m from the plate, where the velocity is 1.2 m/s and shear stress = 0 calculate the velocity gradient and shear stresses at a distance of 0 m, 0.1 m, 0.2 m from the plate, if the Viscosity of the fluid is 0.85 Ns/m^2.

12. (a) (i) A pipe 200 mm long slopes down at 1 in 100 and tapers from 600 mm diameter at the higher end to 300 mm diameter at the lower end, and carries 100 liters/sec of oil having specific gravity 0.8. If the pressure gauge at the higher end reads 60 kN/m^2, determine the velocities at the two ends and also the pressure at the lower end. (7)

(ii) The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower and if the pressure at the higher level is 19.62 N/m^2. (6)

Or

(b) (i) A 0.3 m diameter pipe carrying oil at 1.5 m/s velocity suddenly expands to 0.6 m diameter pipe. Determine the discharge and velocity in 0.6m diameter pipe. (3)

(ii) Derive the momentum equation for steady flow. (10)

13. (a) Derive the expression for shear stress and velocity distribution for the flow through circular pipe and using that derive the Hagen Poiseuille formula.

Or

(b) Water flows at the rate of 200 1/s upwards through a tapered vertical pipe. The diameter at the bottom is 240 mm and at the top 200 mm and the length is 5 m. The pressure at the bottom is 8 bar, and the pressure at the topside is 7.3 bar. Determine the head loss through the pipe. Express it as a function of exit velocity head.

14. (a) A plate of 600 mm length and 400 mm wide is immersed in a fluid of specific gravity 0.9 and kinematic viscosity of (v) = 10^{-4} m^2/s the fluid is moving with the velocity of 6 m/s. Determine :

(i) Boundary layer thickness

(ii) Shear stress at the end of the plate and

(iii) Drag force on one of the sides of the plate.

Or

(b) Briefly explain the following terms.

(i) Displacement thickness.

(ii) Momentum thickness.

(iii) Energy thickness.

15. (a) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $v=\sqrt{gH\phi}\left[\frac{D}{H},\frac{\mu}{\rho vH}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity.

Or

(b) The efficiency η of a fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. Use Rayleigh's method.

PART C — (1 × 15 = 15 marks)

16. (a) With basic assumptions derive the Bernoulli's Equation from the Euler's Equation.

Or

(b) Using Buckingham π method of dimensional analysis obtain an expression for the drag force R on a partially submerged body moving with a relative velocity V in a fluid, the other variables being the linear dimension L, height of surface roughness K, fluid density ρ and the gravitational acceleration g.
