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

Question Paper Code : 31197

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Third Semester

Civil Engineering

CE 2202/CE 35/CE 1203/10111 CE 305/080100015 — MECHANICS OF FLUIDS

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write down the S.I. units for (i) Weight density (ii) Mass density (iii) Dynamic viscosity and (iv) Kinematic viscosity.

2. Define surface tension and capillarity.

3. What is meant by total pressure and centre of pressure?

4. Define steam line, streak line, path line and stream tube.

5. In a pipe of $90mm$ diameter water is flowing with a mean velocity of $2m/\text{sec}$ and at a gauge pressure of 350 kN/m^2. Determine the total head if the pipe is 8 meters above the datum line.

6. State and explain Impulse – momentum equation.

7. Define momentum Thickness and Energy Thickness.

8. What is meant by Total Energy line and Hydraulic Gradient line in pipe flow?

9. Define Dimensional Homogeneity.

10. State and define Buckingham's π - theorem.

PART B — (5 × 16 = 80 marks)

11. (a) A trapezoidal channel $2m$ wide at the bottom and $1m$ deep has side slope 1:1 determine.

(i) Total pressure

(ii) Centre of pressure on the vertical gate closing the channel when it is full of water. (16)

Or

(b) A $400mm$ diameter shaft is rotating at $200\ r.p.m$ in a bearing length $120mm$. If the thickness of oil film is $1.5mm$ and the dynamic viscosity of the oil is $0.7\ NS/m^2$ determine

(i) Torque required to overcome friction in bearing

(ii) Power utilised in overcoming viscous resistance. Assume a linear velocity profile.

12. (a) An opening in a dam is covered by the use of a vertical shice gate. The opening is $2m$ wide and $1.2m$ high on the upstream side of the gate the liquid of specific granty 1.45 lies upto a height of $1.5m$ above the top of the gate whereas on the downstream side the water is available upto a height touching the top of the gate. Find

(i) The resultant force acting on the gate and position of the centre of pressure.

(ii) The force acting horizontally at the top of gate which is capable of opening the gate. Assume that gate is hinged at the bottom. (16)

Or

(b) Given that

$$u = -4ax\left(x^2 - 3y^2\right)$$

$$v = 4ay\left(3x^2 - y^2\right).$$

Examine whether these velocity components represent a physically possible two- dimensional flow, if so whether the flow is rotational (or) irrotational. (16)

13. (a) The following date relate to an inclined venturimeter

Diameter of the pipe line = 400 mm

Inclination of the pipe line with the horizontal = 30°

Throat diameter = 200 mm

The distance between the inlet and throat of the meter = 600 mm

Sp. gravity of oil flowing through the pipe line = 0.70

Sp. gravity of heavy U-tube liquid = 13.6

Reading (deflection) of the differential manometer = 50 mm

Determine the rate of flow in the pipe line. (16)

Or

(b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m / sec . Calculate.

(i) The discharge per metre width

(ii) The shear stress at the plates

(iii) The difference in pressure between two points 20 m apart

(iv) The velocity gradient at the plates and

(v) The velocity at 20 mm from the plate. Assume viscosity of oil to be 24.5 poise.

14. (a) A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5 m / sec . If the oil has a specific gravity of 0.8 and kinematic viscosity of 1 stoke, calculate:

(i) Boundary layer thickness at the middle of plate

(ii) Shear stress at the middle of plate and

(iii) Friction drag on one side of the plate. (16)

Or

(b) A 2500 m long pipe line is used for transmission of power. 120 kW power is to be transmitted through the pipe in which water having pressure of 4000 kN/m^2 at inlet is flowing. If the pressure drop one the length of the pipe is 800 kN/m^2 and $f = 0.006$ find

(i) Diameter of the pipe

(ii) Efficiency of transmission. (16)

15. (a) (i) Determine the dimensions of the following quantities

(1) Discharge

(2) Kinematic viscosity

(3) Force

(4) Specific weight. (4 × 2 = 8)

(ii) Explain in detail about

(1) Geometric similarity

(2) Kinematic similarity

(3) Dynamic similarity. (2+3+3)

Or

(b) (i) What is meant by Dimensionless numbers and their significance. (6)

(ii) Explain in detail about Reynolds's Number, Froude number, Euler's Number, Weber's Number and Mach Number. (10)
