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Question Paper Code : X 60244

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020

Third Semester

Civil Engineering

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

(Regulations 2008/2010)

(Common to 10111CE305 for B.E. (Part Time) Second Semester - Civil Engineering-Regulations 2010)

Time : Three Hours Maximum : 100 Marks

Any missing data can be suitably assumed with proper justification.

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Define weight density of a liquid.

2. What is control volume of fluid ?

3. Enlist different types of differential manometers.

4. State Pascal's law.

5. In a pipe of 90 mm diameter water is flowing with a mean velocity of 2m/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. Differentiate between 'drag' and 'lift'.

8. A 200 mm diameter pipe 30 km long transports oil from a tanker to the shore at 0.01 m^3/s. Find the Reynold's number to classify the flow. Take dynamic viscosity of the fluid = 0.1 Ns/m^2 and mass density = 900 kg/m^3 for oil.

9. Define the term dimensional homogeneity. How is it attained in a fluid equation ?

10. Define the terms geometric similarity and kinematics similarity.

PART – B **(5×16=80 Marks)**

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

i) Total pressure. **(6)**

ii) Centre of pressure on the vertical gate closing the channel when it is full of water. **(10)**

(OR)

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

i) Torque required to overcome friction in bearing. **(8)**

ii) Power utilised in overcoming viscous resistance. Assume a linear velocity profile. **(8)**

12. a) i) A u-tube containing mercury is used to measure the pressure of an oil of specific gravity 0.8 an in Fig. (2). Calculate the pressure of the oil, if the difference of mercury level be 500 mm. **(8)**

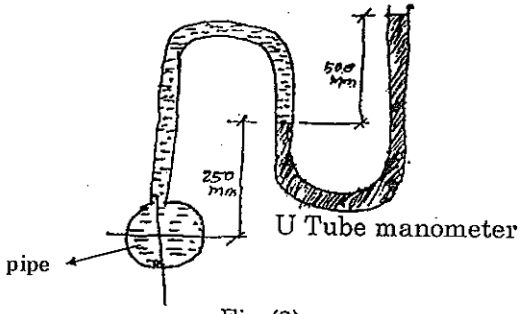

Fig (2)

ii) A square plate ABCD 5m × 5m hangs in water from one of its corner as shown in Fig. (3). Determine the total pressure and the position of the centre of pressure. **(8)**

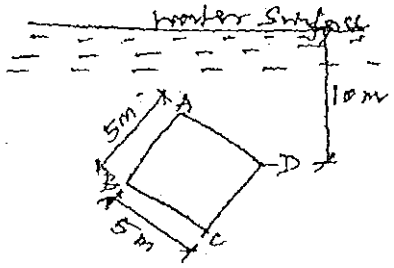

Fig (3)

(OR)

b) i) A vertical sluice gate 4 meters wide and 2 m deep is hinged at the top. A liquid of specific gravity 1.5 stands on the upstream side of the gate and to a height of 3.5 metres above the top edge of the gate and water on the down streak side upto the top edge of the gate. Find the resultant pressure acting on the gate and the point at which the resultant pressure. **(8)**

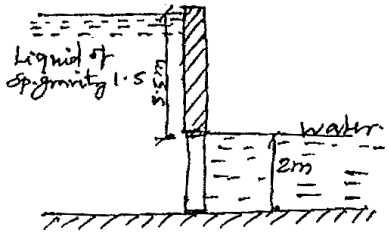

Fig (4)

ii) A two dimensional flour is described by the velocity components, $u = 5x^3$ and $u = -15x^2y$. Determine the steam function, velocity and acceleration at point P(x = 1m; y = 2m). **(8)**

13. a) Derive an expression for the velocity distribution for the viscous flow through a circular pipe and sketch the shear stress distribution and velocity distribution across the section of the pipe. **(16)**

(OR)

b) Derive the Euler's equation of motion for steady flow of an ideal fluid. Using Euler's equation, derive the Bernoulli's equation and also write down the assumption made in the derivation of the above equation. **(16)**

14. a) i) Define boundary layer and why does it increase with distance from the upstream edge. **(8)**

ii) Explain the physical significance of displacement thickness of boundary layer. **(8)**

(OR)

b) Two reservoirs are connected by three pipes of diameters 300 mm, 200 mm and 400 mm and lengths 300 m, 170 m and 210 m respectively. The three pipes are connected in series. The difference in water surface levels of two reservoirs is 12 m. Determine the discharge of water, if friction factor for all the three pipes is 0.02. Neglect the minor losses. **(16)**

15. a) The pressure difference $\Delta\rho$ in a pipe of diameter D and length L due to viscous flow depends on the velocity V. viscosity μ and density ρ. Using Buckingham's π-theorem, obtain an expression for $\Delta\rho$. **(16)**

(OR)

b) i) Differentiate between the following :

1) Geometric similarity and Kinematic similarity.

2) Froude number and Weber number.

3) Distorted model and Undistored model. **(6)**

ii) A spillway model is to be built to a scale ratio of 1:40 across a flume of 600 mm width. The prototype is 10 m high and the maximum head expected is 1.5 m.

1) Find the height of the model and the head on the model.

2) Find the flow over the prototype when the flow over the model is 12 litres per second.

3) If a negative pressure of 0.15 m occurs in the model, what will be the negative pressure in the prototype ? Is this practically possible to occur ? **(10)**

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