



**B.E DEGREE EXAMINATIONS: JUNE 2015**

(Regulation 2009)

Third Semester

**CIVIL ENGINEERING**

CEE104: Mechanics of Fluids

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. One litre of water occupies a volume of \_\_\_\_\_  $\text{cm}^3$ .
  - a) 100
  - b) 250
  - c) 500
  - d) 1000
2. The kinematic viscosity is the
  - a) ratio of absolute viscosity to the density of the liquid
  - b) ratio of density of the liquid to the absolute viscosity
  - c) product of absolute viscosity and density of the liquid
  - d) product of absolute viscosity and mass of the liquid
3. A weir is said to be broad crested weir, if the width of the crest of the weir is \_\_\_\_\_ half the height of water above the weir crest.
  - a) Equal to
  - b) More than
  - c) Less than
  - d) None of the above
4. According to equation of continuity,
  - a)  $w_1 a_1 = w_2 a_2$
  - b)  $a_1 v_1 = a_2 v_2$
  - c)  $w_1 v_1 = w_2 v_2$
  - d)  $a_1 / v_1 = a_2 / v_2$
5. Which of the following is an example of laminar flow?
  - a) Underground flow
  - b) Flow of oil in measuring instruments
  - c) Flow past tiny bodies
  - d) all of these
6. The pressure less than atmospheric pressure is known as
  - a) suction pressure
  - b) negative gauge pressure
  - c) vacuum pressure
  - d) all of these
7. The total energy line lies over the hydraulic gradient line by an amount equal to the
  - a) pressure head
  - b) pressure head + velocity head



**PART C (5 x 14 = 70 Marks)**

21. a) A cylinder of 0.30 m diameter rotates concentrically inside a fixed cylinder of 0.31 m diameter. Both the cylinders are 0.3 m long. Calculate the viscosity of the liquid which fills the space between the cylinders if a torque of 0.98 Nm is required to maintain an angular velocity of 60 rpm.

**(OR)**

- b) A rectangular plate of size 25 cm by 50 cm and weighing 25kgf slides down a  $30^\circ$  inclined surface at a uniform velocity of 2 m/sec. If the uniform 2 mm gap between the plate and the inclined surface is filled with oil, calculate the viscosity of the oil.

22. a) The right limb of U-tube containing mercury is opened to the atmosphere. The left limb contains water and is connected to a pipe full of water at a pressure. The free surface of mercury and the center of the pipe are at the same level. If the difference of level between the two mercury surfaces is 80 mm, estimate the pressure intensity of water in the pipe.

**(OR)**

- b) A sluice gate is 2 m wide and 1.2 m high. It is hinged at the bottom. On the upstream side there is sea water extending to a height of 1.6 m above the top of the gate, and on the downstream side there is fresh water up to the top of the gate. Calculate:

i) The resultant pressure force acting on the gate (5)

ii) The position of the center of pressure (5)

iii) The least force acting at the top of the gate which will open the gate (4)

Fresh water and sea water weigh  $9.81 \text{ kN/m}^3$  and  $10.05 \text{ kN/m}^3$  respectively.

23. a) In a two dimensional incompressible flow, the fluid velocity components are given by  $u=x-4y$  and  $v=-y-4x$ . Defend that the velocity potential exists and evaluate its form. Estimate also the stream function.

**(OR)**

- b) The velocity components in a two-dimensional incompressible flow are:

$$u=y^3+6x-3x^2y, v=3yx^2-6y-x^3$$

Judge:

i) Is the flow continuous? (5)

ii) Is the flow irrotational? (4)

iii) In case the flow is irrotational find the potential function and the stream function. (5)

24. a) The difference of water levels of two water reservoirs is 8 m. They are connected by a 40 m long pipe. For the first 25 m length, the diameter of the pipe is 120 mm and for the remaining length, the diameter is 200 mm, the change in diameter being sudden. Estimate the discharge into the lower reservoir. Take  $f=0.008$ .

(OR)

- b) Water flows through pipes of diameter 8 mm and 4 mm discharging into a third pipe of diameter 10 mm. The rate of flow in the 8 mm diameter pipe is  $6.2 \text{ cm}^3/\text{s}$ . Calculate the maximum discharge in the 10 mm diameter pipe so as to make the flow critical. Take critical value of the Reynolds number as 2300. Analyze also for this condition the type of flow in the 8 mm and 4 mm pipes. Take kinematic viscosity of water equal to  $6.56 \times 10^{-7} \text{ m}^2/\text{s}$ .

25. a) Assuming that the viscous force  $F$  exerted by a fluid on a sphere of diameter  $D$  depends on the viscosity  $\mu$ , mass density of the fluid  $\rho$ , and the velocity of the sphere  $v$ , Formulate an expression for the viscous force by using Buckingham's  $\pi$  theorem.

(OR)

- b) In order to find the resistance to motion of an aeroplane in air, a 1:50 model of the aeroplane was tested in air and water. If the velocity of the model in air is 60 m/s, what should be the corresponding speed at which it should be towed in water? If the drag force on the model in water is 5 N, Estimate the drag on the prototype in air?

Take:

Density of air =  $1.15 \text{ Kg/m}^3$

Kinematic viscosity of air = 0.15 stoke

Kinematic viscosity of water = 0.01 stoke.

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