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Third Semester B.E. Degree Examination, July/August 2021 Fluid Mechanics

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions.

1.
 - a. Explain the following terms with their units : i) Relative density ii) Capillarity. **(04 Marks)**
 - b. An oil of film of thickness 1.5mm is used for lubrication between a square plate of size $0.9\text{m} \times 0.9\text{m}$ and an inclined plane having an angle of inclination 20° . The weight of square is 392.4N and it slides down the plane with uniform velocity of 0.2m/s. Find the dynamic viscosity of oil. **(06 Marks)**
 - c. The dynamic viscosity of soil used for lubrication between shaft and sleeve is 5 Poise. The diameter of shaft is 40cm and it rotates at 200 rpm. Calculate the power lost in bearing for a sleeve length of 100mm. The thickness of film is 2mm. **(06 Marks)**

2.
 - a. Derive an expression for pressure variation in a fluid at rest. **(04 Marks)**
 - b. What are pressure gauges? Explain working of Bowdon's pressure gauge, with neat sketch. **(06 Marks)**
 - c. An U – tube differential manometer is attached to two points A and B in a horizontal pipeline carrying water 5m apart. The pressure at A is 7N/cm^2 and pressure head at B is 150mm of mercury. Find the mercury level differences in manometer. **(06 Marks)**

3.
 - a. Define Total Pressure and Centre of Pressure. **(02 Marks)**
 - b. Derive an expression for depth of centre of pressure from the free surface of liquid of an inclined plane surface submerged in the liquid. **(06 Marks)**
 - c. An equilateral triangular plate of 6m side is immersed in water with its base at 5m below free surface. Determine the total pressure and centre of pressure below free surface. **(08 Marks)**

4.
 - a. Differentiate between :
 - i) Laminar and Turbulent flow
 - ii) Steady and Uniform flow. **(02 Marks)**
 - b. Derive an expression for three dimensional continuity equation. **(06 Marks)**
 - c. If two dimensional potential flow, the velocity potential is given by $\phi = x[2y - 1]$, determine the velocity at point P(4, 5). Determine also the value of stream function ψ at point P. **(08 Marks)**

5.
 - a. Derive Bernoulli's equation from Euler's equation of motion ; also state assumptions and limitations of Bernoulli's equation. **(08 Marks)**
 - b. A venturimeter has its axis vertical , the inlet and throat diameter being 15cm and 7.5cm respectively. The throat is 22.5cm above inlet and $C_d = 0.96$. The fluid is petrol of specific gravity 0.78 and it flows up through the meter at a rate of $0.029\text{m}^3/\text{s}$. Find the pressure difference between inlet and throat. **(08 Marks)**

6.
 - a. What is Momentum principle? Explain. **(04 Marks)**
 - b. What is Static Pitot tube? Explain with neat sketch. **(06 Marks)**
 - c. A pitot static tube placed in centre of 20cm dia pipe has an orifice pointing upstream and other perpendicular to it. If the pressure difference between two orifices is 5cm of water, when the discharge through the pipe is 25.5lit/s. Calculate the coefficient of meter. Take mean velocity of pipe to be 0.83 times central velocity. **(06 Marks)**



- 7 a. Explain classification of Orifices. (04 Marks)
b. Derive an expression for experimental determination of coefficient of velocity of an orifice. (06 Marks)
c. A vertical sharp edged orifice 120mm in diameter is discharging water at the rate of 98.2 lit/s under a constant head of 10 meters. A point on the jet, measured from the vena contracta of the jet has co-ordinates 4.5m horizontal and 0.54 meter vertical. Find the following for the orifice. i) Co-efficient of velocity ii) Co-efficient of discharge. (06 Marks)
- 8 a. Explain classification of Weirs. (04 Marks)
b. Derive an expression for discharge over a rectangular notch. (06 Marks)
c. Water is flowing in a rectangular channel of 1m wide and 0.75m deep. Find the discharge over a rectangular weir of crest length 60cm if the head of water over the crest is 20cm and water from channel flows over weir. Take $C_d = 0.62$. Neglect and contractions. Take velocity of approach into consideration. (06 Marks)
- 9 a. What are the different types of losses in pipe flow? (04 Marks)
b. Derive an expression for equivalent pipe. (06 Marks)
c. A pipe system consists of three pipes arranged in series, the length of pipes are 1200m , 750m and 600m and diameters 750mm, 600mm and 450mm respectively.
i) Transform the system into an equivalent 450mm diameter pipe and
ii) Determine equivalent diameter of pipe, 2250 m long. (06 Marks)
- 10 a. What is the phenomenon of Water hammer? Explain. (04 Marks)
b. Derive an expression for rise of pressure due to sudden closure of valve when pipe is elastic. (06 Marks)
c. The water is flowing with a velocity of 1.5m/s in a pipe of length 2500m of diameter 500mm. At end of pipe a valve is provided. If the valve is closed in 2 seconds, find the rise of pressure behind the valve. Assume the pipe to be rigid and take bulk modulus of water $K = 19.62 \times 10^4 \text{ N/cm}^2$. (06 Marks)

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