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Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Fluid Mechanics

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions, selecting at least TWO full questions from each part.
2. Assume any missing data suitably.

PART – A

1. a. Give the fluid property responsible for the following:
 - i) Shape of rain drop to be spherical.
 - ii) Rise/Fall in the liquid level in a thin glass tube.
 - iii) Resistance to the flow of fluids.
 - iv) Shape of water jet being cylindrical. (04 Marks)
- b. The velocity distribution over a plate is given by $v = \frac{y}{3} - y^2$, where v is in m/s and y is distance from plate in 'm'. Determine the shear stress at $y = 0$ and $y = 0.1$ m. Take $\mu = 0.8$ Pa.s. (08 Marks)
- c. A capillary tube having 4mm diameter is dipped in water at 20°C. Determine the capillary rise. Take $\sigma = 0.075$ N/m and contact angle 60°. What will be the percentage change in capillarity if tube diameter is reduced to half? (08 Marks)
2. a. Differentiate between:
 - i) Absolute pressure and gauge pressure
 - ii) Simple manometer and differential manometer
 - iii) Mechanical and electronic pressure gauges. (06 Marks)
- b. Explain with neat sketch Bourdon type pressure gauge. (06 Marks)
- c. An inverted U-tube differential manometer is connected to two horizontal pipes A and B conveying water whose centers are at 30cm vertical difference, pipe A being higher than pipe B. An oil of sp. gravity 0.8 is used as manometric liquid, with the level 35cm above the center of both the pipes in both limbs. Determine the pressure difference between A and B in kN/m^2 . (08 Marks)
3. a. Sketch the pressure diagrams on the plane surface immersed i) Horizontally ii) Vertically iii) Inclined. (06 Marks)
- b. Derive the expression for total pressure and center of pressure on a vertically immersed plane surface. (08 Marks)
- c. A rectangular tank 10m × 5m and 3.25m deep is divided by a partition wall parallel to the shorter side of tank. One of the compartment contains water upto 3m depth and the other with oil ($S = 0.85$) to a depth of 2m. Determine the position and magnitude of resultant pressure on the partition wall. (06 Marks)
4. a. Define stream function and velocity potential function. Obtain Cauchy-Reimann equations. (06 Marks)
- b. Carbon tetrachloride of specific gravity 1.6 flows through a pipe with a velocity of 2m/s. Calculate the diameter of the pipe if the mass flow rate is 100kg/s. (04 Marks)
- c. In a 2D incompressible flow of fluid the velocity components are $u = x - 4y$ and $v = -y - 4x$. Show that the flow is continuous. Determine the velocity potential and stream function for the flow. (10 Marks)

PART – B

- 5 a. Derive Euler's equation of motion along a stream line and hence obtain Bernoulli's equation. (10 Marks)
- b. 300 lps of water is flowing in a pipe having a diameter and 0.3m and is bent by 90°. Find the magnitude and direction of force on the bend. The pressure of water flowing is 400kPa. (10 Marks)
- 6 a. Derive an expression for instantaneous pressure in an elastic pipe due to sudden closure of a valve. (10 Marks)
- b. Two reservoir having difference in water levels as 12m are connected by a pipeline 3km long and 30cm diameter. Find the discharge through the pipe. If the last 1.5km of the pipe is replaced by two pipes of 1.5km length and 30cm diameter, what is the increase in discharge? Assume $f = 0.04$ in equation $h_f = fLV^2 / 2gD$. (10 Marks)
- 7 a. Explain how the pitot tube is used to obtain point velocity at a point. (06 Marks)
- b. Explain float gauge with a neat sketch. (06 Marks)
- c. The current meter readings at different distance from one of the banks of a river at a section are given below. Compute the average velocity at these locations. The current meter rating curve is $v = (0.05 + 0.8N)$ m/s where N is in revolutions per sec. (08 Marks)

Distance from bank	Depth (m)	Current meter depth (m)	Revolutions (No)	Time (s)
0.6	1.0	0.6	15	30
1.2	4.0	3.2	30	55
		0.8	48	53
2.0	5.5	4.4	40	46
		1.1	60	54
3.0	6.5	5.2	45	48
		1.3	67	52
4.5	2.5	2.0	26	48
		0.5	44	55
5.0	1.0	0.6	20	47

- 8 a. Derive an expression for discharge through a horizontal venturimeter. (08 Marks)
- b. What is the error in the measurement of discharge over a rectangular notch if an error of 2mm has taken place in the measurement of head? Water flows over the notch with a head 400mm. Crest length is 300mm and $C_d = 0.62$. (06 Marks)
- c. The head over the orifice of diameter 10cm is 10m. Rate of discharge through orifice is 100 lps. A point on the jet has coordinates 4m horizontal and 0.45m vertical measured from vena-contracta. Find the hydraulic coefficients of orifice. (06 Marks)

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