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## Third Semester B.E. Degree Examination, June/July 2018 Fluid Mechanics



Time: 3 hrs.

Max. Marks: 80

- Note: 1. Answer any FIVE full questions, choosing one full question from each module.  
2. Assume missing data if any suitably.*

### Module-1

- 1 a. Distinguish between  
i) Ideal fluid and real fluid  
ii) Newtonian and non Newtonian fluid  
iii) Cohesion and adhesion (06 Marks)  
b. State and prove Pascal's law. (04 Marks)  
c. Calculate the specific weight, density, specific volume and specific gravity of two litres of a liquid which weighs 15 N. (06 Marks)

OR

- 2 a. With the help of neat sketches, explain (i) simple U-tube manometer and (ii) differential U-tube manometer. (06 Marks)  
b. What is capillarity? Derive an expression for capillary rise and a liquid in a glass tube. (04 Marks)  
c. A U tube differential manometer connects two pipes A and B. Pipe A contains carbon tetra chloride having specific gravity 1.594 under a pressure of 117.72 kN/m<sup>2</sup> and pipe B contains oil of specific gravity 0.8 under a pressure of 117.72 kN/m<sup>2</sup>. The pipe A lies 2.5 m above pipe B. Find the difference in pressure measured by mercury as fluid filling U-tube. Assume mercury in the right limb is 50 cm below centre of pipe B. (06 Marks)

### Module-2

- 3 a. Distinguish between:  
i) Steady and unsteady flow  
ii) Rotational and irrotational flow (04 Marks)  
b. Derive the expressions for total pressure and centre of pressure for a plane surface submerged vertically in a liquid. (06 Marks)  
c. A circular opening 3m diameter, in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate: (i) The force on the disc, and (ii) The torque required to maintain the disc in equilibrium in vertical position when the head of water above the horizontal diameter is 6m. (06 Marks)

OR

- 4 a. Define the terms velocity potential function and stream function. (04 Marks)  
b. Derive an expression for continuity equation for a three dimensional flow. (06 Marks)  
c. A stream function in a two dimensional flow is  $\psi = 2xy$ . Show that the flow is irrotational and determine the corresponding velocity potential  $\phi$ . (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-3**

- 5 a. What is pitot tube? How will you determine velocity using pitot tube? (04 Marks)  
b. State and prove Bernoulli's theorem for steady flow of an incompressible fluid. (06 Marks)  
c. The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end at the rate of 50 litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher end is 196.2 kPa. (06 Marks)

**OR**

- 6 a. Define the terms: i) forced vortex flow and ii) free vortex flow. (04 Marks)  
b. What is venturimeter? Derive an expression for discharge through a venturimeter. (06 Marks)  
c. A pipe of 300 mm diameter conveying 300 litres/s of water has a right angled bend in a horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and outlet of bend are 245.25 kPa and 235.44 kPa. (06 Marks)

**Module-4**

- 7 a. Explain different hydraulic coefficient and establish the relation between them. (04 Marks)  
b. Derive an expression for discharge over a triangular notch. (06 Marks)  
c. The head of water over an orifice of diameter 100 mm is 5m. The water coming out from the orifice is collected in a circular tank of diameter 2 m. The rise of water level in circular tank is 450 mm in 30 seconds. Also the coordinates at a certain point on the jet, measured from vena-contracta are 1000 mm horizontal and 52 mm vertical. Find the hydraulic coefficients  $C_v$ ,  $C_d$  and  $C_c$ . (06 Marks)

**OR**

- 8 a. Explain the terms:  
i) Velocity of approach  
ii) Effect of end contractions in notches (04 Marks)  
b. What is Cipolletti notch? Derive an expression for discharge over a Cipolletti notch. (06 Marks)  
c. Water flows over a rectangular weir 1.2m wide at a depth of 15 cm and afterwards passes through a triangular right angled weir. Taking coefficient of discharge for rectangular Weir 0.62 and for triangular Weir 0.59 find the depth over the triangular Weir. (06 Marks)

**Module-5**

- 9 a. Explain briefly:  
i) Hydraulic gradient line and  
ii) Energy gradient line (04 Marks)  
b. Derive an expression for head loss due to friction in pipes. (06 Marks)  
c. A rigid pipe conveying water is 3200 m long. The velocity of flow is 1.2 m/s. Calculate the rise of pressure behind a valve at the lower end if it is closed (i) in 20 seconds (ii) in 3 seconds. Take bulk modulus and water equal to 2000 N/mm<sup>2</sup>. (06 Marks)

**OR**

- 10 a. Explain briefly the phenomenon of water hammer. (04 Marks)  
b. Derive an expression for head loss due to sudden enlargement in a pipe flow. (06 Marks)  
c. At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. (06 Marks)

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