# Third Semester B.E. Degree Examination, July/August 2022
## Fluid Mechanics

Time: 3 hrs.                                                                 Max. Marks: 100

***Note: Answer any FIVE full questions, choosing ONE full question from each module.***

## Module-1

1  a. Define the following terms:
   i) Ideal fluids and Real fluids
   ii) Mass density and Specific gravity
   iii) Surface tension and Capillarity                                      **(06 Marks)**
   b. Define Viscosity State and explain the Newton's law of viscosity.     **(06 Marks)**
   c. A U tube differential manometer connects two pressure pipes A and B. Pipe A contains carbon tetra chloride of specific gravity 1.594 under a pressure of 11.772 N/cm$^2$. The pipe B contains oil of specific gravity 0.8 under a pressure of 11.772 N/cm$^2$. The pipe A lies 2.5m above pipe B. Find the difference of pressure measured by mercury of specific gravity 13.6 as manometric fluid. The centre of pipe B coincides with manometer liquid in left limb.
   **(08 Marks)**

### OR

2  a. Differentiate between
   i) Absolute pressure and gauge pressure.
   ii) Simple manometer and Differential manometer.                         **(06 Marks)**
   b. Calculate the capillary effect in millimeters in a glass tube of 4mm diameter, when immersed in (i) water and (ii) mercury. The temperatures of the liquid is 20°C and values of surface tension of water and mercury at 20°C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero and for 130°. Take density of water at 20°C as equal to 998 kg/m$^3$.                              **(08 Marks)**
   c. Determine the viscosity of a liquid having kinematic viscosity 6 stokes and specific gravity 1.9.                                                               **(06 Marks)**

## Module-2

3  a. Derive the expression for total pressure and centre of pressure for an inclined plane surface submerged in a liquid.                                                  **(10 Marks)**
   b. The velocity vector in a fluid flow is given V = 4x$^3$i – 10x$^2$yj + 2tk
      Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time t = 1.  **(10 Marks)**

### OR

4  a. A circular plate 3m diameter having a concentric circular hole of diameter 1.5m is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of centre of pressure.                                                          **(08 Marks)**
   b. Derive continuity equation for three dimensional flow in Cartesian co-ordinates.   **(08 Marks)**
   c. Differentiate between (i) Stream function and velocity potential function
                            (ii) Rotational and Irrotational flow.            **(04 Marks)**

## Module-3

5  a. State and prove Bernoulli's theorem for steady flow of an incompressible fluid.   **(08 Marks)**

b. A 45° reducing bend is connected in a pipe line the diameter at the inlet and outlet of the bend being 600mm and 300mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 $N/cm^2$ and rate of flow of water is 600 $l$/s. **(08 Marks)**

c. What is a pitot tube? How will you determine the velocity at any point with the help of pitot tube? **(04 Marks)**

**OR**

**6** a. Discuss with sketches, the working principles of venturimeter and orificemeter. **(08 Marks)**

b. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 17.658 $N/cm^2$ and the vacuum pressure at the throat is 30cm of mercury. Find the discharge of water through venturimeter. Take $C_d$ = 0.98. **(08 Marks)**

c. Define the terms : i) Forced vortex flow     ii) Free vortex flow. **(04 Marks)**

### Module-4

**7** a. Explain different hydraulic coefficients of an orifice and establish the relation between them. **(08 Marks)**

b. 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 of weir is 20cm and water from channel flows over the weir. Take $C_d$ = 0.62, Neglect end contractions. Take velocity of approach into consideration. **(08 Marks)**

c. Distinguish between   (i) External mouthpiece and Internal mouthpiece
                     (ii) Mouthpiece running free and mouth piece running full. **(04 Marks)**

**OR**

**8** a. Derive an expression for discharge over triangular notch. **(08 Marks)**

b. The head of water over an orifice of diameter 100mm is 10m. The water coming out from orifice is collected in a circular tank of diameter 1.5m. The rise of water level in this tank is 1m in 25 seconds. Also the coordinates of a point on the jet, measured from vena contracta are 4.3m horizontal and 0.5m vertical. Find the coefficients $C_d$ , $C_v$ and $C_c$ . **(08 Marks)**

c. Explain the advantages of Cipolletti notch over trapezoidal notch. **(04 Marks)**

### Module-5

**9** a. Derive Darcy's equation for head loss through pipes. **(08 Marks)**

b. The difference in water surface levels in two tanks which are connected by 3 pipes in series of length 300m, 170m and 210m and of diameters 300mm, 200mm and 400mm respectively is 12m. Determine the rate of flow of water if coefficient of friction are 0.005, 0.0052 and 0.0048 respectively considering (i) Minor losses (ii) Neglecting minor losses. **(08 Marks)**

c. Explain with a sketch:
(i) Hydraulic gradient line     (ii) Total energy line **(04 Marks)**

**OR**

**10** a. Explain the terms: (i) Major energy loss   (ii) Minor energy loss in pipes. **(04 Marks)**

b. The water is flowing with a velocity 1.5 m/s in a pipe length 2500m. thickness 10mm and of diameter 500mm. Find the rise in pressure, if the valve is suddenly closed at the end of the pipe, if the pipe is considered to be elastic. Take E = $19.62 \times 10^{10}$ $N/m^2$ for pipe material and K = $19.62 \times 10^4$ $N/cm^2$ for water. Calculate the circumferential stress and longitudinal stress developed in the pipe wall. **(08 Marks)**

c. Derive an expression for loss of head due to sudden expansion in the pipe. **(08 Marks)**

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