

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

Time: 3 hrs.

USN

Max. Marks: 100

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

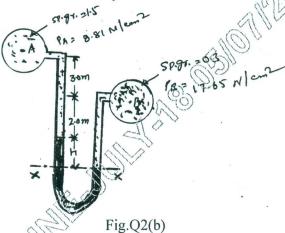
## PART - A

- a. Differentiate between: (i) Newtonian and non-Newtonian fluids, (ii) Ideal and real fluids, (iii) Dynamic and kinematic viscosity of fluids, (iv) Vapour pressure and cavitation, (v) Mass density and specific weight.
  - b. Derive an expression for capillary rise in water.

(03 Marks)

- c. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness of oil film is 1.0 mm.

  (07 Marks)
- Define centre of pressure and total pressure. Prove that centre of pressure lies below the centre of gravity of vertically immersed plane surface in a static fluid.
- b. A differential monometer is connected at the two points A & B of two pipes as shown in Fig Q2(b). The pipe A contains a liquid of specific gravity 1.5 while pipe B contains a liquid of specific gravity 0.9. The pressure at A and B are 9.81 N/cm<sup>2</sup> and 17.65 N/cm<sup>2</sup> respectively. Find the difference in mercury level in the differential manometer. (10 Marks)



- 3 a. Define the equation of continuity. Obtain the expression for continuity equation for a three dimensional flow. Simplify it to two dimensional steady incompressible flow. (10 Marks)
  - b. A ship 70m long and 10m broad has a displacement of 19620 kN. A weight of 343.35 kN is moved across the deck through a distance of 6m. The ship is tilted through 6°. The moment of inertia of the ship at water-line about its force and aft axis is 75% of M.O.I of the circumscribing rectangle. The centre of buoyancy is 2.25m below water-line. Find the metacentre height and position of centre of gravity of ship. Specific weight of sea water is 10104 N/m<sup>2</sup>. (10 Marks)



## 10MEB406/10AUB406

- State and prove Bernoulli's equation for a fluid flow. Mention assumption made in derivation.
  - The water is flowing through a taper pipe of length 100 m diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 litres/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end, if the pressure at the higher level is 19.62 N/cm<sup>2</sup>.

(10 Marks)

What is venturimeter? Derive an expression for the discharge through a venturimeter.

(08 Marks)

Differentiate between Pitot tube and Orifice meter with neat sketches.

(04 Marks)

The frictional torque T of a disc of diameter D rotating a speed N in a fluid of viscosity µ and density  $\rho$  in a turbulent flow is given by  $T = D^5 N^2 \rho \phi \left[ \frac{\mu}{D^2 N \rho} \right]$ . Prove this by the Buckingham method of dimensions.

(08 Marks)

- Derive an expression for the head loss due to:
  - Sudden expansion

(05 Marks)

(ii) Sudden contraction

(05 Marks)

Define hydraulic gradient line and total energy line.

(02 Marks)

- A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm<sup>2</sup> and 11.772 N/cm<sup>2</sup> respectively. Find the loss of head due to contraction if  $C_d = 0.62$ . Also determine the rate of flow of water. (08 Marks)
- Sketch the velocity and shear stress distribution across the section of the pipe for viscous (04 Marks)
  - b. Derive Hagen Poiseuille equation with usual notations.

(08 Marks)

A fluid of viscosity 0.7 Ns/m<sup>2</sup> and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m<sup>2</sup>. Find

(i) The pressure gradient (ii) The average velocity (iii) Reynold number of the flow

- Define the terms: (i) Boundary layer (ii) Boundary layer thickness (iii) Drag (iv) Lift.
  - Define Mach number. What is the significance of mach number in compressible fluid flows? (04 Marks)
  - A flat plate  $1.5 \text{m} \times 1.5 \text{m}$  moves at 50 km/hr in stationary air of density  $1.15 \text{ kg/m}^2$ . If the coefficient of drag and lift are 0.15 and 0.75 respectively. Determine: (i) The lift force (ii) The drag force (iii) The resultant force (iv) The power required to keep the plate in
  - d. A projectile travels in air of pressure 10.1043 N/cm<sup>2</sup> at 10°C at a speed of 1500 km/hr. Find the Mach number and the Mach angle. Take K = 1.4 and R = 287 J/kgK. (04 Marks)