

USN

--	--	--	--	--	--	--	--	--	--

10ME/AU46B

Fourth Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting
at least TWO questions from each part.**

PART – A

- 1 a. Differentiate between :
 - (i) Weight density and mass density.
 - (ii) Steady flow and unsteady flow.
 - (iii) Gas and Vapour (06 Marks)
- b. A cube of 0.25 m sides and mass 28 kg slides down a plane inclined at 2 V: 3 H covered by a thin film of oil of viscosity 2.2×10^{-3} pa-sec. If the thickness of the film is 0.02 mm determine the steady state velocity of the block. (06 Marks)
- c. A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of 181.2 mm. Both the cylinders are 300 mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of liquid if a torque of 20 N-m is required to rotate the inner cylinder at 120 rpm. (08 Marks)

- 2 a. State and prove Pascal's law. (06 Marks)
- b. Derive an expression for centre of pressure on a vertically plane submerged body. (06 Marks)
- c. The diameters of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when
 - (i) The pistons are at the same level.
 - (ii) Small piston is 40 cm above the large piston.
 Take density of liquid in the jack as 1000 kg/m^3 . (08 Marks)

- 3 a. Derive an expression for continuity equation in 3D-flow and deduce it to 2D flow. (10 Marks)
- b. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of specific gravity 0.9. Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of cylinder and 'D' is its diameter. (10 Marks)

- 4 a. Obtain an expression for Euler's equation of motion along a stream line and deduce it to Bernouli's equation. (08 Marks)
- b. A pump has tapering pipe running full of water. The pipe is placed vertically with the diameters at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of mercury (vaccum), while the pressure at the lower end is 15 kN/m^2 . Assume the head loss to be 20% of difference in velocity head. Calculate the discharge. The flow is vertically upwards and difference of elevation is 3.9 m. (12 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.

PART – B

- 5 a. Using Buckingham's π theorem, for a screw propeller. The relation between thrust 'F', torque 'T', diameter 'D', speed of travel 'U', speed of rotation 'N', Density ' ρ ' and viscosity ' μ ' may be put in the form $F = \rho D^2 U^2 \phi \left[\frac{\rho D^3 U^2}{T}, \frac{DN}{U}, \frac{\rho U D}{\mu} \right]$. (10 Marks)
- b. A venturimeter with a throat diameter 10 cm and Area ratio '4' is provided in a vertical pipe line carrying oil of specific gravity 0.9. The difference in elevation of throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 25 cm, calculate
- Discharge of oil.
 - The pressure difference between entrance section and throat section. Take $C_d = 0.98$. (10 Marks)
- 6 a. Derive Darcy's equation for the loss of head due to friction in a circular pipe. (10 Marks)
- b. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end for the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow, take $f = 0.01$ for both sections of pipe. (10 Marks)
- 7 a. Starting from first principles, show that for laminar flow between fixed parallel plates, the mean velocity is two-thirds of maximum velocity. (10 Marks)
- b. The oil of specific gravity 0.82 is pumped through a horizontal pipe line 150 mm in diameter and 3 km long at the rate of $0.015 \text{ m}^3/\text{sec}$. The pump has an efficiency of 68% and requires 7.5 kW to pump the oil.
- What is dynamic viscosity of oil?
 - Is the flow is laminar? (10 Marks)
- 8 a. Explain the following:
- Stream line body
 - Bluff body
 - Mach number
 - Mach angle
 - Boundary layer thickness (10 Marks)
- b. An aeroplane is flying at a height of 15 km where the temperature is -50°C . The speed of the plane is corresponding to $M = 2.0$. Assuming $K = 1.4$ and $R = 287 \text{ J/kg-K}$, find the speed of the plane. (04 Marks)
- c. Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3 . The co-efficients of lift and drag are 0.75 and 0.15 respectively. Determine
- Drag force.
 - Lift force.
 - Resultant force. (06 Marks)

* * * * *