BACHELOR OF ENGG (MECH. ENGG.) 1st Yr. 1st Sem. (Old) EXAM-2019

FLUID MECHANICS - I

Time: Three hours **Full Marks: 100**

*Answer any **FIVE** questions.*
All the parts of a question should be answered together.
Assume any relevant data if necessary with suitable justification.

1. a) Define viscosity along with the dimensional form. What are the effects of temperature and pressure on the viscosity? Graphically explain the Newtonian and non-Newtonian fluids.

   b) The dynamic viscosity of oil used for lubrication between a shaft and sleeve, is 2 poise. The shaft is of diameter 0.2 m and rotates at 300 rpm. Calculate the power lost in the bearing for a sleeve length of 100 mm. The thickness of the oil film is 2 mm. **[13+7]**

2. a) Define pressure and prove Pascal's law of hydrostatic pressure.

   b) Graphically present vacuum pressure, gauge pressure, atmospheric pressure and their relations.

   c) A circular opening of 2 m diameter, located in a vertical side of a water-filled rectangular tank, is closed by a disk of 2 m diameter. The head of the water above the horizontal diameter is 4 m. The disk is supported along its horizontal diameter in such a way that it can rotate about the horizontal axis. Find the force acting on the disk. **[8+6+6]**

3. a) Classify different types of fluid flow with their brief definitions.

   b) Derive continuity equation with help of a neat sketch for a three-dimensional flow. **[8+12]**

4. a) Derive Euler and Bernoulli equations mentioning all the assumptions used.

   b) A bend in horizontal pipeline carrying water gradually reduces from 0.4 m to 0.2 m diameter and deflects the flow through an angle of 45°. At the smaller end the guage pressure is 200kPa. Determine the magnitude and direction of force exerted on the bend when flow is 800 litres/sec. **[12+8]**

5. a) Deduce the working formula for a triangular weir.

   b) A differential manometer containing mercury as gauge fluid is connected across a venturi meter fitted with a horizontal pipe of 80 mm diameter. The diameter of the throat of the venturi meter is 50 mm and the discharge coefficient is 0.95. When the water is flowing through the pipe, the difference of two vertical mercury columns of manometer is found to be 120 mm. Determine the discharge passing through the pipe. **[10+10]**

6. a) Deduce Hagen-Poiseuille equations for laminar flow through a horizontal circular pipe.

   b) A right-angled V-notch is used for measuring a discharge of 40 litres/sec. An error of 2 mm was made while measuring the head over notch. Calculate the percentage error in the discharge. Take Cd = 0.62. **[15+5]**

7. a) Deduce Darcy-Weisbach equation for pipe friction.

   b) A 100 mm diameter and 1 km long new mild steel pipe line (roughness size = 0.045 mm) consists of two 90° elbows (k = 0.9), two gate valve fully open (k = 0.2) and one foot valve (k = 1.5). The pipe line carries water at a flow rate of 200 m^3/hr and discharges freely into air. Determine the total head loss in the system. (You may use Moody diagram or any suitable correlation for the purpose) **[10+10]**

8. a) Derive Chezy's formula for open channel flow and relate the same with Manning's formula.

   b) A flow of water of 100 litres/sec flows down in a rectangular channel of width 400 mm and depth 200 mm. Find the bottom slope for uniform flow if Manning's constant is 0.012. **[10+10]**

9. Write short notes on: (any **FOUR**) **[4 × 5]**

   a) Streamline and stream tube
   b) Free and forced vortices
   c) Moody diagram
   d) Manometer
   e) Venturi meter
   f) Most economical channel section