The Assam Royal Global University, Guwahati
Royal School of Engineering & Technology
B. Tech (Civil Engineering), 3rd Semester
Semester End Examination, January 2023
Course Title: Introduction to Fluid Mechanics
Course Code: CEE022C304

Time: 3 Hours

Maximum Marks: 70

Note: Attempt all questions as per instructions given.
The figures in the right-hand margin indicate marks.

Section – A

1. Attempt **all questions**. (Maximum word limit 50) **2 x 8**

   a. Differentiate between Ideal fluid and real fluid.

   b. Explain Newtonian and Non-Newtonian fluid.

   c. Determine the intensity of shear of an oil having viscosity = 1 poise. The oil is used for lubricating the clearance between a shaft of diameter 10 cm and its journal bearing. The clearance is 1.5 mm and the shaft rotates at 150 r.p.m.

   d. Explain Kinematic Viscosity.

   e. Explain gauge pressure and atmospheric pressure.

   f. Explain Continuity equation.

   g. A plate 0.030 mm distant from a fixed plate, moves at 40 cm/s and requires a force of 1.5 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates.

   h. A hydraulic press has a ram of 30 cm diameter and a plunger of 4.5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500 N.

Section – B

2. Attempt **any one** of the following: **12 x 1**

   a. Derive Euler's equation of motion. Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross-section, which is 5 m the datum line.

   b. Explain Surface Tension and Capillarity with the help of a diagram. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m x 0.8 m and an inclined plane with angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm.

3. Attempt **any two** of the following: **7 x 2**

   a. Calculate the density, specific weight, and weight of two litre of oil of specific gravity = 0.90

b. What is Piezometer? The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The center of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.

c. Two horizontal plates are placed 1.25 cm apart, the space between them being filled with oil of viscosity 14 poises. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s.

4.   Attempt **any two** of the following: 7 x 2

a. The diameters of a pipe at the sections 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Also determine the velocity at section 2.

b. Explain compressible and incompressible fluid flow.

c. Explain Laminar and Turbulent flow. What are the assumptions in the derivation of Bernoulli's equation?

5.   Attempt **any two** of the following: 7 x 2

a. Derive Bernoulli's equation from Euler's equation.

b. The velocity function (ϕ) is given by an expression

$$\phi = -\frac{xY^3}{3} - x^2 + \frac{x^3Y}{3} + y^2$$

Find the velocity component in x and y direction.

c. Explain equipotential line and flow net.