CBCS SCHEME

USN | | | | | | | | | | |

18MR46

Fourth 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 properties of fluids with their SI units i) Mass density ii) Weight density iii) Dynamic viscosity iv) Kinematic viscosity. **(08 Marks)**

b. Derive an expression for pressure intensity in case of liquid droplet. **(06 Marks)**

c. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m × 0.8m and an inclined plane with angle of inclination 30° as shown in The Fig Q1(c). The weight of the square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3m/s. The thickness of oil film is 15mm.

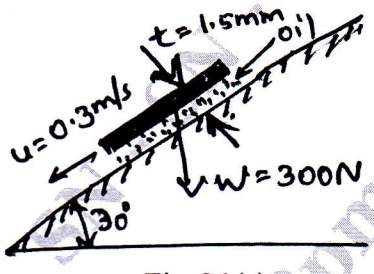

Fig Q1(c) **(06 Marks)**

OR

2 a. State and explain 'Pascal's law. **(06 Marks)**

b. The right limb of a simple U-tube monometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of Specific gravity 0.9 is flowing. The center of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury levels in the two limbs is 20cm. **(06 Marks)**

c. A differential monometer is connected at the two points A and B of two pipes as shown in Fig Q2(c). 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 1Kgf/cm^2 and 1.80 Kgf/cm^2 respectively. Find the differences in mercury levels in the differential monometer.

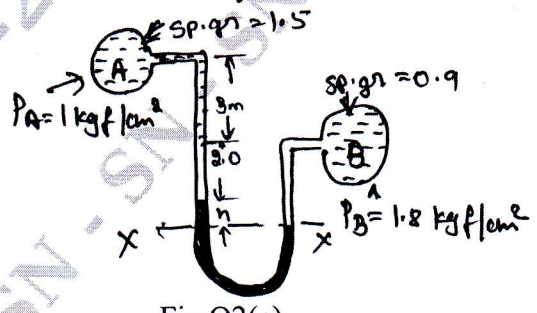

Fig Q2(c) **(08 Marks)**

Module-2

3 a. Define : i) Buoyancy ii) Center of Buoyancy iii) Meta center iv) Meta centric height. **(08 Marks)**

b. Explain the analytical method to find out meta –centric height. **(04 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine the meta centric height of the block if its size is 2m × 1m × 0.8m. **(08 Marks)**

OR

4 a. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for such a derivation. **(10 Marks)**

b. The water is flowing through a pipe having diameter 20cm and 10cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/sec. The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure of section 1 is 39.24N/cm^2, find the intensity of pressure at section 2. **(10 Marks)**

Module-3

5 a. Derive an expression for rate of flow through on orifice meter. **(10 Marks)**

b. An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20cm and throat diameter 10cm. The oil mercury differential monometer shows a reading of 25cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. **(10 Marks)**

OR

6 a. Define and explain : i) Reynold's number ii) Euler's number iii) Froude's number iv) Mach's number. **(08 Marks)**

b. Write a note on Buckingham's π-Theorem. **(04 Marks)**

c. Water is flowing through a pipe of diameter 30cm at a velocity of 4m/s. find the velocity of oil flowing in another pipe of diameter 10m, if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and oil is given as 0.01 poise and 0.25 poise. The specific gravity of oil = 0.8. **(08 Marks)**

Module-4

7 a. Derive Darcy-Weisbach equation for loss of head due to friction in pipes. **(10 Marks)**

b. Find the diameter of a pipe of length 2000cm when the rate of flow of water through the pipe is 200 litres/s and the head lost due to friction is 4m. Take the value of C =50 in Chezy's formula. **(10 Marks)**

OR

8 a. Derive Hagen Poseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe if 100Kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. **(10 Marks)**

Module-5

9 a. Explain the terms : i) Drag ii) Lift iii) Boundary layer thickness iv) Turbulent boundary layer v) Momentum thickness. **(10 Marks)**

b. Experiments were conducted in a wind tunnel with a speed of 50km/hour on a flat plate of size 2m long and 1m wide. The density of air is 1.15Kg/m^3. The co-efficient of lift and drag are 0.75 and 0.15 respectively. Determine :
i) The lift force ii) The drag force ii) the resultant force iv) Direction of resultant force
v) Power exerted by air on the plate. **(10 Marks)**

OR

10 a. Derive an expression for Drag and Lift. **(08 Marks)**

b. Derive an expression for velocity of sound in a fluid. **(08 Marks)**

c. Calculate the mach number at a point on a jet propelled aircraft, which is flying at 1100Km/hours at sea level where air temperature is 20°C. Take K = 1.4 and R = 287 J/Kg.K. **(04 Marks)**

* * * * *