USN | | | | | | | | | | | Course Code | 2 | 1 | M | E | 4 | 3

Third Semester B.E. Degree Examinations, March/April 2023
FLUID MECHANICS

Duration: 3 hrs   **Max. Marks: 100**

Note: *1. Answer any **FIVE** full questions, choosing **ONE** full question from each module.*
       2. Missing data, if any, may be suitably assumed

Q. No		*Question*	*Marks*	*(RBTL:CO: PI)*
		MODULE – 1		
1.	**a.**	Define Following terms with SI Units: i) Weight density ii) Dynamic Viscosity iii) Bulk Modulus iv) Capillarity.	**04**	(1 :1: 1.6.1)
	b.	Determine the specific gravity of a fluid having viscosity 0.05 poise and kinematic viscosity of 0.035 stokes.	**08**	(2 :1: 1.6.1)
	c.	An oil of thickness 1.5 mm is used for lubrication between a square plate of size 0.9 m × 0.9 m slides down an inclined plane having an inclination of 20o with the horizontal. The weight of square plate is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Find the kinematic viscosity of oil specific gravity of the oil is 0.7.	**08**	(3 :1: 1.7.1)
		OR		
2.	**a.**	State Pascals law. Show that rate of increase in pressure in a vertical direction is equal to weight density of the fluid at that point (p= ρgh)	**08**	(2 :1: 1.6.1)
	b.	Differentiate between Absolute, Gauge atmospheric and vacuum pressures	**04**	(1 :1: 1.7.1)
	c.	A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of sp.gr 0.95 and having a vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in the pipe, if the difference of mercury level in the two limbs is 40cm and the height of the fluid in the left from the center of pipe is 15cm below	**08**	(3 :1: 1.7.1)
		MODULE – 2		
3.	**a.**	Define: 1) Buoyancy ii) Centre of Buoyancy iii) Meta-centre	**06**	(1 :2: 1.6.1)
	b.	A block of wood of specific gravity 0.7 floats in water. Determine the meta centric height of the block if its size is 2 m × 1 m × 0.8 m	**08**	(3 :2: 1.7.1)
	c.	Find the density of a metallic body which floats at the interface of mercury of sp.gr. 13.6 And water such that 40% of its volume is sub-merged in mercury and 60% in water.	**06**	(3 :2: 1.7.1)
		OR		
4.	**a.**	Derive the continuity equation for the 3-Dimensional flow in Cartesian coordinates.	**08**	(2 :2: 1.6.1)

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator**)

b. If for a two- dimensional potential flow, the velocity potential is given by $\Phi = x (2y - 1)$ Determine the velocity at the point p (4, 5). Determine also the value of stream function Ψ at the point P. **08** (3 :2: 1.7.1)

c. Write the expressions for Velocity and acceleration of a fluid in x, y and z directions. **04** (2 :2: 1.6.1)

MODULE – 3

5. **a.** Derive Euler's equation of motion along a stream line and deduce Bernoulli's equation. State the assumptions made. **10** (2 :3: 1.6.1)

b. A Horizontal Veturimeter with Inlet diameter 20 cm & throat diameter 10 cm is used to measure the flow of water. The pressure at the Inlet is 17.65 N/cm2 & vacuum pressure at the throat is 30 cm of mercury. Find the discharge through Veturimeter (Cd=0.98) **10** (3 :3: 1.7.1)

OR

6. **a.** Obtain expression for the forced excreted by the jet of water on a fixed vertical plate in the direction of Jet. **10** (2 :3: 1.6.1)

b. A Jet of water of diameter 50 mm strikes a fixed plate in such a way that the angle between the plate and jet is 30^0. The force excreted in the direction of jet is 1471.5 N. Determine the rate of flow of water. **10** (3 :3: 1.7.1)

MODULE – 4

7. **a.** Derive Darcy-Welsbach equation for fluid flow through pipe **10** (2 :4: 1.6.1)

c. An oil of specific gravity 0.7 flowing through the pipe of diameter 300 mm at the rate 500 l/sec. Find the head loss due to friction and power required to maintain the flow for a length of 1000 m. Take v=0.29 stokes. **10** (3 :4: 1.7.1)

OR

8. **a.** Define: i) Laminar boundary layer ii) Turbulent boundary layer iii) Laminar- sub layer iv) Boundary layer thickness **10** (2 :4: 1.6.1)

b. Define the drag force and lift force. Also derive their expressions
A man weighing 882.9 N descends to the ground from an aeroplane with the help of a parachute against the resistance of air. The velocity with which the parachute, which is hemispherical in shape, comes down is 20 m/s. Find the diameter of the parachute. Assume C_d= 0.5 and density of air=1.25 kg/m^3. **10** (3 :4: 1.7.1)
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MODULE – 5

9. **a.** What is dimensional homogeneity? Explain with examples **04** (2 :5: 1.6.1)

b. The Frictional Torque T of a Disc Diameter D rotating at a speed N in a Fluid of viscosity μ and density ρ in a turbulent flow is given by $T=D^5N^2 \rho \phi [\mu / D^2 N \rho]$ **10** (3 :5: 1.7.1)

c Define Similitude and Explain the following: i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity. **06** (1 :5: 1.6.1)

OR

10. **a.** Define: i) Mach number ii) Mach cone iii) Mach angle iv) sonic flow v) Subsonic flow vi) supersonic flow. **06** (2 :5: 1.6.1)

b. Derive an expression for velocity of sound in Fluids in terms of Bulk Modulus. **06** (3 :5: 1.7.1)

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| c | An aeroplane flying at a height of 15km, where the temperature is -50°C The speed of the plane is corresponding to Mach numbers is 2.0. Assuming k=1.4 and R=287 J/kg °K, find the speed of the plane. | **08** | (3 :5: 1.7.1) |

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