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Course Code

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Fourth Semester B.E. Degree Examinations, September/October 2024

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.

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>
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MODULE – 1

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| 1. | a. Define the following terms with SI Units: (i) Mass density (ii) Kinematic viscosity (iii) Surface tension (iv) Capillarity (v) Bulk modulus | 10 | (2 : 1 : 1.2.1) |
| | b. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with angle of inclination 30° and shown in fig. 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. | 10 | (2 : 1 : 1.2.1) |

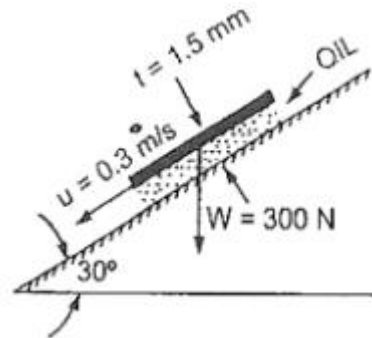


Fig. 1(b)

OR

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| 2. | a. What is Manometer? How are they classified? | 04 | (2 : 1 : 1.2.1) |
| | b. State and prove Pascal law | 08 | (2 : 1 : 1.2.1) |
| | c. A simple U – tube manometer containing mercury is connected to a pipe in which a fluid of sp.gr.0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40cm. and the height of the fluid in the left tube from the centre of pipe is 15cm below | 08 | (2 : 1 : 1.2.1) |

MODULE – 2

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|----|---|----|-----------------|
| 3. | a. Define: (i) Buoyancy (ii) Meta-centre | 04 | (2 : 2 : 1.2.1) |
| | b. Derive an expression for total pressure and centre of pressure for a plane surface immersed vertically in a static mass of fluid. | 08 | (2 : 2 : 1.2.1) |
| | c. Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the center of plate is 3 m below the free surface of water. Find the position of center of pressure. | 08 | (2 : 2 : 1.2.1) |

OR

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| 4. | a. Briefly explain different types of fluid flow | 04 | (2 : 2 : 1.2.1) |
| | b. Derive the continuity equation for the 3-Dimensional flow in Cartesian coordinates. | 08 | (2 : 2 : 1.2.1) |

- c. 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** (2 :2 : 1.2.1)

MODULE – 3

5. a. With a suitable assumption, derive Euler's equation of motion along a stream line and deduce to Bernoulli's equation. **10** (2 :3 : 1.2.1)
- b. A pipe through which water is flowing is having diameters 20cms and 10cms at cross sections 1 and 2 respectively. The velocity of water at section 1 is 4 m/sec. Find the velocity head at section 1 and 2 and also find rate of discharge? **10** (2 :3 : 1.2.1)

OR

6. a. Obtain an expression for the force exerted by the jet of water on a fixed vertical plate in the direction of Jet. **10** (2 :3 : 1.2.1)
- b. A jet of water of diameter 75 mm moving with a velocity of 25 m/sec strikes a fixed plate in such a way that the angle between the jet and plate is 60° . Find the force exerted by the jet on the plate
(i) In the direction normal to the plate and (ii) In the direction of the jet. **10** (2 :3 : 1.2.1)

MODULE – 4

7. a. Derive Darcy-Weisbach equation for fluid flow through pipe. **08** (2 :4 : 1.2.1)
- b. Define HGL and TEL with a neat sketch. **04** (2 :4 : 1.2.1)
- c. An oil of specific gravity 0.9 and viscosity 0.06 poise flowing through a pipe of diameter 200 mm at the rate 60 lit/sec. Find the head loss due to friction and power required to maintain the flow for a length of 500 m. **08** (2 :4 : 1.2.1)

OR

8. a. With a neat sketch, Define the following: (i) Laminar boundary layer (ii) Turbulent boundary layer (iii) Laminar- sub layer (iv) Boundary layer thickness (v) Displacement thickness **10** (2 :4 : 1.2.1)
- b. A plate of 600 mm length and 400 mm wide is immersed in a fluid of sp. gravity 0.9 and kinematic viscosity 10^{-4} m/s. The fluid is moving with a velocity of 6 m/s. Determine (i) boundary layer thickness (ii) shear stress at end of the plate (iii) drag force on one side of the plate **10** (2 :4 : 1.2.1)

MODULE – 5

9. a. Explain (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity (iv) Model (v) prototype **10** (2 :5 : 1.2.1)
- b. State and explain Buckingham's π theorem. **10** (2 :5 : 1.2.1)

OR

10. a. Define: (i) Mach number (ii) Sub-sonic flow (iii) Sonic flow (iv) Supersonic flow v) Compressible flow **10** (2 :5 : 1.2.1)
- b. Derive an expression for velocity of sound in Fluids in terms of Bulk Modulus. **10** (2 :5 : 1.2.1)

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