Reg. No.



ANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, MARCH 2021

SUBJECT: FLUID DYNAMICS [AAE 2156]

REVISED CREDIT SYSTEM (12/03/2021)

Time: 3 Hours

MAX. MARKS: 50

(03)

(05)

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitable assumed.
- 1A. Find i) Mass density ii) Weight density iii) Specific gravity and iv) Specific volume of a fluid, which weighs 10 N in a volume of 1000cc. (02)
- **1B** Give reasons for the variation viscosity of liquids and gases with temperature.
- 1C Velocity profile for a fluid over a stationary plate can be assumed a parabola as per relation $u = ay^2 + by + c$, where 'u' is velocity and 'y' distance from plate. Maximum velocity reaches 120 cm/s at a distance of 20 cm from the plate. Calculate the shear stress at a distance of 10 cm and 20 cm from the plate. Viscosity is 8.5



poise (refer Figure 1)

2A Refering to figure (a) and (b), which case is under vacuum pressure? Obtain an expression to find the pressure inside pipe in both cases. (03)



2B Find the height of the building if pressure meaured at the top of builing and bottom of the building are 750 mm of mercury and 760 mm of mercury respectively. Density of air near the building is uniform and is equal to 1.1 kg/m³(03)

(b)

- **2C** For a plate placed vertically inside a liquid at a depth of 'h', find the expression for magnitude and location of total pressure acting on it. (04)
- **3A** A circular opening at the side wall of a tank is covered by a circular disk (3 m diameter). If water level is 4 meter from the center of the disk (as shown in figure), where should a force F needs to be applied to keep the disk intact? At A or B? what is the magnitude?

(a)



3B A solid cylinder, 10 cm diameter and 40 cm length, consists of two parts made up two different materials. Bottom part, 1 cm long, is made up of material with S=9 and top part is made of material with S=0.6. The cylinder is floating vertically in water. Is this cylinder in stable equilibrium? Justify.

(04)

3C Show that equipotential line and line of constant stream function are orthogonal to (02)



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each other.

- **4A** Elaborate the classification of fluid flow as a)steady-unsteady, b)compressibleincompressible, c) 1D,2D & 3D flow. (03)
- **4B** With the help of Bernoulli's equation, show that total head of liquid is constant in ideal case. Briefly explain each components of total head. (05)
- 4C For a fluid flow, if velocity potential function is given by, $\emptyset = x(2y-1)$, determine the velocity at a point P(4,5) and also find the stream function. (04)
- 5A Show that the thrust developed by a propeller can be expressed as $P = D^2 V^2 \rho \quad f(\frac{D\omega}{V}, \frac{\mu}{DV\rho}, \frac{C}{V})$

where *P* is thrust, ω is angular velocity, *V* is speed of air, *D* is diameter of propeller, μ is and ρ are dynamic viscosity and density of air and *C* is elasticity of air. (04)

- 5B A pipe of diameter 1.5m is required to transport an oil of specific gravity 0.9, viscosity 0.03 poise at a rate of 3000litre/s. What will be the flow rate if tests are conducted on a 15cm diameter pipe with water? Viscosity of water is 0.01poise (03)
- 5C Define a)displacement thickness, b)momentum thickness c)energy thickness. (03)