Exam.Code:0940
Sub. Code: 33859

2056
B.E. (Mechanical Engineering)
Fourth Semester
MEC-405: Fluid Mechanics

**Time allowed: 3 Hours** **Max. Marks: 50**

*NOTE: Attempt five questions in all, including Question No.1 (Section-A) which are compulsory and selecting two questions each from Section B-C.*

*x-x-x*

**Section – A (2 marks each)**

1. i. Define Vapour pressure and Cavitation.
   ii. Define absolute pressure and vacuum pressure.
   iii. Explain why streamlines cannot intersect each other.
   iv. What is meant by the term "Vena-Contracta".
   v. Define Mach number. Classify flow as subsonic, sonic and supersonic based on Mach number

**Section – B (Do any two questions)**

2. **(a)** Compute the horizontal and vertical components of the total force acting on a curved surface **AB**, which is in the form of a quadrant of a circle of radius **2 m** as shown in **Fig. A** Take the width of the gate as unity. **(6)**

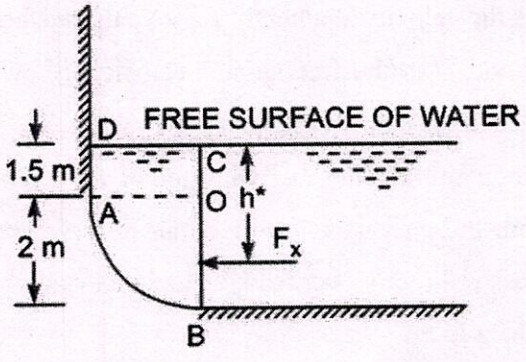


**Fig. A**

**(b)** Explain the concepts of Centre of buoyancy and Meta-centre. How do they affect the stability of floating bodies. **(4)**

3. **(a)** Prove that streamlines and equipotential lines intersect orthogonally in a two-dimensional irrotational flow. **(4)**

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(b) The velocity potential function ($\phi$) is given by:

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

Determine the velocity components in x and y directions and show that $\phi$ represents a possible case of flow. **(6)**

4. State Buckingham's π–theorem and obtain an expression for the force **(F)** exerted by a flowing fluid on a stationary body if it depends upon the length **(L)** of the body, velocity **(V)** of the fluid, density **(ρ)**, viscosity **(μ)** of the fluid and acceleration due to gravity **(g)**.

**Section – C (Do any two questions)**

5. **(a)** Differentiate between Minor and Major Losses. **(4)**

**(b)** A pipe line carrying oil of specific gravity **0.8**, changes in diameter from **300 mm** at position **A** to **500 mm** at position **B** which is **5 m** at a higher level. If the pressures at A and B are **19.62 N/cm²** and **14.91 N/cm²** respectively, and the discharge is **150 litres/s**, determine the **loss of head** and **direction of flow**. **(6)**

6. What is Boundary layer. Why does it form over a solid surface.

For the velocity distribution in a boundary layer given by:

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

where $u$ is the velocity at a height $y$ above the surface, $\delta$ is the nominal boundary layer thickness and $U$ is the free stream velocity. Show that the ratio of boundary layer thickness to displacement thickness is equal to **3**. **(3,7)**

7. **(a)** A supersonic aircraft flies at an altitude of **1.8 km** where the temperature is **4°C**. The sound from the aircraft is heard by an observer on the ground **4** seconds after the aircraft passes directly overhead. Calculate the speed of the aircraft. Take $\gamma$ **= 1.4** and **R = 287 J/kg K**. **(5)**

**(b)** Explain Reynolds experiment for determining the nature of flow in pipes. Define critical velocity and derive the expression for Reynolds number. **(5)**

*x-x-x*