

DUAL DEGREE B.SC(H)-M.SC MATHEMATICS-ASSIGNMENT

Course Code: DMT318B

Course title: Hydrostatics

Sem.: IVth

UNIT-I

Q.1. If the components of force (X,Y,Z) parallel to the axes acting on an element of fluid are proportional to $y^2 + z^2 + 2\lambda yz$, $z^2 + x^2 + 2\mu zx$, $x^2 + y^2 + 2\nu xy$. Show that for equilibrium to be possible, $2\lambda = 2\mu = 2\nu = 1$

Q.2. A liquid of a given volume V is at rest under the action of forces:

$$X = \frac{-\mu x}{a^2}, \quad Y = \frac{-\mu y}{b^2}, \quad Z = \frac{-\mu z}{c^2}$$

Find the pressure at any point of the liquid and the surface of equal pressure.

Q.3. A fluid rests in equilibrium in a fluid of force, so that

$$X = y^2 + z^2 - xy - xz$$

$$Y = z^2 + x^2 - zy - xy$$

$$Z = x^2 + y^2 - xz - yz$$

Show that the curves of equal pressure and density is a set of circles.

Q.4. Derive the conditions of equilibrium for heterogeneous liquids.

UNIT-II

Q.1 A rectangle is immersed vertically in a homogeneous liquid with two of its sides horizontal and at depth 'a' and 'b' from the surface. Show that the depth of centre of pressure is

$$\frac{2(a^2+ab+b^2)}{3(a+b)}$$

Q.2. An ellipse is completely immersed with its minor axis horizontal at a depth 'h'. Find the position of the centre of pressure

Q.3. State the conditions of equilibrium of a floating body.

Q.4. A thin hollow cone with a base floats completely immersed in water wherever it is placed. Show that the vertical angle of cone is $2\sin^{-1}(1/3)$.

UNIT-III

- Q.1. A hollow cone containing water floats in water with its axis vertical. Discuss its stability.
- Q.2. Prove that equilibrium is stable or unstable according as the metacenter is above or below the centre of gravity.
- Q.3. If a plane section of body cuts off volume which remains unaltered for small displacement of plane, the axis about which the plane turns must pass through the centroid of section.
- Q.4. If the floating solid be a cylinder with its axis vertical and ratio of whose specific gravity to that of liquid is σ , prove that the equilibrium will be stable if ratio of radius of base to height is greater than $[2\sigma(1-\sigma)]^{1/2}$.

UNIT-IV

- Q.1. Explain the terms:
- Boyle's Law
 - Charle's Law
 - Pressure Law
 - Gas Equation
- Q.2. Obtain work done in compressing a gas isothermally.
- Q.3. Define specific heat and internal energy for gases.
- Q.4. If $P_1, P_2, P_3, \dots, P_n$ be pressures and $V_1, V_2, V_3, \dots, V_n$ be volumes of a number of gases at same temperature, then if P be pressure of mixture and V be volume of mixture, then prove: $P = (P_1V_1 + P_2V_2 + \dots + P_nV_n)/V$