STABILITY OF IMMERSED AND FLOATING BODIES

CONCEPT OF STABILITY
Consider a pendulum of mass $m$ attached to a rod suspended from a pivot. The pendulum can adopt two static equilibrium positions shown below:

- Equilibrium position 1 is **stable** since any small disturbance would generate a restoring force (due to gravity) that would return the mass to its initial position.

- Equilibrium position 2 is **unstable** since any disturbance, even an infinitesimal one, would cause the mass to fall while preventing it from returning to its initial position.

STABILITY OF IMMERSED BODIES
For an immersed body in static equilibrium, the weight and the buoyant force acting on the body balance each other. The stability of an immersed body depends on the respective positions of the center of buoyancy (i.e., centroid of the displaced volume) and the center of gravity, which do not always coincide.

Two different cases can be distinguished:

- An immersed body is **stable** if its center of gravity is aligned below the center of buoyancy (bottom-heavy body). In this case, a small rotational disturbance would produce a restoring moment that would return the body to its initial stable position.

- An immersed body whose center of gravity is aligned above the center of buoyancy is **unstable**. Any disturbance would cause the body to turn upside down.

STABILITY OF FLOATING BODIES
The stability criteria are similar for floating bodies. However, unlike immersed bodies, a floating body may still be stable when the center of gravity is directly above the center of buoyancy.