Undergraduate Certificate in Offshore Pipeline Engineering

Hydrodynamics and Fluid Flow

Hydrodynamics and Fluid Flow Glossary

A

Advection: The process by which a fluid transports a property, such as heat or momentum, from one location to another. This occurs through the bulk motion of the fluid.

Archimedes' Principle: A fundamental principle in fluid mechanics stating that the buoyant force on an object immersed in a fluid is equal to the weight of the fluid displaced by the object.

B

Bernoulli's Equation: An equation that describes the conservation of energy in a fluid flow system. It relates the pressure, velocity, and elevation of a fluid at any two points along a streamline.

Buoyancy: The upward force exerted by a fluid on an object that is immersed in it. This force is equal to the weight of the fluid displaced by the object.

C

Capillary Action: The ability of a liquid to flow in narrow spaces without the assistance of, or even in opposition to, external forces like gravity.

Compressible Flow: Flow in which the density of the fluid changes significantly due to changes in pressure and temperature. This type of flow is common in high-speed aerodynamics.

Continuity Equation: An equation that expresses the principle of mass conservation for fluid flow. It states that the mass flow rate of a fluid is constant along a pipe or duct.

D

Drag: The force that opposes the motion of an object through a fluid. It is caused by the interaction between the object and the fluid.

Darcy's Law: An equation that describes the flow of a fluid through a porous medium. It relates the flow rate to the pressure drop and the permeability of the medium.

E

Eulerian Approach: A method of describing fluid flow in which the properties of the fluid at a fixed point in space are studied over time.

F

Fluid Dynamics: The study of fluids in motion and the forces acting on them. It encompasses both hydrodynamics and aerodynamics.

Fluid Mechanics: The branch of physics that deals with the behavior of fluids at rest or in motion. It includes the study of fluid properties, fluid flow, and fluid forces.

Fluid Viscosity: A measure of a fluid's resistance to deformation or flow. It is a crucial property in determining the behavior of fluids in motion.

G

Gravity Drainage: A process by which a fluid flows under the influence of gravity. It is commonly used in the oil and gas industry to recover hydrocarbons from reservoirs.

H

Head Loss: The decrease in total energy of a fluid as it flows through a pipe or duct due to friction, bends, or other flow obstructions.

Hydraulic Jump: A phenomenon in fluid dynamics where there is a rapid increase in the water depth and a decrease in the velocity of flow. It occurs when supercritical flow transitions to subcritical flow.

Hydrodynamics: The study of the motion of fluids and the forces acting on them. It includes the analysis of fluid flow, turbulence, and drag forces.

I

Incompressible Flow: Flow in which the density of the fluid remains constant. This type of flow is commonly assumed in the study of fluid mechanics.

Irrotational Flow: Flow in which the fluid particles do not rotate as they move. This type of flow is characterized by a velocity field that can be described by a scalar potential.

J

Jet: A narrow stream of fluid that is projected into a surrounding medium. Jets are commonly used in fluid mechanics experiments to study fluid behavior.

K

Kinematic Viscosity: A measure of a fluid's resistance to flow due to its internal friction. It is defined as the ratio of dynamic viscosity to density.

L

Laminar Flow: Flow in which the fluid moves in parallel layers with minimal mixing between them. This type

of flow is characterized by smooth streamlines.

M

Mass Flow Rate: The amount of mass flowing through a cross-section of a pipe or duct per unit time. It is a fundamental quantity in the analysis of fluid flow.

N

Navier-Stokes Equations: A set of partial differential equations that describe the motion of viscous fluid substances. They are used to model fluid flow in many engineering applications.

O

Orifice: An opening through which fluid flows. Orifices are commonly used in flow measurement devices and control valves.

P

Poiseuille's Law: An equation that describes the flow of a viscous fluid through a cylindrical pipe. It relates the volume flow rate to the pressure drop and the viscosity of the fluid.

Pressure Gradient: The change in pressure per unit distance in a fluid flow. It is a driving force for fluid motion in pipes and channels.

Q

Quasi-Steady Flow: A flow regime in which the flow properties change slowly with time. This approximation is often used to simplify the analysis of unsteady flows.

R

Reynolds Number: A dimensionless quantity that characterizes the flow regime of a fluid. It is the ratio of inertial forces to viscous forces in the flow.

S

Stokes' Law: An equation that describes the drag force on a small sphere moving through a viscous fluid at low Reynolds numbers. It is used to calculate the terminal velocity of the sphere.

Streamline: A line that is everywhere tangent to the velocity vector of a fluid flow. Streamlines are useful for visualizing the flow direction and patterns.

T

Turbulence: Chaotic and irregular fluid motion characterized by eddies, vortices, and fluctuations in velocity. Turbulence is a complex phenomenon that is still not fully understood.

U

Uniform Flow: Flow in which the velocity of the fluid remains constant along streamlines. This type of flow is often used as an idealization in fluid mechanics.

V

Velocity Profile: A graph that shows how the velocity of a fluid varies across a cross-section of a pipe or channel. Velocity profiles are important for analyzing flow distribution.

Viscous Drag: The drag force experienced by an object moving through a fluid due to the viscosity of the fluid. It is proportional to the velocity gradient near the surface of the object.

W

Wake: The region of disturbed flow downstream of an object moving through a fluid. Wakes are characterized by low pressure and high turbulence.

Water Hammer: A surge in pressure that occurs in a fluid due to a sudden change in flow velocity. Water hammer can cause damage to pipes and valves if not properly controlled.

X

X-Component: The horizontal component of a vector quantity in a Cartesian coordinate system. In fluid mechanics, the x-component of velocity is used to describe flow in the horizontal direction.

Y

Yield Stress: The minimum stress required to make a fluid flow. Fluids with yield stress behave like solids until a certain stress threshold is exceeded.

Z

Zero Velocity: A special condition in fluid mechanics where the velocity of the fluid at a point is zero. This can occur at stagnation points or in regions of recirculating flow.