Subdisciplines & Associated Disciplines of Fluid Mechanics

Hydraulics: Branch of engineering that studies the mechanical properties of fluids. There are two subdivisions.

Hydrostatics: The study of liquids at rest, involves the problems of buoyancy and flotation, pressures on dams and submerged devices, and hydraulic presses.

Hydrokinetics: The study of liquids in motion, is concerned with such matters as friction and turbulence generated in pipes by flowing liquids and the use of hydraulic pressure in machinery.

Hydrology: Deals with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere. The hydrologic cycle consists of the passage of water from the oceans into the atmosphere; onto, through, and under the lands; and back to the ocean. Hydrology is mainly concerned with the part of the cycle that follows the precipitation of water onto the land and precedes its return to the oceans.

Rheology: Study of the deformation and flow of fluids such as for purposes of lubrication.

Hydroelectricity: Generating electricity by conversion of the energy of running water.

Hydrostatics: Deals with the characteristics of fluids at rest, particularly with the pressure exerted by a fluid on an immersed body. Examples: dams, underwater gates, tunnels, etc..

Hydrodynamics: Deals with the motion of fluids (especially, incompressible fluids), and the forces acting on solid bodies immersed in such fluids and in motion relative to them. Examples: ships, submarines, torpedoes, etc..

Meteorology: Deals with the atmosphere and its conditions. Meteorology is based on the scientific measurement of various atmospheric conditions with a wide assortment of instruments. Air temperature is measured with the thermometer; air pressure with the barometer; wind direction with the weather vane; wind speed with the anemometer; high-altitude air-pressure and wind information with the weather balloon; relative humidity with the hygrometer; precipitation with the rain gauge; and cloud formations and weather fronts with both radar and high-altitude weather

satellites. The meteorologist uses the data collected from many geographical locations to create a weather map. On a typical map the various weather elements are shown by figures and symbols. Isobars are drawn to show areas of equal pressure, and fronts and areas of precipitation are also indicated. Meteorologists also analyze the data collected with computer models in order to predict, or forecast, the weather for the next few hours and the next few days. Long-range weather forecasts, which are more general and less accurate, are also made for future periods of several months.

Oceanography: Deals with the oceans, marine biology, the physics and chemistry of their waters, and the exploitation of their resources. The study of the sea attempts at integrating marine applications of geography, geology, physics, chemistry, marine biology, and meteorology. Comprehensive study of the sea dates from the 1872–76 Challenger expedition. Today there are about 250 oceanographic institutions, notably the Scripps Institution of Oceanography in California, the Woods Hole Oceanographic Institution in Massachusetts, and the Lamont-Doherty Geological Observatory of Columbia Univ. Oceanography is important to shipping, fisheries, the laying of telegraph cables, and climatological studies.

Marine biology: Study of ocean plants and animals and their ecological relationships. Marine organisms are classified according to their mode of life as nektonic (free-swimming), planktonic (floating), or benthic (bottom-dwelling). Their distribution depends on the chemical and physical properties of seawater (e.g., temperature, salinity, and dissolved nutrients), ocean current, and penetration of light.

Aeromechanics: The science of the motion and equilibrium of air and other gases, comprising aerodynamics and aerostatics.

Aerodynamics: The dynamics of bodies moving relative to gases, especially the interaction of moving objects with the atmosphere. Because the principal application of aerodynamics is the design of airplanes, air is the principal gas with which this science is concerned. Bernoulli's principle, which states that the pressure of a moving gas decreases as its velocity increases, has been used to explain the lift produced by a wing having a curved upper surface and a flat lower surface. Because the flow is faster across the curved surface than across the flat one, a greater pressure is exerted in the upward direction. Aerodynamics is also concerned with the drag caused by air friction, which is reduced by making the surface area of the craft as small as possible. At speeds close to the speed of sound, or Mach 1, there is also a large, sudden increase of drag, which has been called the sonic, or sound, barrier. Aerodynamics is also used in designing automobile bodies and trains for minimum drag and in computing wind stresses on bridges, buildings, and the like. The wind tunnel is one of the basic experimental tools of the aerodynamicist.

Aerostatics: The science of gases in equilibrium and of the equilibrium of balloons or aircraft under changing atmospheric flight conditions.

Aeronautics: The design and construction of aircraft. The theory and practice of aircraft navigation.

Astronautics: The science and technology of space flight.

Rocketry: The science and technology of rocket design, construction, and flight.

Aerospace engineering: Engineering related to aircraft and space vehicles.

Aerothermodynamics: The study of the thermodynamics of gases, especially at high relative velocities.

Ballistics: The study of the dynamics of projectiles. The study of the flight characteristics of projectiles. The study of the functioning of firearms. The study of the firing, flight, and effects of ammunition.

Aeroballistics: Ballistics, especially of missiles, in the atmosphere.

Acoustics: The science of sound, including its production, propagation, and effects. An important practical application of acoustics is in the designing of auditoriums, which requires a knowledge of the characteristics of sound waves. Reflection of sound can cause an echo, and repeated reflections in an enclosed space can cause reverberation, the persistence of sound. Some reverberation in auditoriums is desirable to avoid deadening the sound of music. Reflection can be reduced through the proper configuration and texture of walls, and by the use of sound-absorbent materials. Another acoustical problem is interference, which can create “dead spots” in auditoriums for certain frequencies.

Convection: Transfer of heat by the flow of a liquid or gas. A fluid expands when heated and thus undergoes a decrease in density. The warmer, less dense regions of a fluid tend to rise, in accordance with Archimedes’ Principle, through the surrounding cooler fluid. If the heat continues to be supplied, the cooler fluid that flows in to replace the rising fluid will also become heated and will rise, setting up a convection current.

Advection: A local change in the properties, such as temperature, of an air mass caused by the horizontal movement of the air mass.