— University of Mosul —
College of Petroleum & Mining Engineering

Fluid I

Lecture (1)
Properties of Fluid

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- Fluid
- Mechanics Fluid

Properties of Fluid

Fluid

A fluid is any substance that flows or deforms under applied shear stress. Fluids comprise a subset of the states of matter and include liquids, gases, and plasma.

States of matter are divided

Properties	Solids	Liquid	Gases
Rigidity	Solids are rigid	Liquid is not rigid	Gases are not rigid
Shape& Volume	Solid have definite shape and volume	Liquid has definite volume but no definite shape	Gases have neither definite shape nor definite volume
Fluidity	Solids cannot flow	Liquids can flow from higher to a lower level	Gases can flow in all direction
Compressibility	Solids cannot be compressed appreciably	Liquid can be easily compressed	Gases can be easily compressed
Inter molecular attraction	Solids have maximum inter molecular attraction	Liquids inter molecular attraction is less than solids	Gases inter molecular attraction is the least

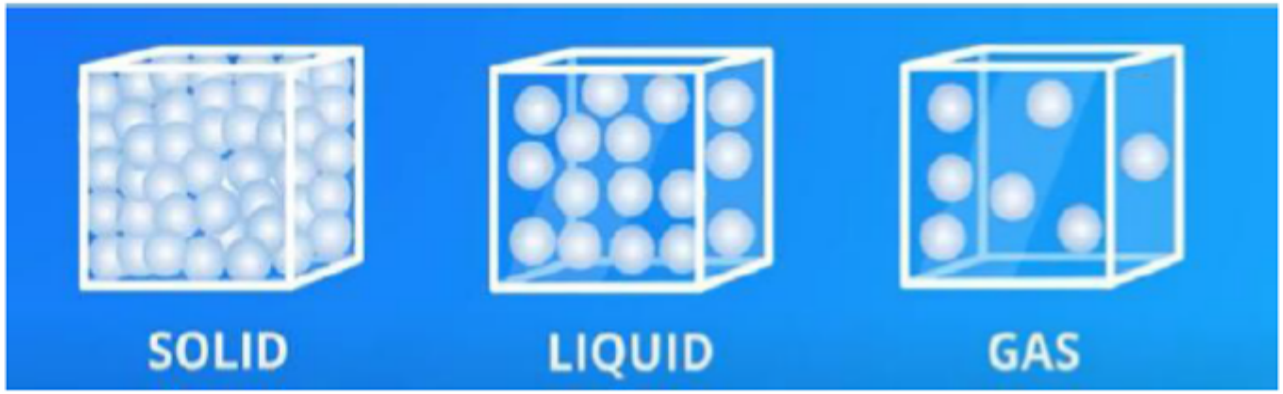


Fig (1)

Solid and fluid (liquid &gas)

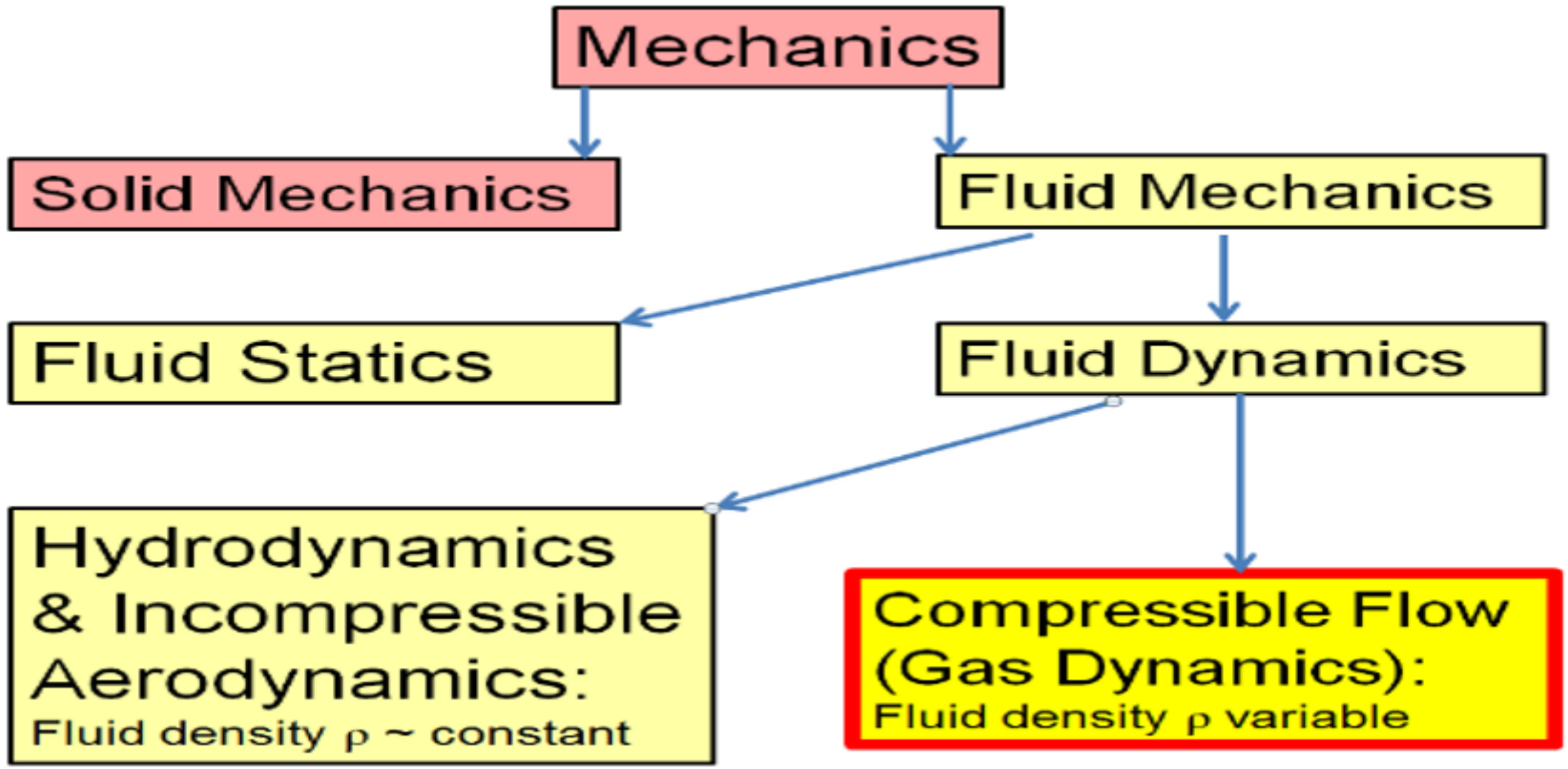
In solids, the molecules are very closely spaced whereas in liquids (such as water, oil, and gasoline) the spacing between the different molecules is relatively large and in gases (such as CO_2 and methane) the spacing between the molecules is still large.

Difference between liquid and gases

Liquid	gases
Difficult to compress and often regarded as incompressible	Easily to compress- changes of volume is large, cannot normally be neglected and are related to temperature
Occupies a fixed volume and will take the shape of the container	No fixed volume, it changes volume to expand to fill the containing vessels
A free surface is formed if the volume of container greater than the liquid	Completely fill the vessel so that no free surface is formed

Shear force: is the force component tangent to surface.

Shear stress (force per unit area): is the shear force divided by the area of surface.


Mechanics
Solid Mechanics
Fluid Mechanics
Fluid Statics
Fluid Dynamics
Hydrodynamics & Incompressible Aerodynamics:
Fluid density ρ ~ constant
Compressible Flow (Gas Dynamics):
Fluid density ρ variable

Fluid Mechanics

Is that branch of science, , which the behavior of the fluid (liquids or gases) at rest as study at motion. Thus, this branch of science deal with statics, kinematic and dynamic aspect of fluid. The study of fluid at rest is called fluid statics. The study of fluid in motion where Pressure forces are **not considered** is called fluid kinematics. and the pressure forces are **considered** in fluid motion that branch of science is called fluid **dynamics.**

The fluid mechanics may be divided into three parts

Fluid statics

The study of incompressible fluid under statics is conditions is called hydrostatics, and that dealing with the compressible static gases is termed as aerostatics.

Fluid Dynamics

It deals with the relations between velocities, accelerations of fluid with the forces or energy causing them.

Fluid Kinematics

It deals with the velocities, accelerations and patterns of flow only. Forces or energy causing velocity and acceleration are not dealt under this heading.