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- تواصل مستمر مع معلم المادة

للتواصل

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Hydraulics

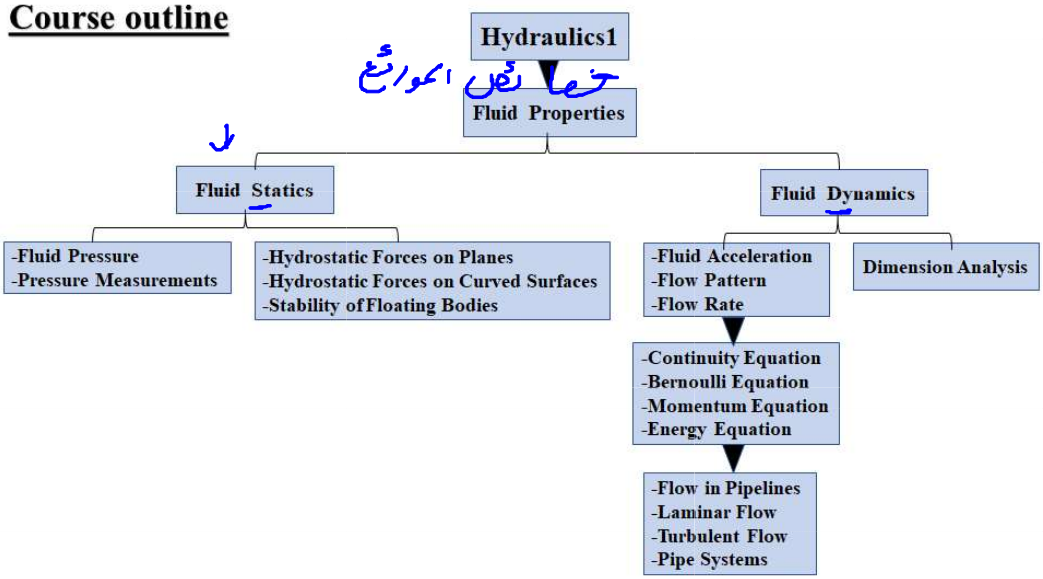
Chapter1: Fluids and their Properties

Lecture1

Lecture 1

1. Course outline
2. About Hydraulics, Hydraulic Engineering, and Hydraulic systems
3. What is the meaning of fluid & fluid mechanics?
4. Units and Dimensions
5. Physical properties of a liquid
6. Examples

Course outline



About Hydraulics, Hydraulic Engineering, and Hydraulic systems

Hydraulics is the science of studying the mechanical behavior of water at rest or in motion.

Hydraulic Engineering is the application of fundamental principles of fluid mechanics on water.

Hydraulic systems

Systems which are designed to accommodate water at rest and in motion.

Examples of Hydraulic Projects

- Water pipelines
- Sewer systems
- Dams and water control structures
- Storm sewer systems
- Rivers and manmade canals
- Coastal and Harbour structures
- Irrigation and Drainage Projects

What is the meaning of fluid & fluid mechanics?

- **Fluid** is a substance that has no fixed shape and yields easily to external pressure; a gas or (especially) a liquid.
- **Fluid mechanics** is that branch of science which deals with the behavior of the fluids (liquids or gases) at rest as well as in motion.
- This branch of science deals with the static, kinematics and dynamic aspects of fluids.
  - The study of fluids at rest is called fluid statics.
  - The study of fluids in motion, where pressure forces are not considered, is called fluid kinematics and if the pressure forces are also considered for the fluids in motion, that branch of science is called fluid dynamics.

Units and Dimensions

Main Units and Dimensions

Quantity	SI Units	Dimensions
Mass	ton, Kg, gm	M
Length	m, cm, mm	L
Time	hour, min, sec	T

Common Units and Dimentions

Quantity	Dimension	Units
Length	L	m
Area (A)	L^2	m^2
Volume (V)	L^3	m^3
Velocity (v)	LT^{-1}	m/s
Flow (Q)	L^3T^{-1}	m^3/s
Density (ρ)	ML^{-3}	Kg/m^3
Acceleration(g)	LT^{-2}	m/s^2
Specific Weight (γ)	$M\,T^{-2}L^{-2}$	$Newton/m^3$
Power (P)	????????	watt

Physical properties of a liquid

1-Density 2-Specific Weight 3-Specific Gravity 4-Viscosity
5-Vapor Pressure 6-Surface Tension 7-Capillary

1-Density(ρ)

Definition: Density is simply mass per unit volume.

$$\rho = Mass/Volume = M/V$$

Water = 1000 kg/m^3, Mercury = 13546 kg/m^3

Air = 1.23 kg/m^3, Paraffin Oil = 800kg/m^3

2-Specific Weight(γ)

Definition: the weight per unit volume

$$weight = Mass \times Gravity\ Acceleration = M.g$$

$$\gamma = weight/Volume = M.g/V = \rho.g$$

Water = 9814 N/m^3, Mercury = 132943 N/m^3

Air = 12.07 N/m^3, Paraffin Oil = 7851 N/m^3

الكتلة	الوزن
m	W
1kg	N
0.5kg	5N

3-Specific Gravity (*SG*)

Definition: the ratio of the density of a substance to the density of water at a standard temperature

$$SG = \rho_{substance} / \rho_{water}^{1000} = \frac{\rho}{\rho} = \frac{\text{Mass}}{\text{Mass}} = \text{no unit}$$

Water = 1 , Mercury = 13.5, Paraffin Oil = 0.8

Examples

Example1

A reservoir of oil has a mass of 825 kg. The reservoir has a volume of 0.917 m^3. Compute the density, specific weight, and specific gravity of the oil.

Solution:

$m = 825\ kg$, $v = 0.917\ m^3$, ρ ??, γ, SG

$$\rho = \frac{m}{v} = \frac{825}{0.917} = 900\ kg/m^3$$

$$\gamma = \frac{w}{v} = \frac{mg}{v} = \frac{825 \times 9.81}{0.917} = 8826\ N/m^3$$

$$SG = \frac{\rho_s}{\rho_w} = \frac{900}{1000} = 0.9$$