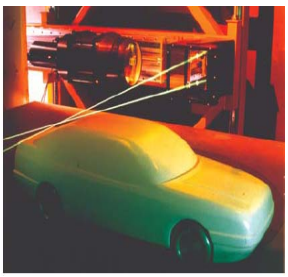
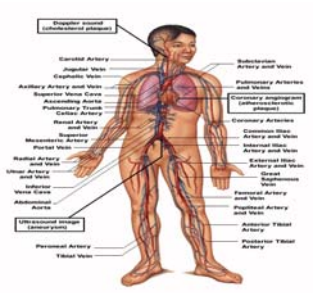
Fluid Mechanics (0905241)

Introduction



Prof. Zayed Al-Hamamre

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Requirement

Students attending this course **MUST** be familiar with

- ✓ Basic mathematics: Integration and differentiation
- ✓ Units and dimensions (Dimensional Homogeneity, SI and English unit) and unity conversion ratios.
- ✓ Basic physical definitions and concepts
- ✓ Estimation, calculation and investigation of the different physical and chemical properties such as viscosity, density , vapor pressure…. Etc.
- ✓ Mass and energy conservation laws (Material and Energy Balance)
- ✓ Equation of stats (ideal gas law)

Course Objectives	This course is an introduction to fluid mechanics, and emphasizes fundamental concepts and problem-solving techniques.
Text Book	1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics: Fundamentals and Applications, McGraw Hill Higher Education, 3rd edition SI unit, 2014.
References	1. Clayton T. Crowe , Donald F. Elger, John A. Roberson, Engineering Fluid Mechanics, John Wiley & Sons, Inc. USA; 8th edition, 2005 2. Noel de Nevers, Fluid Mechanics for Chemical Engineers, McGraw Hill Higher Education, 3rd edition, 2005

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Course Assessment

Participation, Assignments and Quizzes	30%	
Midterm	30%	
Final Exam	50%	

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Course Content I

	Topic	Text	Ref. 1
1.	Introduction to fluid mechanics	Chapter 1	Chapter 1
2.	Physical properties and type of fluids	Chapter 2	Chapter 2
3.	Fluid Statics: Basic hydrostatic equation, Buoyancy and manometers	Chapter 3	Chapter 3 and Chapter 4
4.	Bernouli's equation	Chapter 5	Chapter 4
5.	Fluid flow measurements	Chapter 5	Chapter 13

Course Content II

6.	Fluid friction in steady flow	Chapter 8	Chapter 9, Chapter 10 and 11
7.	Macroscopic momentum balances	Chapter 6	Chapter 6
8.	Open channel flow	Chapter 13	Chapter 15
9.	Dimensional analysis	Chapter 9	Chapter 8
10.	Pumping of fluid and pump selection	Chapter 8	Chapter 14
11.	Fluid mixing	Chapter 19 Ref. 2	

Expected Course Outcomes

Upon completion of this course, students will be able to:

1. Determine pressures and forces on submerged bodies
2. Analyze flow rates, velocities, energy losses, and momentum fluxes for fluid systems
3. Describe fluid flow phenomena
4. Analyze, design, and evaluate pumping systems and pipeline components
5. Communicate effectively with engineering graphics

Regulations

I. Attendance:

Attendance of classes is obligatory. Absence must be verified according to the university's regulation.

II. Quizzes and homework

All students are required to finish their homework assignments, and submit them on time. Late homework ***will not be accepted*** under any circumstances. Popup quizzes will be given without any prior notice. You need to come prepared to class. A hand calculator is recommended to be available in every class**.** In addition to the final exam, there will be one midterm exam. These exams will be challenging and comprehensive during the class

IV. Conduct in classroom:

While in the class room, all cell phones, Laptops need to be turned off.

Fluid Mechanics

- **Mechanics** is the physical science that deals with both stationary and moving bodies under the influence of forces.
- The branch of mechanics that deals with bodies at rest is called **statics,** while the branch that deals with bodies in motion is called **dynamics.**

- **Fluid mechanics** is defined as the science that deals with the behavior of fluids (liquids and gases) at rest (fluid statics) or in motion (fluid dynamics), and the interaction of fluids with solids or other fluids at the boundaries.
- It is concerned with understanding, predicting, and controlling the behavior of a fluid.

Fluid Mechanics

Fluid mechanics categories

- **Hydrodynamics referred for** the motion of fluids that are practically incompressible (such as liquids, especially water, and gases at low speeds)
  a) **Hydraulics, which deals with liquid** flows in pipes and open channels.
  b) **Gas dynamics deals with the flow of** fluids that undergo significant density changes, such as the flow of gases through nozzles at high speeds.
- **Aerodynamics deals with the** flow of gases (especially air) over bodies such as aircraft, rockets, and automobiles at high or low speeds.
- **Meteorology, oceanography, and hydrology** deal with naturally occurring flows.

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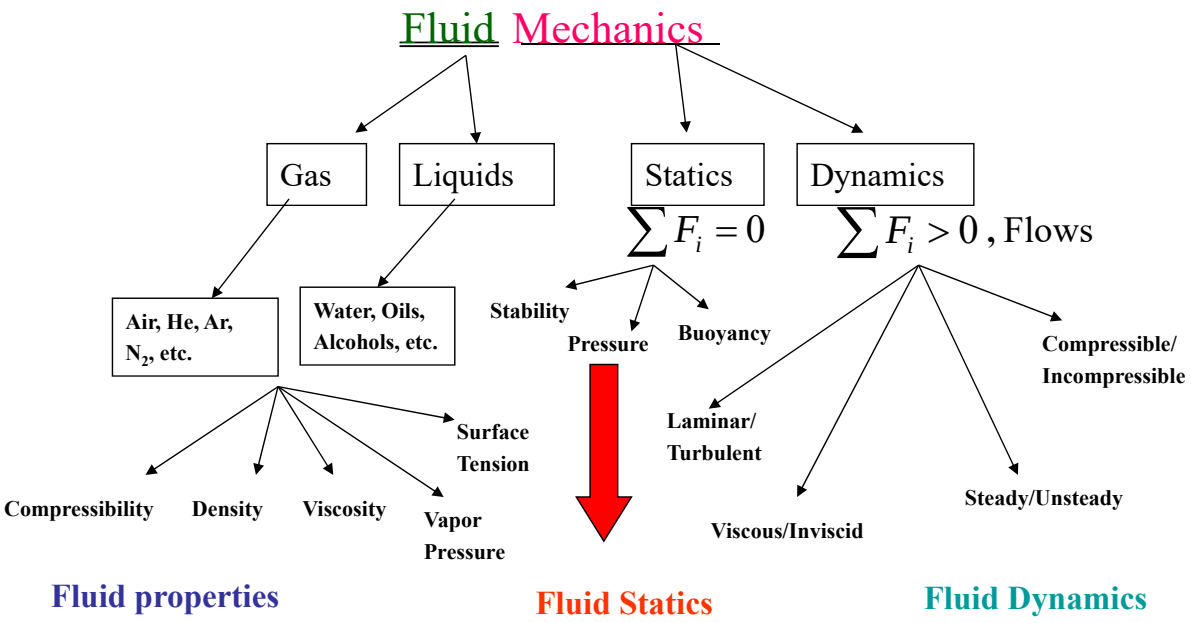
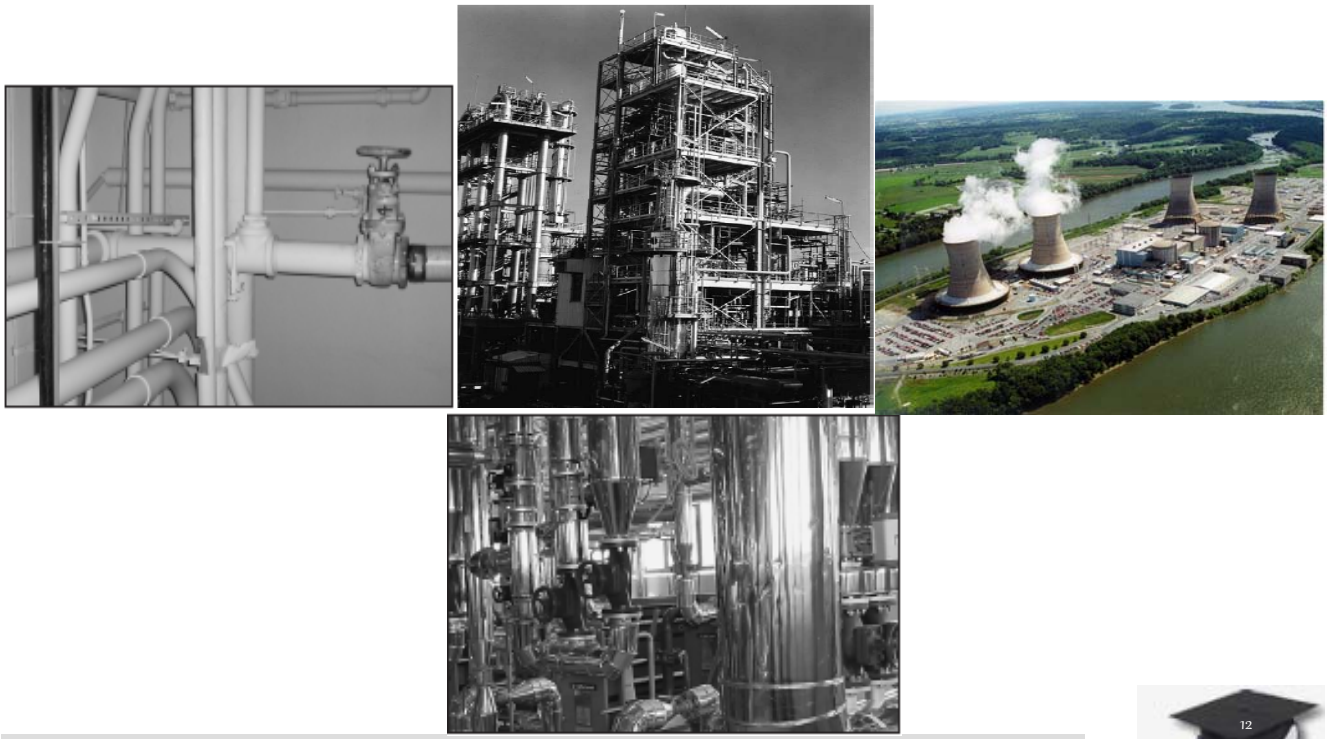
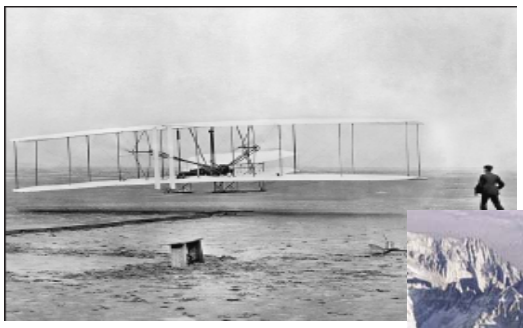
Fluid Mechanics



Importance of Fluid Mechanics



Importance of Fluid Mechanics: Aerodynamics



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Importance of Fluid Mechanics: Aerodynamics

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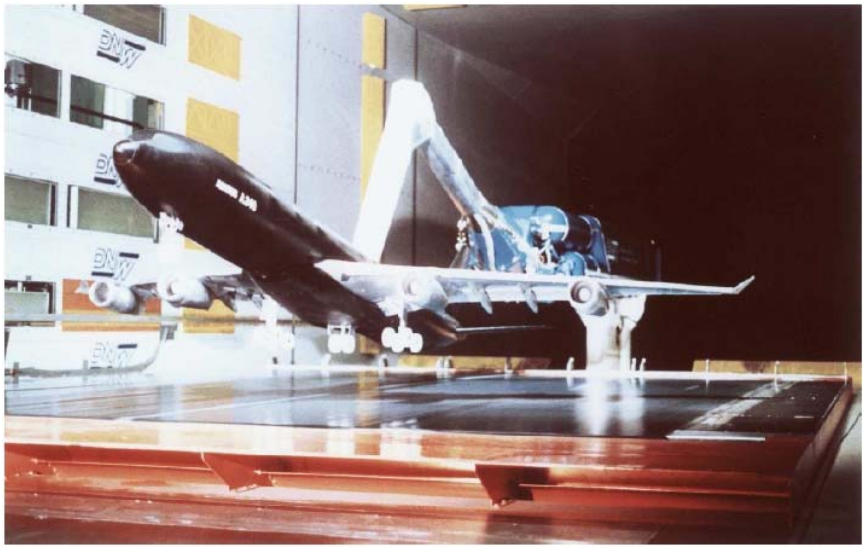

Model of an Airbus A 340 in a wind tunnel

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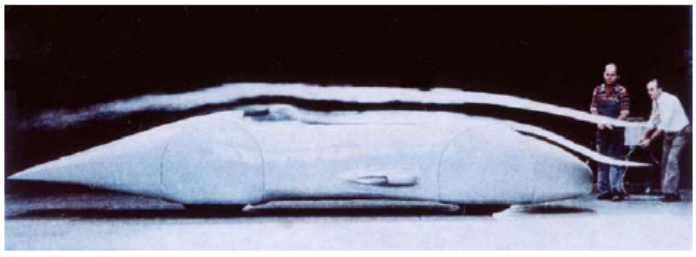
Importance of Fluid Mechanics: Aerodynamics

Mercedes-Benz W125 in a wind tunnel

$c_w = 0.365$ 1937



$c_w = 0.170$ 1938

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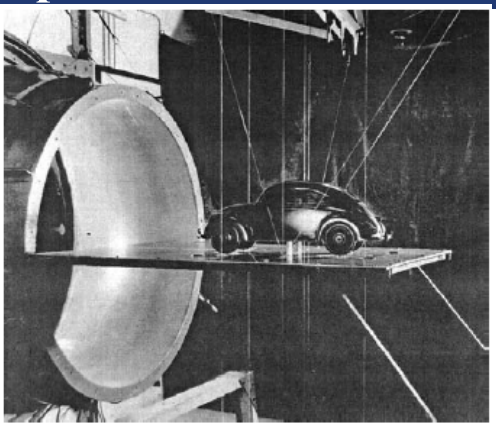
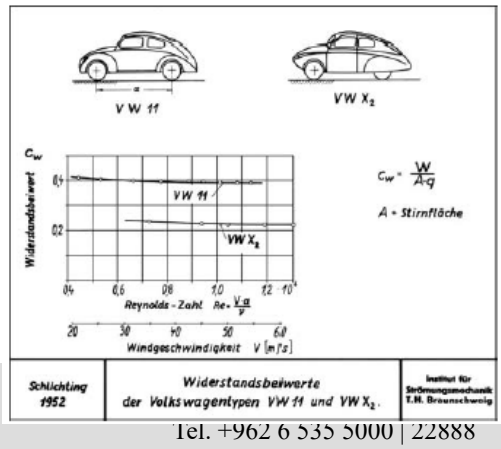
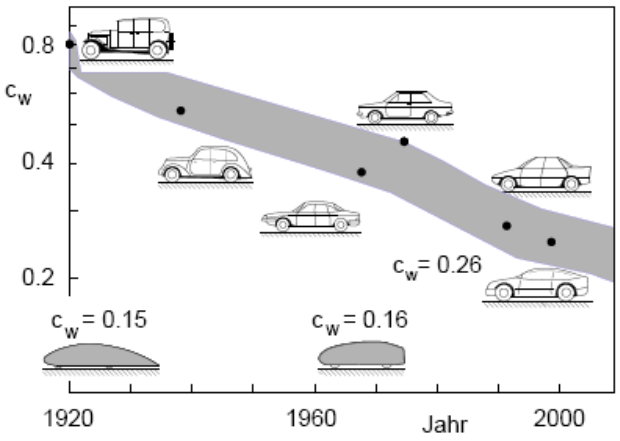
Importance of Fluid Mechanics: Aerodynamics



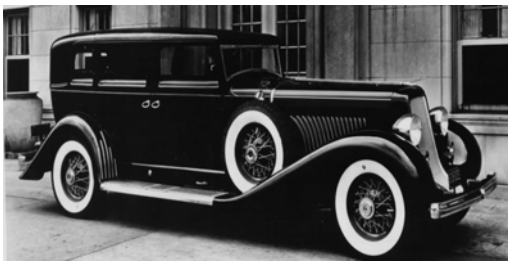
Measurement of automobile drag coefficients in the wind tunnel



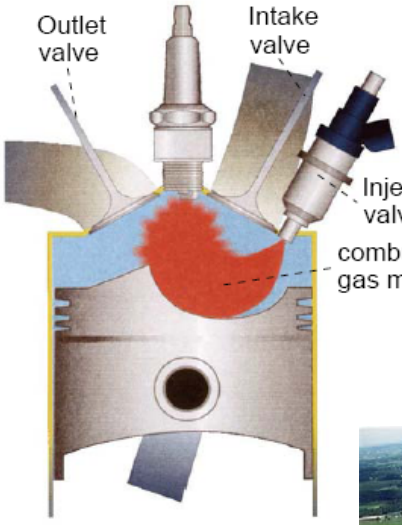


Development of the C_w value for motor vehicles

Importance of Fluid Mechanics: Aerodynamics



Importance of Fluid Mechanics: Energy Generation

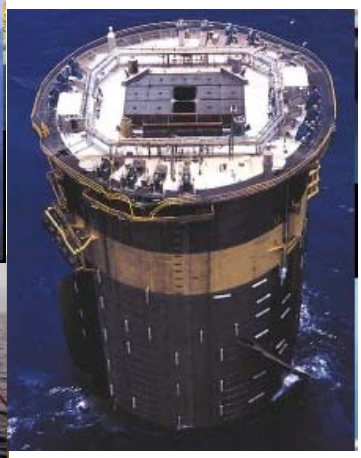


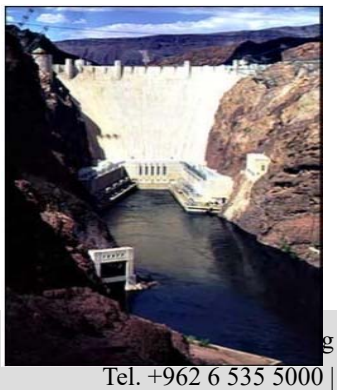
Otto engine with direct fuel injection

Wind turbines

Importance of Fluid Mechanics

Hydrodynamics, Hydraulic Structures





Importance of Fluid Mechanics

Geology and Meteorology

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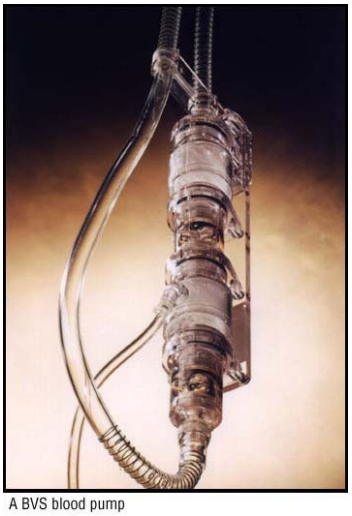
Importance of Fluid Mechanics

Bioengineering

Ventricular assist device

Blood pump



A BVS blood pump

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