

ME-301

**Measurement techniques**

Mulleners Karen

| Cursus                 | Sem. | Type |
|------------------------|------|------|
| Mechanical engineering | BA6  | Obl. |

|                            |                 |
|----------------------------|-----------------|
| Language of teaching       | English         |
| Credits                    | 4               |
| Session                    | Summer          |
| Semester                   | Spring          |
| Exam                       | Written         |
| Workload                   | 120h            |
| Weeks                      | 14              |
| <b>Hours</b>               | <b>4 weekly</b> |
| Courses                    | 1 weekly        |
| TP                         | 3 weekly        |
| <b>Number of positions</b> |                 |

**Summary**

Theoretical and practical course on experimental techniques for observation and measurement of physical variables such as force, strain, temperature, flow velocity, structural deformation and vibrations, etc.

**Content**

This is a theoretical and practical course on the use of various experimental techniques related to mechanical engineering. The physical background, practical implementation, and limitations of common measurement methods will be taught through video lecture by various lecturers. The theoretical knowledge will be put in practice through independent group projects where students pick a topic and a question, design experiments, and measure different physical quantities such as force, strain, temperature, flow velocity, structural deformation and vibrations, etc. to solve their question.

**Keywords**

measurement techniques, data processing, experimental design, sensors

**Learning Prerequisites****Important concepts to start the course**

Basic understanding in:

- fluid mechanics, thermodynamics, heat and mass transfer
- electrical engineering / electronics
- numerical data analysis and processing

**Learning Outcomes**

By the end of the course, the student must be able to:

- Carry out an experimental modal analysis of a real structure, S4
- Characterize experimentally the steady-state or dynamic response of solids, fluids S11
- Quantify the temperature, pressure, flow and composition of a fluid E24
- Propose mechanical tests for the characterization of biologic tissues and fluids B6
- Identify a dynamic system using experimental data A6
- Integrate similarity laws and their use for dimensioning an experimental testbed AH23
- Describe the technics used to measure physical flow quantities; choose the appropriate technic to measure to a desired accuracy AH24

**Transversal skills**

- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Demonstrate a capacity for creativity.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Write a scientific or technical report.
- Collect data.

### Teaching methods

The physical background and working principles of various measurement techniques will be taught through video lecture by various lecturers. This knowledge will then be put into practice in the form of independent group projects. Students will pick a topic and they will be guided to systematically find answers by applying different measurement techniques they select. Support will be provided by teaching assistants during practice sessions.

### Assessment methods

Final written exam (40%)

Scientific and technical report (60%)

### Resources

#### Bibliography

- Holman, J.P. "Experimental Methods for Engineers", <https://mech.at.ua/HolmanICS.pdf>
- Springer Handbook of Experimental Solid Mechanics  
<https://link.springer.com/referencework/10.1007/978-0-387-30877-7>
- Springer Handbook of Experimental Fluid Mechanics  
<https://link.springer.com/referencework/10.1007/978-3-540-30299-5>
- Organtini, G. Physics Experiments with Arduino and Smartphones. (2021).  
<https://link.springer.com/book/10.1007/978-3-030-65140-4>
- Digital Signal Processing: An Experimental Approach  
<https://link.springer.com/book/10.1007/978-1-84800-119-0>

#### Ressources en bibliothèque

- [Holman, J.P. "Experimental Methods for Engineers"](#)
- [Springer Handbook of Experimental Solid Mechanics](#)
- [Springer Handbook of Experimental Fluid Mechanics](#)
- [Organtini, G. Physics Experiments with Arduino and Smartphones](#)
- [Digital Signal Processing: An Experimental Approach](#)

#### Moodle Link

- <https://go.epfl.ch/ME-301>