ME-301

Measurement techniques

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Cursus	Sem.	Type
Mechanical engineering	BA6	Obl.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	1 weekly
TP	3 weekly
Number of positions	

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:
- conduct measurements
- condition the data signals
- perform an error analysis for the measurement data,
- perform a frequency analysis on the data from one of the measurement systems.

The focus lies on the practical design of the experiment, the selection and correct application of the measurement techniques, and the signal conditioning and analysis.

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
- Carry out an experimental analysis of heat flow experiment in convection and/or conduction
- Carry out an experimental analysis of static deformation of beam structures under load
- Analyze experimental data points and extract key statistical values and physical magnitudes.
- Describe experimentally the steady-state or dynamic response of solids, fluids S11
- Describe the temperature, pressure, flow and composition of a fluid E24

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 be guided through the process of designing and conducting a reliable and repeatable engineering experiment and will learn how to use different measurement techniques. Support will be provided by teaching assistants during practice sessions.

Assessment methods

Final written exam (60%)
Experimental work (40%)

Supervision

Office hours	Yes
Assistant.e.s	Yes

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

- Find the references at the Library

Moodle Link

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

Videos

- https://mediaspace.epfl.ch/channel/ME-301+Measurement+techniques/30161/subscribe