UNIVERSITY OF LJUBLJANA
Faculty of Mechanical Engineering

Noise, Vibrations and Acoustic Engineering (6007-M) 5 ECTS

Lecturer: **J. Prezelj**

Lectures: 30h | Tutorials: 4h | Labs: 26h | Project: 0h | Lang. :

Objectives

The objective of this course is to provide students with a clear, intuitive, and application-oriented understanding of sound and vibrations, from their physical origin to human perception and environmental impact. The course presents sound as a physical phenomenon that carries information and strongly influences human experience, making it relevant for students from engineering, environmental sciences, design, architecture, urban studies, and related fields.

Students will learn:

- how sound is generated by vibrations and how it propagates in air and water,
- how sound and vibrations are measured, visualized, and interpreted,
- how human perception of sound (psychoacoustics) relates to physical quantities,
- how environmental noise is assessed and managed in real environments,
- how to apply sound absorption and insulation for noise control and to influence acoustic comfort,
- how convolution and time domain analysis provide a powerful framework for understanding sound and vibration,
- how sound events can be classified, including a basic introduction to artificial intelligence methods used in acoustics.

The course emphasizes hands on experiments, demonstrations, and real world examples, enabling students to connect theory with perception and practical applications.By the end of the course, students will be able to critically interpret acoustic data, understand the relationship between measured signals and human noise experience, and recognize sound as a valuable source of information about processes, machines, and environments.

Programme

1. Introduction to sound perception and perception of different sound environments
2. Experimental methods for sound measurement and evaluation of human response
3. Digital signal processing: FFT, convolution, signal differentiation and integration
4. Time–frequency representations and transient sound analysis
5. Noise control measures using sound absorption and sound insulation
6. Introduction to artificial intelligence in acoustics: sound event classification based on feature extraction, supervised (k-NN) and unsupervised (K-Means) methods
7. Case studies from real environments and machines (urban soundscapes, machinery, transport, nature)

Prerequisites

Basic knowledge of physics and mathematics is recommended.
Students from non-engineering backgrounds are welcome; necessary physical concepts will be introduced intuitively and supported by practical demonstrations.

Learning outcomes

After completing the course, students will:

1. understand how sound is generated, propagated, and perceived,
2. be able to measure, visualize, and interpret acoustic and vibration signals,
3. understand the role of time-domain analysis and convolution in signal processing,
4. be able to assess environmental noise and acoustic comfort,
5. apply basic principles of noise control, sound absorption, and sound insulation,
6. gain introductory experience in sound event classification and data-driven analysis,
7. develop the ability to connect physical measurements with human perception and context.

Assessment

Group oral presentation with peer self-assessment
Evaluation of group performance during experimental work

Literature

Thomas D. Rossing, “Springer Handbook of Acoustics”, Springer 2007, LLC New York
David M. Howard & Jamie A.S. Angus, “Acoustics and Psychoacoustics”, Focal Press 2009, Oxford