University of Ljubljana
Faculty of Mechanical Engineering

Noise, Vibrations and Acoustic engineering 5 ECTS

Lecturer: **J. Prezelj**

Lectures: 30h | Tutorials: 2h | Labs: 28h | Project: 0h | Lang.:

Objectives

This course is designed to make complex acoustic concepts easy to understand, engaging, and highly relevant to your future career in engineering, environmental sciences, and technology. Through interactive lessons, real-world case studies, and hands-on projects, you'll develop highly required skills that are in high demand across various industries. By the end of this course, you will:

- Master the fundamental physics and mathematics behind sound and vibrations without getting lost in equations.
- Learn practical measurement techniques for analyzing sound, noise, intensity, reverberation, and noise control. These skills are directly applicable to real-world problems.
- Gain hands-on experience with AI-driven sound recognition, acoustic monitoring, and digital signal processing, preparing you for careers in modern engineering and smart technology environment.
- Understand how sound interacts with materials, spaces, and human perception. This is critical knowledge for designing high value-added products, safer machines, quieter cities, and immersive audio experiences.

Be a part of an interdisciplinary learning experience, where acoustics connects with mechanical engineering, AI, environmental sciences, and product design.

Programme

1. **The Science of Sound:** What is sound? How does it move through different materials? Discover the fundamentals of acoustics and their relevance in nature, technology, and industry.
2. **Noise & Vibration in Engineering**: Learn how sound and vibration affect machinery, buildings, and vehicles, and why noise control is critical in modern product design.
3. **Acoustic Measurement Techniques**: Get hands-on experience with cutting-edge measurement tools, such as sound level meters, intensity probes, and reverberation chambers.
4. **AI & Sound Recognition**: Explore how artificial intelligence is transforming acoustics, from speech recognition to smart noise reduction in cars, smart devices, and industrial monitoring.
5. **Psychoacoustics**: How Humans Perceive Sound – Why do some sounds feel pleasant while others are annoying? Learn how sound influences human perception, product design, and user experience.
6. **Noise Pollution & Environmental Acoustics**: Understand the impact of noise on health, wildlife, and urban life, and explore strategies for designing quieter cities.
7. **Ultrasound & High-Frequency Acoustics**: Discover how ultrasound is used in medicine, engineering, and material testing, including non-invasive diagnostics and industrial applications.
8. **Sound Absorption & Insulation**: Learn how materials can absorb and block sound and apply this knowledge to designing effective noise barriers and quiet spaces.
9. **Digital Signal Processing:** Master essential techniques such as Fourier transforms, Convolution, filtering, and real-time noise reduction used in modern technology.
10. **Smart Sound Engineering**: Apply computational models to simulate sound behavior in cars, buildings, and outdoor environments, preparing you for future industry challenges.

Prerequisites

Meeting the enrolment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.

Learning outcomes

Theoretical and practical knowledge in Acoustics, Artificial Inteligence, Digital Signal Processing, Noise Control , Psychoacoustics, equipping you with essential skills to analyze, model, and apply sound-related technologies across various industries to:

- apply cutting-edge methods to measure, model, and control sound, enabling you to design high-value products, optimize noise reduction, and enhance acoustic environments,
- bridge physics, engineering, and AI, making you a strong candidate for research, innovation, and high-tech careers.

Assessment

- Theory – 40 %
- Coursework – 20 %
- Reporting on experiments – 20 %
- Seminar with content from laboratory exercises – 20 %

Literature

- D.R .Raichel, The science and application of Acoustics, Springer, 2000
- G. Müller, M. Möser, Handbook of Engineering Acoustics, Springer Verlag, 2013
- M. Möser, S. Zimmermann, R. Ellis, Engineering Acoustics: An Introduction to Noise Control, Springer Verlag, 2004