

Dynamic of Machines and Structures (6038-M)

5 ECTS

Lecturer: G. Čepon

Lectures: 30h | Tutorials: 10h | Labs: 20h | Project: 65h | Lang.: 

Objectives

The objective of this course is to provide students with advanced knowledge of the dynamics of machines and structures, with emphasis on numerical and analytical modelling of dynamic systems. The course aims to develop a deep understanding of elasto-dynamic behaviour of continuous and discrete systems, modal analysis, damping, and dynamic response of complex mechanical systems. Special focus is placed on the finite element method (FEM), dynamics of rotating machinery, and dynamic modelling of robotic systems, enabling students to apply advanced dynamic techniques to real engineering problems. The course will cover:

- Fundamentals of machine and structural dynamics and system discretization
- Elasto-dynamic formulation and numerical approximation methods
- Finite element modelling, modal analysis, reduction, and damping
- Dynamics of rotating machinery and mechanical components
- Dynamics and modelling of robotic and flexible multibody systems

Programme

- Fundamentals of machine and structural dynamics, including discretization and elasto-dynamic formulation of continuous systems
- Numerical methods for dynamic analysis, including Rayleigh–Ritz approximation, modal analysis, and eigenvalue problems
- Finite element method in linear dynamics, modal superposition, model reduction, and damping modelling
- Dynamics of mechanical systems and machinery, including belt drives, rotors, flexible rotors, bearings, and piston machinery
- Dynamics of robotic and flexible multibody systems and application of the presented methods to real engineering structures

Prerequisites

To successfully complete this course, students should have:

- Good knowledge of engineering mechanics
- Basic understanding of dynamics and mechanical vibrations
- Fundamental knowledge of differential equations and linear algebra

Learning outcomes

After attending this course, the student will:

- Develop analytical and finite element models for dynamic analysis of machines and structures
- Analyse dynamic response and vibration behaviour of mechanical and structural systems
- Perform modal analysis, damping modelling, and model reduction
- Evaluate dynamics of rotating machinery and robotic systems
- Apply advanced dynamic analysis methods to real engineering problems

Assessment

- Written examinations (mid-term tests and final exam)
- Laboratory work and written reports

Literature

- Rao, S. S. *Mechanical Vibrations*, 5th ed., Addison-Wesley Publishing Company, 2011.
- Maia, N. M. M., Silva, J. M. M. *Theoretical and Experimental Modal Analysis*, Research Studies Press, 1997.
- Craig, R., Kurdila, A. *Fundamentals of Structural Dynamics*, Wiley, 2006.