



Advanced Dynamics

5 ECTS

Lecturer: Assoc. Prof. Dr. Gregor Čepon, Prof. Dr. Janko Slavič, Prof. Dr Miha Boltežar

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

Objectives

The objectives of this course are to learn mathematical formulations of theories in the field of mechanics for structural analysis, to learn the procedures of mechanical analyses of structural elements (trusses, beams, shafts, walls, panels, shells), mastery the skills of treating real construction with mathematical models, which requires critical reflection on the idealization of structures and the synthesis of individual theories. With this course student will get the following competences:

- ability to correctly use discrete and continuous dynamical systems,
- ability of independent description of harmonic, random and impulse loads,
- ability to understand and prepare accelerated vibration tests.

Programme

- Introduction to the course, introduction to analytical mechanics, the concept of generalized coordinates, the principle of virtual work
- Dirichet's stability criterion. Analytical Dynamics: The D'Alembert Principle,
- Lagrange 2nd order equations, conservative systems
- Hamiltonian principle for conservative systems, examples from analytical dynamics
- SDOF systems at impact excitation, transition to convolution, graphical approach
- Single degree of freedom systems at periodic excitation, Fourier decomposition, spectrum
- Free vibrations of MDOF systems, stiffness infl. coeff. method. Determination of natural fr.
- Determination of eigenvectors and modal matrix, orthogonality and normalization of eigenvectors.
- Modal transformation, response in modal and physical space.
- Forced vibrations of multi degree of freedom systems, response in physical and modal coordinates
- Vibrations of continuous systems, free vibrations of a string
- Torsional vibrations of a shaft, natural frequencies and mode shapes.
- Visit by an industry expert, case studies
- Free vibrations of a beams, Euler-Bernoulli theory for undamped beams
- Applications to real systems

Prerequisites

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

Learning outcomes

In-depth theoretical and analytical knowledge of the dynamics of discrete and continuous systems, which is the basis for demanding professional or scientific work.

- A systematic approach to modeling discrete systems with multiple degrees of freedom. The correct approach to modeling continuous systems. Decomposition of different excitatory mechanisms in dynamics.
- Transitions from physical to modal coordinates. Understanding generalizations in discrete and continuous dynamics.
- Performing basic accelerated vibration tests and vibration fatigue

Assessment

- 5% Laboratory work (at least 80%)
- 45% Exam / seminar work (at least 50%) theory exam (at least 50%)
- 50% Oral defense of the proposed grade

Literature

- Boltežar M: Mehanska nihanja – 1.del, druga izdaja, Fakulteta za strojništvo, 2010
- Rao SS: Mechanical vibration, 6th Ed, 2018
- Tomson WT, Dahleh MD: Theory of Vibration with Applications, 5th Ed, 1997