Module Description

Vibrations and Control

General Information

Number of ECTS Credits

3

Abbreviation

TSM_VibrContr

Version

2016.03.17

Responsible of module

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Language

	Lausanne	Bern	Zürich	Lugano/Manno
Instruction	☐ E ☐ F	☐ D ☐ E ☐ F	☐ D ☐ E	☒ E
Documentation	☐ E ☐ F	☐ D ☐ E ☐ F	☐ D ☐ E	☒ E
Examination	☐ E ☐ F	☐ D ☐ E ☐ F	☐ D ☐ E	☒ E

Module category

☐ Fundamental theoretical principles

☒ Technical/scientific specialization module

☐ Context module

Lessons

☒ 2 lecture periods and 1 tutorial period per week

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Brief course description of module objectives and content

Examination of structural vibrations and their representation and modeling. Tools and methods for vibration control in traditional and modern industrial environments.

Aims, content, methods

Learning objectives and acquired competencies

- Consolidate theoretical knowledge on structural vibration and control systems.
- Numerical modeling (by lumped masses) and experimental characterization of mechanical structures.
- Dynamic analysis of high performance machine tools.

Contents of module with emphasis on teaching content

Introduction
- Scope and examples.

Structural Vibrations
- Static and dynamic behavior.
- Steady state, frequency response, resonance.
- Time response, one degree of freedom systems, numerical modeling and simulation.
- Experimental identification (impact test with instrumented hammer & accelerometers).
- Analytical FRFs, poles and zero.
- N degrees of freedom. Mode shapes.
- Tuned passive dampers.
- Distributed compliance modeling (FEM. Examples).

Control
- Feed-forward and feedback control
- The PID regulator.
- Stability vs. performance issues. Tuning criteria. Root locus.
- Regulator architecture in classical industrial drives.
- Modern control approaches (outline only).

Teaching and learning methods

Frontal theoretical lessons with interaction. Self developed numerical exercises. Numerical simulation in MATLAB/Simulink. Experimental measurement of a dynamic compliance by impact testing

Prerequisites, previous knowledge, entrance competencies

- Linear algebra (matrices, eigenvalues, eigenvectors,…), linear differential equations.
- Dynamic equilibrium of a mechanical systems (mass, springs, dampers, natural frequencies,…)
- Fourier transform.
- Entry-level experience with MATLAB/Simulink

Literature

Assessment

Certification requirements for final examinations (conditions for attestation)

Positive evaluation of numerical exercises and simulations is prerequisite for entering the final exam, will not contribute to final mark.

Written module examination

Duration of exam:	120 minutes
Permissible aids:	none