Module Description, available in: EN

Vibrations and Control

General Information

Number of ECTS Credits

3

Module code

TSM_VibrContr

Valid for academic year

2019-20

Last modification

2018-11-06

Coordinator of the module

Giacomo Bianchi (SUPSI, giacomo.bianchi@supsi.ch)

Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Berne	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%			
Documentation					**X** E 100%			
Examination					**X** E 100%			

Module Category

TSM Technical scientific module

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

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

Brief course description of module objectives and content

Structural vibrations: theoretical aspects, numerical modelling, experimental testing. Passive vibration control. Elements of classic control theory: industrial motion controllers applied to flexible structures.

Aims, content, methods

Learning objectives and acquired competencies

- Consolidate theoretical knowledge on structural vibrations
- Passive solutions for vibration alleviation
- Performance analysis of flexible structures in systems with position controllers (mechatronic analysis)
- Numerical modelling by lumped masses and Finite Elements. Experimental Modal Analysis

Contents of module with emphasis on teaching content

Introduction

- Scope and examples.

Structural Vibrations

Theory review: systems with one degree of freedom (DOF). Energy dissipation: viscous and hysteretic damping

- Dynamic modelling in matlab/Simulink
- Dynamic vibrations isolation
- Tuned Mass Dampers
- Theory review: multi-DOF systems. Eigen-frequencies and mode shapes. Modal coordinates
- Dynamic analysis by a Finite Element package. Model reduction techniques: Modal and Craig Bampton.
- Experimental Modal Analysis: tools and basic methodologies. Impact hammer, shakers, accelerometers

Control

- The PID regulator
- Stability vs. performance issues. Tuning criteria. Root locus
- Cascaded current, velocity and position control loops in classical industrial drives

Teaching and learning methods

Frontal theoretical lessons with interaction. Self-developed numerical analysis in MATLAB/Simulink and Siemens Nastran NX.

Group project.

Literature

Lecture notes.

Assessment

Certification requirements

Module uses certification requirements

Certification requirements for final examinations (conditions for attestation)

Positive evaluation of numerical exercises and simulations is prerequisite for entering the final exam. The group exercise, the group project and the final exam contribute with the same weight to the final mark.

Basic principle for exams

As a rule, all the standard final exams for modules and also all resit exams are to be in written form

Standard final exam for a module and written resit exam

Kind of exam

written

Duration of exam

120 minutes

Permissible aids

No aids permitted

Special case: Resit exam as oral exam

Kind of exam

oral

Duration of exam

30 minutes

Permissible aids

No aids permitted