Module Description

Mechatronics for production and logistics

General Information

Number of ECTS Credits

3

Module code

TSM_Mechatr

Responsible of module

Marco Silvestri, SUPSI

Language

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	☐ E 100%	☐ E 100%		☑ F 100%	☐E 100%	☑ E 100%		☐ D 100%
Documentation	☐ E 100%	☐ E 100%	☑ E 20%	☑ F 80%	☐ E 100%	☑ E 100%	☐ E %	☐ D %
Examination	☐ E 100%	☐ E 100%	☐ E 100%	☑ F 100%	☐ E 100%	☑ E 100%	☐ E 100%	☐ D 100%

Module category

☐ FTP Fundamental theoretical principles

☑ TSM Technical/scientific specialization module

☐ CM Context module

Lessons

2 lecture periods and 1 tutorial period per week

Entry-level competencies

Prerequisites, previous knowledge

Basic knowledge of:

- Mechanics (e.g.: Detailed Mechanical Design: A Practical Guide, J. Skakoon, 2000),
- Modeling of simple mechanical systems (e.g.: http://lpsa.swarthmore.edu/Systems/MechTranslating/TransMechSysModel.html),
- Electrical circuits and components (e.g.: Basic Circuit Theory (Prentice-Hall Computer Applications in Electrical Engineering Series) Oct 1990 by Lawrence P. Huelsman),
- Programming fundamentals (e.g.: Programming: Learn the Fundamentals of Computer Programming Languages (Swift, C++, C#, Java, Coding, Python, Hacking, programming tutorials) (Volume 1) Paperback – August 16, 2016 by Marc Rawen).

Brief course description of module objectives and content

Virtually all consumer and utility goods today are produced in high volumes in highly automated factories and then delivered to the customer via equally automated logistics and distribution centers. From the technological viewpoint, the entire production system is based on controlled drives which connect the automation control systems and sensor devices, which nowadays are software-based systems, to the mechanical machinery elements. These complex systems can be designed and described through a combination of IT, electronic and mechanical systems known as mechatronics. Despite the fact that production machines are often highly specialized, there is a level at which commonalities can be found among mechatronic solutions in different machines, separately considering their principal tasks (e.g.: conveying, lifting, positioning, winding) and can then be classified and described in a non-industry specific manner. On the basis of this analysis, requirements can be defined for the configuration of the components (motor, inverter, gearbox) as well as for the software functions to allow a quick and reliable design and implementation. Even the rising productive paradigms that use alternative approaches to traditional mass production (e.g.: additive manufacturing systems, networked factories) are implemented through highly automated systems and can be analyzed, by one side, as combinations of the same types of basic physical task and, by the other, as an even more tight and organic combination of IT and mechanics (often indicated as cyber physical systems). On this perspective, the course offers an insight of some key elements of the Industrie 2025 initiative as well as of other related approaches (Industrie 4.0, Factory of the Future, Smart Factory…)

Aims, content, methods

Learning objectives and acquired competencies

- to analyse the end user requirements of production plants and their impact on mechatronics systems
- to design drive systems for automated plants with a mechatronic approach
- to implement methods and tools for a consistent modeling and design of manufacturing systems
- to be able to select industrial components consistently with the design specifications

Contents of module with emphasis on teaching content

The content of the module covers the very large range of mechatronics, to show its importance and to cover quite completely the production and logistics fields. During lessons the course focus will consist in mechatronics methods and tools and not all the listed topics will be described with the same level of detail.

- How production and logistics systems are structured
- UML representation of mechatronics requirements
- Machines in production and logistics
- General concepts of mechatronic systems
- Mechatronic drive and sensor elements
- Reliability issues of mechatronic systems
- Conveyors and lifting machineries
- Drive for not controlled, open loop systems
- Positioning systems and sensors for travelling systems
- Electronic cams and multi-axis systems
- Drive for forming processes
- Choose and dimension drive systems for machining tools (e.g.: lathe, milling, grinding…)
- Using OpenModelica to model and simulate mechatronic systems

Teaching and learning methods

- Classes, exercises and a course project announced at the first lesson, consisting in a realistic example preferable based on industrial input.

Literature

- E. Kiel (Ed.), Drive Solutions – Mechatronics for Production and Logistics, Springer, ISBN 978-3-540-76705-3
- Drive Engineering – Practical Implementation, SEW EURODRIVE
- G. Pelz, Mechatronics systems, Wiley ISBN 0-470-84979-7
- M. Nakamura and Oth., Mechatronic Servo System Control, Springer, ISBN 3-540-21096-2

Assessment

Certification requirements for final examinations (conditions for attestation)

An assessment consisting in an oral discussion of the course project will be done during the tutorial period in the last week of lessons. The weight of the assessment on the final grade will be equal to 1/3.

Basic principle for exams:
All the standard final exams for modules are written exams.
The repetition exams can be either written or oral.

Standard final exam for a module and written repetition exam

Kind of Exam	written
Duration of exam	120 minutes
Permissible aids	☐ no aids
	☑ permissible aids:
	☐ Electronical aids: _____
	☑ Hardcopy form: a formula summary
	☐ _____

Special case: Repetition exam as an oral exam

If an oral exam is set (only possible for ≤ 4 students), the following applies:

Kind of Exam	oral
Duration of exam	30 minutes
Permissible aids	No aids