Module Description, available in: EN

Laser and laser applications

General Information

Number of ECTS Credits

3

Module code

TSM_Laser

Valid for academic year

2026-27

Last modification

2019-10-11

Coordinator of the module

Ronald Holtz (FHNW, ronald.holtz@fhnw.ch)

Explanations regarding the language definitions for each location:

- Instruction is given in the language specified for each location and module execution.
- Documentation is available in the language(s) listed for each location and module execution. If the documentation is in multiple languages, the percentage distributed is indicated (100% = all documentation provided).
- The examination, including both questions and answers, is provided entirely (100%) in the language(s) specified for each location and module execution. The exams are on-site.

	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

Optics: Basics of wave and geometrical optics; without optics basics during bachelor studies, the EVA "Fundamentals of light" should be visited before visiting further TSM modules.
Physics: Basics for engineers (bachelor niveau)

Brief course description of module objectives and content

TSM module “Laser and Laser applications” provides a broad overview about the fascinating field of state-of-the-art Laser technology and its applications in industry, R&D, medicine and communication. The modul provides a comprehensive insight into the Laser and applications market, Laser types and devices, Beam deliveries, Laser machines, Physics of interaction between laser and material, and real industrial application examples presented by experts with industrial background. Module objective is to increase and enhance the technological competences on laser generation, control, and laser-material interaction.physical/ technological limits and competing technology.

Aims, content, methods

Learning objectives and competencies to be acquired

After successfully completing this course the student:

- knows the concepts of the most important laser types with their respective advantages and disadvantages and will be informed about future trends.
- will be skilled to decide between Laser-based technology or other manufacturing technology based on knowledge in technology, efficiency, economical, and ecological reasons
- knows industrial relevant beam guiding and delivery systems and technologies
- will be skilled to make decision on suitable laser source and beam delivery depending on application process.
- thoroughly understands important laser applications and can design the most relevant features of the systems required for them
- knows the most relevant physical effects which happen during the interaction between laser and material
- will be skilled to determine processing strategy, basic parameters and supporting technology
- knows basics methods of beam diagnostics, process monitoring, and industry 4.0 technology

Module content with weighting of different components

Laser [7 weeks]

1. Basics [2 wk]
   Repetition of basics, Resonators, Laser modes, etc.
2. Technical realization of Lasers [3 wk]
   Design concepts of significant laser sources, Pulse generation, Wavelength conversion,
3. Beam Delivery and Optics [1 wk]
   hard optics, fibers, working head concepts, beam forming, Scanners, fast and ultra-fast optics etc.
4. Laser Safety and health protection [1 wk]

Laser Applications [7 weeks]

1. Industrial Laser Applications [4 wk]Market description, Applications (Welding, Cutting, Drilling, Structuring, Hardening, Marking, Additive Manufacturing etc.), Laser – materal interaction, parameters, process properties and limits, laser machine concepts
2. Lasers in Medicine, Measuring Technology, Communication and Science [2 wk]
   Interferometry, Spectroscopy, Surgery, Ophthalmology, Displays and Communication, Microscopy
3. Beam and process diagnostics [1 wk]
   Methods of beam analytics and validations, Methods of process monitoring and control, lasers and industry 4.0

Teaching and learning methods

- Lectures and self-study
- Practical and theoretical exercises

Literature

1) William Silfvast: Laser fundamantals

2) Rainer Dohlus: Lasertechnik

3) Helmut Hügel, Thomas Graf: Laser in der Fertigung

4) Saleh, Teich: Photonics

5) Fritz Kneubühl: Laser

Assessment

Additional performance assessment during the semester

The module does not contain an additional performance assessment during the semester

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

- calculator

Other permissible aids

- personal formulary 4 A4 pages

Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

specified by the lecturers

Other permissible aids

specified by the lecturers