Module Description, available in: EN

Medical Diagnostics & Devices

General Information

Number of ECTS Credits

3

Module code

TSM_MedDD

Valid for academic year

2025-26

Last modification

2019-08-31

Coordinator of the module

Stephan Scheidegger (ZHAW, scst@zhaw.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.

	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

Engineering mathematics (algebra, calculus, numerical methods), physics, electricity of BSc engineering programs or similar (including systems and signals, Fourier transform)

Brief course description of module objectives and content

This module gives an introduction to the physical and technical principles and applications of common diagnostic modalities. Starting with an overview of clinically used modalities and their applications, technical requirements and limitations based on the fundamental principles will be discussed. Furthermore, efficient methods for biomedical signal processing and analysis are introduced.

Aims, content, methods

Learning objectives and competencies to be acquired

Upon completition of the module, the student will be able to

- gain knowledge in fundamentals of chemical, biological and physical sensors
- achieve basic knowledge in the design of sensor systems
- apply sensors and systems in medical diagnostics
- apply signal processing methods on biosignals for diagnostic purposes
- achieve basic signal processing skills to perform artifact removal, feature extraction, and classification on biological signals.
- explain fundamental principle of medical imaging modalities (XR, CT, MRI, Ultrasound)
- achieve basic knowledge of the most important clinical application of medical imaging modalities
- describe approaches and methods for image reconstruction and quality assessment

Module content with weighting of different components

Part 1 Devices & Sensors: Overview of diagnostic instrumentation and modalities:

Principles of Ultrasound and MRI

Generation of X-ray, X-ray detectors, technology and application of Fluoroscopy, CT

Image quality, radiation protection and QA for diagnostic devices

Part 2 Signal processing

Chemical, biological, and physical sensors, design requirements for sensors and devices in diagnostics, sensor application in medical diagnostics (ECG, EEG, EMG, optical pulsoxymetrie, (Blood)pressure, flow sensor, otoacoustic emission (OAE), etc.)

Measurement in medical diagnostics, amplifier, signal conversion and quantization

Standard methods for biomedical signal processing and analysis, Imaging processing

- Background on time- and frequency-domain characteristics of particular biosignals and common artifacts
- Techniques for artefact removal, event detection, feature extraction, pattern recognition, classification

Teaching and learning methods

Presentations, Excersises and Labs

Literature

Dance DR, Christofides S, Maidment ADA, McLean ID, Ng KH (Eds): Diagnostic Radiology Physics. Vienna, 2014: IAEA, ISBN 978-92-0-131010-1

Oppelt A (Ed.): Imaging Systems for Medical Diagnostics. Siemens, Publicis Corporate Publishing, Erlangen; ISBN 3-89578-226-2

John D. Enderle, Joseph D. Bronzino, Introduction to Biomedical Engineering, Academic Press

R. A. Wildhaber et al., "Signal detection and discrimination for medical devices using windowed state space filters," 2017 13th IASTED International Conference on Biomedical Engineering (BioMed), Innsbruck, Austria, 2017, pp. 125-133.

R. A. Wildhaber et al., "Windowed State-Space Filters for Signal Detection and Separation," in IEEE Transactions on Signal Processing, vol. 66, no. 14, pp. 3768-3783, 15 July15, 2018.

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

No aids permitted

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

No aids permitted