

**Module Description, available in: EN**

## ***Numerical methods for building engineering***

**General Information**

Number of ECTS Credits

3

Module code

TSM\_NumMeth

Valid for academic year

2026-27

Last modification

2022-01-11

Coordinator of the module

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**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		
<b>Instruction</b>					<b>X</b>	<b>E</b>	<b>100%</b>
<b>Documentation</b>					<b>X</b>	<b>E</b>	<b>100%</b>
<b>Examination</b>					<b>X</b>	<b>E</b>	<b>100%</b>

**Module Category**

TSM Technical scientific module

**Lessons**

2 lecture periods and 1 tutorial period per week

**Entry level competences****Prerequisites, previous knowledge**

Solid knowledge in physics, thermodynamics and mathematics.

**Brief course description of module objectives and content**

Description of numerical methods and application in building thermodynamics and heat transfer. Modelling complex heat transfer through building construction and for modelling air movement outside and inside the building. Numerical methods for fire simulations. Modeling and solving practical problems in different fields of building engineering.

## Aims, content, methods

### Learning objectives and competencies to be acquired

1. Introduce the fundamentals of numerical methods used for the solution of engineering problems.
2. Improve the competences in modeling practical engineering problems in different fields of building engineering.
3. Improve the computer skills of the students.

### Module content with weighting of different components

#### Part 1) Numerical methods in building thermodynamics and heat transfer

- Heat conduction in building elements - steady state conditions.
- Heat conduction in building elements - dynamic conditions:
  1. Analytical Solution
  2. Lumped Capacitance Method
  3. Numerical solutions (Finite Differences)
  4. Graphical solutions (Binder-Schmidt-Method)
- Models for the thermal balance of a room:
  1. Steady state model
  2. Non-steady state model
  3. Boundary conditions on external surfaces
- Introduction to OCTAVE software, application on test cases in fields of building engineering.
- Introduction to commercial building simulation software, application on test cases in fields of building engineering.

#### Part 2) Numerical methods for modelling complex heat transfer

- through building construction
- air movement outside and inside the building
- use of Ansys CFX / Ansys Fluent / OpenFOAM

#### Part 3) Numerical methods for fire simulations

### Teaching and learning methods

- 3 lecture periods per week, with integrated exercise sessions.
- Teaching: Frontal teaching and storytelling. Discussion of practical cases. Guided learning using lecture notes and textbooks.
- Exercises: Solving practical problems under the guidance of the tutors (problem solving, modeling and programming in OCTAVE, IDA-ICE, Ansys, OpenFOAM, FDS).

### Literature

- Bergman, Theodore L.; Lavine, Adrienne S.: Fundamentals of heat and mass transfer. John Wiley [2017]
- Incropera, F.P., DeWitt, D.P. , Bergman T.L., Lavine, A. S.: Incropera's Principles of Heat and Mass Transfer: Global Edition. Wiley [2017]
- Linge, S., Langtangen, H. P.: Programming for Computations – MATLAB/Octave. Springer [2015]
- Chapra, S. C.: Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill [2005]

## 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

Pocket calculator

Other permissible aids

- Lecture notes
- Personal summary
- Course textbooks

**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