Numerical methods for building engineering

General Information

Number of ECTS Credits

3

Module code

TSM_NumMeth

Valid for academic year

2024-25

Last modification

2022-01-11

Coordinator of the module

Axel Seerig (HSLU, axel.seerig@hslu.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

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

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.

Contents of module with emphasis on teaching content

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

Module does not use certification requirements

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

Aids permitted as specified below:

Permissible electronic aids

Pocket calculator

Other permissible aids

- Lecture notes
- Personal summary
- Course textbooks

Special case: Resit exam as oral exam

Kind of exam

oral

Duration of exam

30 minutes

Permissible aids

No aids permitted