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

2020-2021

Last modification

2019-10-09

Responsible of module

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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						**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

Learning objectives and acquired competencies

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:

- Numerical methods for modelling indoor and weather conditions (thermal comfort, indoor air quality, climatic conditions).
- Heat conduction in building elements - steady state conditions.
- Heat conduction in building elements - dynamic conditions:
    - Numerical solutions (Finite Differences);
    - Graphical solutions (Binder-Schmidt-Method);
    - Electrical analogy.
- Models for the thermal balance of a room:
    - Steady state model;
    - Quasi steady state model;
    - Detailed model of the thermal balance of a room;
    - Models based on the thermal response of the room;
    - Boundary conditions on external surfaces.
- Introduction to MATLAB software, application on test cases in fields of building engineering.
- Introduction to IDA-ICE software, application on test cases in fields of building engineering.

Part 2) Numerical methods for modelling complex heat transfer through building construction and for modelling air movement outside and inside the building (Ansys CFX / Ansys Fluent / OpenFOAM).

Part 3) Numerical methods for fire simulations (FDS).

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 MATLAB, IDA-ICE, Ansys, OpenFOAM, FDS).

Literature

- Chapra, S. C., Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill, 2005.

- Rao, S. S., Applied Numerical Methods for Engineers and Scientists, Prentice-Hall, 2002.

- Incropera, F.P., DeWitt, D.P. , Bergman T.L., Lavine, A. S., Incropera's Principles of Heat and Mass Transfer: Global Edition. Wiley, 2017.

Assessment

Certification requirements

Module does not use certification requirements

Basic principle for exams

As a rule, all the standard final exams for modules and also all repetition exams are to be in written form

Standard final exam for a module and written repetition 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 (Chapra, S. C., Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill, 2005 / Rao, S. S., Applied Numerical Methods for Engineers and Scientists, Prentice-Hall, 2002 / Incropera, F.P., DeWitt, D.P. , Bergman T.L., Lavine, A. S., Incropera's Principles of Heat and Mass Transfer: Global Edition. Wiley, 2017)

Special case: Repetition exam as oral exam

Kind of exam

oral

Duration of exam

30 minutes

Permissible aids

No aids permitted