**Module Description, available in: EN**

# *Thermal Hydraulic Methods for Energy Systems in Buildings*

## General Information

**Number of ECTS Credits**

3

**Module code**

TSM_HydMeth

**Valid for academic year**

2020-2021

**Last modification**

2019-10-11

**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**

Basic knowledge of thermodynamics, heat transfer and fluid dynamics.

## Brief course description of module objectives and content

The course imparts knowledge on practical design methods for thermal systems such as heating and cooling circuits, solar thermal systems and district networks. Special emphasis is placed on the conditions for safe operation. The design and integration of storage tanks and heat pumps into thermal networks is also covered. Furthermore, building physical aspects and practical rules regarding pipe routing, building integration, and maintenance are discussed as well.

## Aims, content, methods

### Learning objectives and acquired competencies

Practical design problems are best solved in a holistic approach. It is therefore advantageous to solve thermodynamic and hydraulic dimensioning problems in conjunction. This approach is expressed by the term “thermal-hydraulics”.

The students will learn how to solve thermal hydraulic engineering problems in the fields of building technology, solar thermal energy and thermal network design.

The aim of these methods is to enable the design of energetically and economically efficient as well as maintenance friendly technical components and systems, and, to prove their functionality by way of simulation.

### Contents of module with emphasis on teaching content

A short introduction into thermodynamics, fluid mechanics as well as mass and heat transfer will be given, tailored to the needs of this course. The theory of two-phase flow is taught to the degree necessary to deal with the ventability of pipe networks and the stagnation safety of solar thermal plants.

Dedicated code snippets and open source simulation tools allow the students to apply the methods to real cases.

### Teaching and learning methods

The content is taught in frontal lessons.
Numerous examples are motivated and illustrated by story-telling.

Homework exercises are solved using the provided VBA codes running under Excel.

### Literature

The script is provided in the form of ppt-presentations.

Further reading:

Massoud, M., 2005, "Engineering Thermofluids", Springer-Verlag, Berlin, Heidelberg, New York. https://doi.org/10.1007/b138870

Eismann, R., 2017, "Thermohydraulische Dimensionierung von Solaranlagen : Theorie und Praxis der kostenoptimierenden Anlagenplanung", Springer Vieweg, Wiesbaden. ISBN: 978-3-658-07124-0. https://doi.org/10.1007/978-3-658-07125-7

## 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**

Own Laptop

**Other permissible aids**

Open book (Slides, Lecture notes, Exercises)

### Special case: Repetition exam as oral exam

**Kind of exam**

oral

**Duration of exam**

30 minutes

**Permissible aids**

No aids permitted