MASTER OF SCIENCE IN ENGINEERING

Special Course (SpC) on MSE Moodle Platform

Title: Computational science and engineering applied to intelligent energy buildings

Abbrev: DMBEM

Credits	3
Responsible UAS	ZHAW
Responsible MRU	IEFE
Course responsible	Frank Tillenkamp: till@zhaw.ch, Christian Ghiaus: christian.ghiaus@insa-lyon.fr
Examination	33.3% Written 2h, w/o documents on 26/11/2021 33.3% Written report of group work due on 26/11/2021 33.3% Oral presentation of group work on 26/11/2021
Face to face period	25/10/2021 09:00 – 29/10/2021 18:00 Note: the course may be physical or distant face-to-face, depending on the sanitary requirements. In both situations, the contents and the requirements are the same.
End date (exam)	26/11/2021
Location	ZHAW, Winterthur
Course type	Face to face lectures and tutorials (25/10/2020 – 27/10/2020) 20h (22%) Accompanied exercises and mini-project (27/10/2021 – 29/10/2021) 20h (22%) Autonomous group project (02/11/2021 – 24/11/2021) 50h (56%) Total 90h (100%)
Language	English
Short Content (max. 300 chars)	Buildings are responsible for about 40 % of energy consumption and CO2 emissions. The course develops computational skills for modelling and problem solving of coupled heat transfer with special applications to optimize energy consumption for indoor climate control.
Content and Goals	**Face to face** Lecture module 1 • thermal transfer phenomena: conduction, convection and radiation Lecture module 2 • continuous and discrete models

Special Course (SpC) on MSE Moodle Platform

	• thermal networks • transforming the thermal networks into state-space and transfer functions • coupling the models Tutorial 1: Read weather data and calculate solar radiation: 1) introduction to linear algebra and tools (MATLAB, Octave); 2) use MATLAB/Octave for reading (weather) data 3) calculating the solar load Tutorial 2: Simple wall 1) physical analysis and mathematical models 2) discretization of mathematical models 3) numerical stability 4) implementation Tutorial 3: Simple building in free-running: controlled natural ventilation 1) physical analysis and mathematical models 2) discussion of examples 3) implementation Tutorial 4: Simple building controlled by an HVAC system 1) physical analysis and mathematical models 2) discussion of examples 3) implementation **Accompanied individual mini-project:** Intelligent control of a single zone building **Autonomous group project:** Students define their own subject on indoor climate control: - dynamic insulation - dynamic solar protection - control of floor-heating and fan coils - influence of set-point setback - control of intermittently heated buildings
Pre-requisites	Required (undergraduate level): linear algebra, calculus, heat transfer, thermodynamics, computer programming. Desirable (but not compulsory): dynamic systems, control engineering

Special Course (SpC) on MSE Moodle Platform

Literature	The course is self-contained: all teaching materials are provided as PDF (bibliography, supporting materials and slides for lectures and tutorials). Bibliography • G. Strang (2007) Computational Science and Engineering, Wellesley-Cambridge Press, ISBN-10 0-9614088-1-2 • J.A. Clarke (2001) Energy Simulation in Building Design, 2nd edition, Butterworth Heinemann, ISBN 0 7506 5082 6 • C. Ghiaus (2013) Causality issue in the heat balance method for calculating the design heating and cooling load, Energy, vol. 50, pp. 292-301 • MATLAB / Octave tutorials (Learn with MATLAB and Simulink Tutorials, www.mathowirks.com and/or Octave Programming Tutorial, en.wikibooks.org
Special requirements	Before the beginning of the course: - Every student needs to have access to MATLAB, and/or Octave software. Octave software is free and open source; it can be installed on Windows, macOS and Linux operating systems. - Teaching materials need to be downloaded and saved on each computer before the first lecture.