MSE | MASTER OF SCIENCE IN ENGINEERING

Special Course (SpC) on MSE Moodle Platform

Title: Dynamic models for building energy management systems

Abbrev: DM4BEM

Credits	3
Responsible UAS	ZHAW
Responsible MRU	IEFE
Course responsible	till@zhaw.ch, Christian Ghiaus: christian.ghiaus@insa-lyon.fr
Examination	33.3% Written 2h, w/o documents on 29/11/2019 33.3% Written report of group work due on 27/11/2019 33.3% Oral presentation of group work on 29/11/2019
Face to face period	28/10/2019 – 01/11/2019
End date (exam)	29/11/2019
Location	Winterthur
Course type	Face to face lectures and tutorials (28/10/2019 – 30/10/2019) 24h (27%) Accompanied exercises and mini-project (30/10/2019 – 01/11/2019) 24h (27%) Autonomous group project (04/11/2019 – 27/11/2019) 42h (46%) Total 90h (100%)
Language	English
Short Content (max. 300 chars)	The course develops skills for modelling and problem solving for coupled heat transfer with special applications to 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 thermal networks transforming the thermal networks into state-space and transfer functions coupling the models

Special Course (SpC) on MSE Moodle Platform

	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:** model-predictive controlled 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
Literature	The course is self-contained: all teaching materials are provided as PDF (bibliography, teaching materials and slides for lectures and tutorials). Bibliography - J.A. Clarke (2001) Energy Simulation in Building Design, 2nd edition, Butterworth Heinemann, ISBN 0 7506 5082 6

Special Course (SpC) on MSE Moodle Platform

	- G. Strang (2007) Computational Science and Engineering, Wellesley-Cambridge Press, ISBN-10 0-9614088-1-2 - 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. - MATLAB / Octave tutorials need to be done by each student. - Teaching materials need to be downloaded and saved on each computer.