MSE | MASTER OF SCIENCE IN ENGINEERING

Special Course (SpC) on MSE Moodle Platform

Title: Design and simulation testing of HVAC systems coupled to buildings

Abbrev: EVA_DSH

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 29/05/2020 33.3% Written report of group work due on 27/05/2020 33.3% Oral presentation of group work on 29/05/2020
Start date	27/04/2020
End date	29/05/2020
Location	Winterthur
Course type	Face to face lectures and tutorials (27/04/2020 – 28/04/2020) 16 h (18 %) Tutorial and accompanied mini-project (29/04/2020 – 30/04/2020) 16 h (18 %) Autonomous group project (04/05/2020 – 27/05/2020) 58 h (64 %) Total 90 h (100 %)
Language	English
Short Content	The course develops competences for practical optimization of HVAC systems coupled to buildings based on mathematical modelling.
Content and Goals	**Face to face** **Lectures** Module 1: Psychrometrics (numerical calculation of moist air properties, typical transformations). Thermal comfort. Module 2: Modelling of typical elements of HAVC systems Module 3: Modelling and simulation of HVAC systems coupled to buildings **Tutorials** Tutorial 1: Calculation of moist air properties and matrix formulation of models Tutorial 2: Numerical modelling of HVAC systems

Special Course (SpC) on MSE Moodle Platform

	Tutorial 3: Coupling HVAC systems and complex buildings **Accompanied individual mini-project:** Free-cooling Air mixing and heating Air-mixing, heating, humidification Heat recovery, heating, adiabatic humidification heat recovery and cooling **Autonomous group project:** The students will define their own subject on indoor climate control (temperature and humidity): a building and its HVAC system will be modelled. On this model, optimisation of design parameters and energy management will be done. Examples of projects: detached house, school, office building, green house, supermarket, research laboratory, restaurant.
Pre-requisites	**Required** (undergraduate level): linear algebra, calculus, thermodynamics, heat transfer, computer programming (MATLAB / Octave). **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** - C. Ghiaus (2014) Linear algebra solution to psychometric analysis of air-conditioning systems, Energy vol. 74, pp. 555-566 - MATLAB / Octave tutorials (Learn with MATLAB and Simulink Tutorials, www.mathowirks.com and/or Octave Programming Tutorial, en.wikibooks.org - G. Strang (2007) Computational Science and Engineering, Wellesley-Cambridge Press, ISBN-10 0-9614088-1-2 - ASHRAE Fundamentals, chapters F01 Psychrometrics, F07. Fundamentals of controls, F09 Thermal Comfort, F16 Ventilation and Infiltration, F17 and F18 Heating and Cooling Loads
Special requirements	Before the beginning of the class: - 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

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	student. - Teaching materials need to be downloaded and saved on each computer.