MSE | MASTER OF SCIENCE IN ENGINEERING

Zürcher Hochschule für Angewandte Wissenschaften
zh aw School of Engineering

Supplementary Course (EVA) at ZHAW School of Engineering

Title: Computational science and engineering for air conditioning systems

Short Code: rEVA_CE4AC

ECTS Credits	3
Profile	Energy & Environment (EnEn)
Responsible Institute /Centre	Institute of Energy Systems and Fluid Engineering (IEFE)
Responsible lecturer and contact informtion	Frank Tillenkamp: till@zhaw.ch, Christian Ghiaus: christian.ghiaus@insa-lyon.fr
Type and duration of examinations	33.3% Written exam 1h, w/o documents on 30/05/2025 33.3% Written report of group project due on 28/05/2025 33.3% Oral presentation of group project on 30/05/2025
Start date and duration	Semester: Spring Detail: 21/04/2025 09:00 – 28/04/2025 18:00
Location	Winterthur
Course type	BLOCK-COURSE Face to face lectures and tutorials 8h/day 20 h (22 %) First 2 ½ days: Face to face accompanied project 8h/day 20 h (22 %) Next 2 ½ days: Autonomous group project 50 h (56 %) 28/04/2025 – 28/05/2025 Total 90 h (100 %)
Language of instruction	English
Short description (max. 300 characters)	Air conditioning increases productivity and comfort but it is responsible for about 15 % of total energy consumption. The course develops computational skills in Python for practical optimization of air conditioning systems coupled to buildings.
Contents and Learning Objectives	**Face to face Lectures** Module 1: Psychrometrics (numerical calculation of moist air properties, typical transformations). Thermal comfort. Module 2: Modelling of typical elements of air conditioning systems Module 3: Modelling and simulation of air conditioning systems coupled to buildings **Tutorials** Tutorial 1: Calculation of moist air properties

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	Tutorial 2: Numerical modelling of air conditioning systems Tutorial 3: Coupling air conditioning systems to buildings **Accompanied individual 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 air conditioning 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.
Prerequisites	Subjects useful at undergraduate level: linear algebra, thermodynamics, heat transfer, computer programming.
Literature	The course is self-contained: all teaching materials are provided as PDF (bibliography, supporting materials and slides for lectures and tutorials in Python). **Bibliography** 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 C. Ghiaus (2014). Linear algebra solution to psychometric analysis of air-conditioning systems, Energy vol. 74, pp. 555-566 C. Ghiaus (2022) Computational psychrometric analysis as a control problem: case of cooling and dehumidification systems, International Journal of Building Performance Simulation, 15(1), pp. 21-38, https://doi.org/10.1080/19401493.2021.1995498 C. Ghiaus. (2021). PsychroAn_cool: Psychrometric analysis of cooling systems as a control problem. In Journal of Building Performance Simulation (0.0.0, Vol. 15, Number 1, pp. 21–38). Zenodo. https://doi.org/10.5281/zenodo.5236450 C. Ghiaus (2022). Computational psychrometric analysis of HVAC systems: tutorials, https://github.com/cghiaus/PsychroAn_tuto

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Special requirements	Every student needs to have a laptop during the course. Before the beginning of the course, students need to have Python (Anaconda distribution is recommended) on their laptops.			
Offer for profiles	Aviation (Avi)	☐	Business Engineering (BE)	☐
	Computer Science (CS)	☐	Data Science (DS)	☐
	Electrical Engineering (ElE)	☒	Energy & Environment (EnEn)	☒
	Mechanical Engineering (ME)	☒	Mechatronics & Automation (MA	☒
	Medical Engineering (Med)	☐	Photonics and Laser Engineering (Pho)	☐
	Information and Cyber Security (ICS)	☐	Civil Engineering (CE)	☐

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