

Syllabus

Course description

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| Course title | Building HVAC Systems |
| Course code | 45528 |
| Scientific sector | ING-IND/11 Building Physics and Building Energy Systems" |
| Degree | Master Energy Engineering |
| Semester | 2 nd |
| Year | 1 |
| Academic year | 2024/25 |
| Credits | 9 |
| Modular | no |

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| Total lecturing hours | 60+30 |
| Total lab hours | |
| Total exercise hours | |
| Attendance | Strongly recommended |
| Prerequisites | <p>All students officially enrolled in the first year of the master's Program in Energy Engineering are eligible to take this course. Exceptional cases should be discussed with the instructor.</p> <p>It is recommended that students also attend the "Applied Energetics" course.</p> <p>This course covers the engineering applications of topics studied in "Applied Energetics" and "Advanced Applications of Building Physics" (concurrent enrolment in "Advanced Applications of Building Physics" is advised). Additionally, there are connections with the "Special Issues of Building Physics" course.</p> |
| Course page | https://www.unibz.it/en/faculties/engineering/master-energy-engineering/course-offering/?academicYear=2024 |

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| Specific educational objectives | <p>This course comprises 60 hours of lectures and 30 hours of practical design applications. In the initial segment, students will focus on determining heating loads and ensuring occupant comfort to accurately size HVAC systems for buildings. Following this, they will learn to prepare a building's energy balance by technical standards. The course will then cover various types of HVAC systems, including all-water, mixed air-water, and all-air systems. The fundamentals of HVAC design will be outlined in the concluding part of the course. Additionally, students will complete a design project, such as developing an HVAC system for a building.</p> |
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| Lecturer | Prof. Prada Alessandro Prof. Benedetti Vittoria |
| Scientific sector of the lecturer | ING-IND/11 |
| Teaching language | English |
| Office hours | Tuesday 18:30 – 20:00 - Check online updates |
| Teaching assistant (if any) | |
| Office hours | |
| List of topics covered | <p>The course will cover the following topics:</p> <p>Heating Design Load Calculation:</p> <ul style="list-style-type: none"> • Heating load calculations • Natural and mechanical ventilation • User profiles and operation schedules • Occupant comfort and health <p>Energy Balance of a Building:</p> <ul style="list-style-type: none"> • Preparation of a building's energy balance • Heat losses due to transmission and ventilation • Effects of solar radiation • Heat gains • HVAC systems efficiency • Basics of energy performance evaluation and certification <p>HVAC Systems:</p> <ul style="list-style-type: none"> • Design of heating, cooling, ventilation, and air conditioning systems • Hydronics, all-air, and mixed air/water systems • Distribution networks (piping and air ducts) • Terminal units and heat recovery equipment • Equipment for heating and cooling, including boilers, unitary air conditioners, water chillers, storage tanks, and circulation pumps • Renewable energy equipment such as thermal solar panels and heat pumps • Equipment operating curves and partial load operation • Safety devices and an introduction to safety standards |
| Teaching format | <p>Class lectures will be conducted using a combination of blackboard instruction and slide presentations, supplemented by design exercises utilizing spreadsheets. All lecture materials will be made available for students to download.</p> <p>In addition to attending classes, students will be required to work in teams to prepare a report on the design, sizing, and performance evaluation of a basic HVAC system.</p> |

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| <p>Learning outcomes</p> | <p>Knowledge and Understanding: By the end of the course, students should be able to:</p> <ol style="list-style-type: none"> 1. Master key concepts related to heating and cooling loads and the overall energy performance of buildings. 2. Understand the operation and functionality of various HVAC systems. <p>Applying Knowledge and Understanding:</p> <ul style="list-style-type: none"> • Apply the learned concepts to the practical design and implementation of HVAC systems. <p>Making Judgments:</p> <ul style="list-style-type: none"> • Assess the heating and cooling loads of buildings, evaluate HVAC system performance, and analyze the energy usage of buildings. <p>Communication Skills:</p> <ul style="list-style-type: none"> • Effectively convey engineering concepts using technical drawings and reports. <p>Learning Skills:</p> <ul style="list-style-type: none"> • Self-train and stay current with evolving technical standards and market innovations. |
| <p>Assessment</p> | <p>The evaluation comprises two components:</p> <ul style="list-style-type: none"> • Group project: this involves sizing an HVAC system and calculating its energy efficiency and indoor comfort performance. • Individual oral examination: in this segment, the student will discuss his/her design choices and demonstrate his/her theoretical understanding of HVAC systems. |
| <p>Assessment language</p> | <p>English</p> |
| <p>Evaluation criteria and criteria for awarding marks</p> | <p>The coursework will be assessed as follows:</p> <ul style="list-style-type: none"> • HVAC system project work: 50% • Final oral examination: 50% <p>Completion of the project work is a prerequisite for taking the oral examination.</p> |
| <p>Required readings</p> | <ul style="list-style-type: none"> • EN ISO 12831 and other relevant EN ISO standards (especially the EN ISO 52000 family) • Notes taken during the lessons • W. T. Grondzik. "Air-Conditioning System Design Manual" 2nd ed-, ASHRAE/Butterworth, 2007 • J.W. Mitchell and J.E. Braun "Principles of Heating, Ventilation and Air Conditioning in Buildings" Wiley 2013 |
| <p>Supplementary readings</p> | <ul style="list-style-type: none"> • ASHRAE, HANDBOOK - Vol. 1-4 ed. ASHRAE 2017-2020 (or other recent editions). • G.F. Hundry, A.R. Trott, and T.C. Welch. "Refrigeration, Air Conditioning and Heat Pumps" 5th ed, Butterworth-Heinemann. 2016 • I. Beausoleil-Morrison "Fundamentals of Building Performance Simulation" Routledge. 2021 • L. Socal and B. Grassi. "Compendium of hydraulics |

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| | <p>for heating technicians". IVAR 2018</p> <ul style="list-style-type: none">• R. McDowall. "Fundamentals of HVAC systems". ASHRAE/Elsevier 2007• R. Montgomery and R. McDowall. "Fundamentals of HVAC Control Systems". ASHRAE/Elsevier 2007 |
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