Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Modelling Methods for Applied Physics
Course code	46013
Scientific sector	ING-IND/11 (09/C2)
Degree	PhD in Sustainable Energy and Technologies PhD in Advanced-Systems Engineering
Semester	2
Year	1
Academic year	2022/2023
Credits	3

Total lecturing hours	20

Specific educational objectives	Learning objective of the course: 1. mastering the most important concepts about heat and mass transfer through the building envelope and the corresponding equations 2. mastering the most important concepts about environmental comfort and indoor air quality and their quantitative expressions 3. applying these concepts to the calculation and simulation of components and buildings 4. applying numerical and analytical approaches to the design of building envelope structures. 4. understanding and using building simulation

Lecturer	Andrea Gasparella
Scientific sector of the lecturer	ING-IND/11 (09/C2)
Teaching language	English
Office hours	To be defined
List of topics covered	<u>Building Energy Balance:</u> Steady state and dynamic calculations of the heating and cooling peak load and energy needs of a building. Thermal losses through structure and fenestration, ventilation. Thermal gains, solar radiation, hourly and monthly averaged solar irradiation. Transient energy balance, detailed simulation methods, transfer functions. Heat transfer and dynamic transfer properties. <u>Psychrometrics and moisture migration:</u> Introduction to psychrometrics, basic psychrometric processes, heat and mass transfer through building structures, interstitial and surface condensation, and appropriate design practices.

	Environmental comfort: Energy balance of human body, sensible and latent heat exchanges with the environment, thermal comfort, relevant factors affecting comfort in winter and summer, evaluation indices, effective temperature. Indoor air quality and evaluation indexes. Measurement and instruments. European and international standards: Contents and application of the European and international standards about the calculation of energy use for space heating and cooling and the energy performance of buildings.
Teaching format	*Lectures (blackboard and/or slides) and spreadsheet implementation.*

Learning outcomes	**(1) Knowledge and understanding:** - Building energy balance terms - Building envelope behavior (heat and mass transfer) - Occupants' thermal comfort - Indoor air quality **(2) Applying Knowledge and understanding:** - Solving the main energy balance calculation aspects and using simulation - Calculating heat and mass transfer in building components - Assessing thermal comfort - Sizing ventilation systems **(3) Making judgments:** - Comparing different building envelope configuration and contrasting their performance - Optimizing the envelope design as for heat and mass transfer - Assessing thermal comfort and making decisions about improvement strategies - Assessing and improving indoor air quality **(4) Communication skills:** - Using the appropriate technical vocabulary related to the topic - Preparing a report representing and summarizing complex results and providing appropriate interpretation **(5) Learning skills** - Decomposing a complex problem into sub-problems, finding the analytical expression and the numerical solution - Comparing different methods and sources

	- Consulting technical standards and keeping up to date with regulation
Evaluation criteria and criteria for awarding marks	Marks are attributed according to the following assessment aspects: - Synthesis ability to explain the fundamental aspects of the problem (0= nothing, 1= insufficient; 2=sufficient; 3 = full) - Analysis ability to describe details and specific formulas/models (0= nothing, 1= insufficient; 2=sufficient; 3 = full) - Application ability to implement the principles and formulas and to solve practical cases (0= nothing, 1= insufficient; 2=sufficient; 3 = full) - Reporting ability to represent and summarize the main results and to provide an appropriate interpretation

Required readings	- Teaching material, handouts, booklets from the reserve collection
Supplementary readings	- H. Hens, 2012, Building Physics: Heat, Air and Moisture, Fundamentals and Engineering Methods with Examples and Exercises, Second Edition - Carl-Eric Hagentoft, 2001, Introduction to Building Physics, Professional Pub Service - ASHRAE, HANDBOOKS - Vol. 1-4 ed. ASHRAE 2009-2012. - (UNI) EN ISO 52016-1, 13791 and other relevant UNI EN ISO standards