COURSE DESCRIPTION CARD - SYLLABUS

Course name
Modeling and simulations in Environmental Engineering

Course

Field of study
Environmental Engineering Second-cycle Studies

Year/Semester
1/1

Area of study (specialization)
Heating, Air Conditioning and Air Protection

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	30	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:
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Prerequisites

Basic knowledge about Windows operating system.

Basics of building physics and heating systems (hygrothermal properties of buildings, operation principles of heating systems).

Basics of thermodynamics and fluid mechanics (heat and mass transfer, laminar and turbulent fluid flow).

Spatial imagination, ability to edit and create technical drawings using CAD / CAM software.

Ability to work in a team. Awareness of the constant need to update and supplement one's knowledge and skills.

Course objective

Learning about the latest methods and software used for computer modeling and simulation in the field of Environmental Engineering.

Course-related learning outcomes

Knowledge

Methodology of dynamic energy modeling of buildings and thermal systems.

Numerical modeling methodology for typical heat- and fluid flow problems considered in the field of Environmental Engineering.

Fundamentals of Integrated Design Process.

The latest computer programs used for modeling and simulation in Environmental Engineering.

Skills

Student can indicate correct modeling method for solving clearly defined technical problem (in the scope described in Programme Content).

Student can state basic assumptions and define boundary conditions necessary to build valid model for specific numerical simulation.

Student can use specific modeling/simulation software (THERM, TRNSYS, Ansys Fluent).

Social competences

Awareness of the need to constantly acquire and expand one's knowledge in order to competently pursue the career in engineering.

Awareness of responsibility associated with participation in complex engineering projects.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written test at the end of the term.The student must obtain a above 50% of the possible points.

Laboratory classes: checking and grading specific tasks performed by student during classes. The student must achieve a minimum above 50% advancement in each task.

Programme content

Lecture:

1. Building energy simulations performed during design (history of energy simulations, concept of Integrated Design Process, place of building energy efficiency analysis in the process, relationship between BIM and energy modelling).

2. Dynamic numerical simulations of heat transfer through walls.

3. Dynamic energy performance analysis of buildings - numerical modelling of heat and mass transfer

4. Dynamic energy performance analysis of buildings - boundary conditions and data for analysis

5. Passive house analysis in terms of energy performance.

6. Basics of modeling external and internal building environment using Computational Fluid Dynamics (CFD).

7. Resources and databases useful for numerical simulations - and available on the Internet / case studies

Laboratories:

Dynamic simulation of 1D partition wall.

2D analysis of thermal bridging.

Thermal dynamics of the building.

Multi-zone energy analysis of a building; energy system analysis.

Dynamic energy system analysis.

Model of fluid flow through HVAC system components (CFD).

Teaching methods

Lecture: multimedia presentation.

Laboratory classes: multimedia presentation and practical tasks performed by students (practical use of simulation software).

Bibliography

Basic

Hensen, J. L. M. & Djunaedy, E. „Jak niewidzialne uczynić widzialnym - zastosowanie symulacji budynku na przykładzie przepływów powietrza". W: Popiołek, Z. (red.), Energooszczędne kształtowanie środowiska wewnętrznego, Gliwice, Politechnika Śląska, 2005

Lain, M., Bartak, M., Drkal, F., & Hensen, J. L. M. „Wykorzystanie symulacji komputerowej do oceni niskoenergetycznych systemów chłodzenia w Czechach", w: Popiołek, Z. (red.), Energooszczędne kształtowanie środowiska wewnętrznego, Gliwice, Politechnika Śląska, 2005

Beausoleil-Morrison I., Fundamentals of Building Performance Simulation, Routledge, 2020

Building Performance Simulation for Design and Operation, red. J. L. M. Hensen, R. Lamberts, Son Press, 2011, 2019

De Wilde P., Building Performance Analysis, Wiley Blackwell, 2018

Advanced Building Simulation, red. Malkawi A. i Augenbroe G., Son Press, 2004

Additional

Górka A., Bandurski K., Szczechowiak E., „Budynki efektywne energetycznie –zintegrowane metody symulacji i projektowania", w: Innowacyjne wyzwania techniki budowlanej: 63 Konferencja Naukowa Komitetu Inżynierii Lądowej i Wodnej PAN oraz Komitetu Nauki PZITB, Krynica 2017

Komputerowa fizyka budowli: komputerowa symulacja procesów wymiany masy i energii w budynku: przykłady zastosowań, red. Gawina D., Wyd. PŁ, 1998

Hensen J. L. M., On the thermal interaction of building structure and heating and ventilation systems, Rozpraw doktorska, Eindhiven, 1991 http://www.esru.strath.ac.uk/Documents/PhD/hensen_thesis.pdf

Nagórski Z., Modelowanie przewodzenia ciepła za pomocą arkusza kalkulacyjnego : MRS Excel -> KM3R, Oficyna Wydawnicza PW, 2001 ISBN: 83-7207-226-4IBPSA-USA,

Building Energy Software Tools Directory https://www.buildingenergysoftwaretools.com/

Passive House Institute, PHPP 9 –the energy balance and Passive House planning tool", 2015 http://passivehouse.com/04_phpp/04_phpp.htm

TRNSYS 18 Documentation

Training materials provided by the developers of the software.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3
Classes requiring direct contact with the teacher	45	2
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, additional homework precribed by the teacher) [1]	30	1

[1] delete or add other activities as appropriate