POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name

Elective course III - Building performance modeling and simulation

Course

Field of study

Green energy

Area of study (specialization)

-

Level of study

Second-cycle studies

Form of study

full-time

Year/Semester

2 / 3

Profile of study

general academic

Course offered in

English

Requirements

elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	30	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

Katarzyna Ratajczak, PhD

Institute of Environmental Engineering and Building Installations

Faculty of Environmental and Energy Engineering

Katarzyna.m.ratajczak@put.poznan.pl

Tel. 61 647 58 243

Responsible for the course/lecturer:

Karol Bandurski, PhD

Institute of Environmental Engineering and Building Installations

Faculty of Environmental and Energy Engineering

Karol.bandurski@put.poznan.pl

Prerequisites

Fundamentals of architectural design, fundamentals of building physics and building construction. Knowledge of how to evaluate heat transfer phenomena in buildings and how to use computer programs such as Excel..

Course objective

Introduction to methods of thermal modeling of buildings and building elements. Introduction to simulation programs dedicated to energy analysis of buildings.

Course-related learning outcomes

Knowledge

1. Student knows different standards of ensuring energy efficiency in buildings.

2. Student knows the basics of energy balancing of buildings and tools for energy simulation of buildings and their systems.

3. Student knows the parameters of design, systems and use and climate variables that affect the energy balance of buildings and building elements.

4. Student knows software for building performance analysis of buildings and building elements.

Skills

1. Student is able to use theoretical knowledge to analyze the energy balance of a building or its element.

2. Students are able to plan a computer simulation for a simple dynamic energy analysis of a building.

3. Students are able to assess the influence of different thermal parameters of building materials on heat transfer in a building.

4. Students are able to use a spreadsheet as well as dedicated programs (e.g. TRNSYS ,Therm) for simple building performance simulations and their elements.

Social competences

1. Student is able to communicatively formulate conclusions and define problems within the energy analysis of buildings.

2. Student is able to solve tasks in a teamwork.

3. Student is able to advise when choosing a program for the building performance analysis.

4. Student understands the need and knows the consequences of describing the reality by models, he/she can critically analyze the results of their simulations described in public discussion.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture

Credit in the form of test. Closed questions of different kind. 50% of possible points are required.

Labs:

Working with simulation programs.

In each of the programs you will be asked to complete one or more tasks and compare your results with those of other students in search of errors or differences in analysis methodology.

Credit based on attendance and class work with a grade 3.0. Higher grades for those who complete and report (present a written report) their own original analysis - expert evaluation.

Programme content

Lecture:

1. 1 and 2 dimensional heat transfer modeling with examples of partitions and thermal bridges.
2. Modelling of air flows between building zones.
3. Dynamic thermal models of buildings and systems
4. Design of passive buildings using PHPP.
5. Computational fluid dynamics - CFD.

Labs:

1. 1 and 2 D thermal model in MS Excel.
2. Thermal bridge analysis in THERM program.
3. Ventilation system performance analysis in CONTAM program.
4. Dynamic thermal model of building in TRNSYS program.
5. Computational fluid dynamics in Autodex CFD program.

1. Simple dynamic thermal model of nZEB building in MS Excel.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples, discussion.
2. Lab exercises: multimedia presentation, performing energy simulations on computers - practical exercises.

Bibliography

Basic

1. Hensen, J. L. M., & Djunaedy, E. (2005). Building simulation for making the invisible visible - air flow in particular. in Z. Popiołek (Ed.), Proc. Int. Conference Energy Efficient Technologies in Indoor Environment and in Proc. IBPSA-NVL conference (pp. 312-324). Politechnika Śląska (Ener-Indoor Centre).

https://research.tue.nl/en/publications/building-simulation-for-making-the-invisible-visible-air-flow-in-

2. Lain, M., Bartak, M., Drkal, F., & Hensen, J. L. M. (2005). Use of computer simulation for the evaluation of low energy cooling in the Czech Republic]. In Z. Popiołek (Ed.), Proc. Int. Conference Energy

Efficient Technologies in Indoor Environment end in Proc. IBPSA-NVL conference (pp. 324-339). Politechnika Śląska (Ener-Indoor Centre)

https://research.tue.nl/en/publications/use-of-computer-simulation-for-the-evaluation-of-low-energy-cooli

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

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

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

Additional

Articles posted next to each topic and scholarly articles in the topic (Scoups database)

TRNSYS 18 Documentation

CONTAM Documantation

THERM Documantation

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,0
Classes requiring direct contact with the teacher	45	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam) [1]	45	1,5

[1] delete or add other activities as appropriate