FACULTY OF ARCHITECTURE

COURSE SYLLABUS

Course title in Polish: Obliczanie numeryczne efektywności energetycznej budynku
Course title in English: Modelling the energy efficiency of a building
Specialization (if applicable): Architektura
Profile (if applicable):
Level and form of studies: 1st level, full-time
Course type: elective
Course code:
Group of courses: NO

	Lecture	Tutorial	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					45
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
For group of courses mark (X) final course					
Number of ECTS points					5
including number of ECTS points for practical (P) classes					5
including number of ECTS points for direct teacher-student contact classes or other people conducting classes (BU)					5

*niepotrzebne skreślić

PREREQUISITES RELATED TO KNOWLEDGE, COMPETENCES AND SOCIAL SKILLS

Knows the basics of building physics.
Has knowledge of energy-saving construction.
Has a basic ability to use IT techniques.
Has the ability to cooperate in a group.

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COURSE OBJECTIVES

C1 Transfer of knowledge about numerical modeling of a building and preparation of energy efficiency simulations with the use of selected tools
C2 Transfer of knowledge about the design of energy-efficient buildings
C3 Transfer of sensitivity to environmental conditions of building design in the context of energy consumption

COURSE LEARNING OUTCOMES

Relating to knowledge:

A.W1. - architectural design related to completing simple tasks, in particular simple buildings that satisfy basic needs of users, single-family and multi-family residential buildings, service facilities in residential complexes, public use buildings in an open landscape or in an urban environment

B.W5 – the issues of construction, technology and building services engineering, structures and physics of buildings, including key issues in architectural, urban design and urban planning as well as problems related to fire protection of buildings

Relating to competences:

A.U7 – communicate by means of various techniques and tools in a professional environment that is appropriate for architectural and urban design

B.U3 – make use of properly selected computer simulations, analyses and information technologies that aid architectural and urban design

B.U4 - develop solutions for individual systems and elements of buildings with respect to technology, construction, and materials used;

Relating to social skills:

A.S1 - thinking independently to solve simple design problems

PROGRAMME CONTENT

Form of classes - SEMINAR		Number of hours
Se1	The presentation: 1. Overview and presentation of the course topics; examining the state of knowledge of students in the subject of classes 2. Overview of trends in the field of energy-saving construction in the world.	3
Se2	The presentation: 1. Discussion of European (Directives) and Polish (PB, Regulations) law in the field of energy saving in buildings and sustainable development. 2. Presentation of the environment for simulating the energy efficiency of buildings. 3. Installing the software.	3
Se3	The presentation: 1. Overview of a tool for simulating the energy efficiency of buildings. 2. Choosing a building to perform calculations. Building modeling: - location of the building, elements of the topography. - division into heated and cooled zones.	3
Se4	The presentation: 1. Examples of energy-efficient and innovative building envelope. 2. Introduction to thermal bridges and linear heat transfer coefficient ψ (psi). 3. Long-term heat accumulation systems. Building modeling: - building envelope	3

	- heat loss through the building envelope - protection against heat loss in the building. - heat accumulation in the building envelope - independent work - work control	
Se5	The presentation: 1. Examples of ventilation systems with heat recovery, active and passive systems, solar chimneys. Building modeling: - selection of the ventilation system in the building, analysis of variants - independent work - work control	3
Se6	The presentation: 1. Calculation of heat gains in buildings. 2. The energy of solar radiation. 3. Passive and active solar systems Building modeling: - selection of the heating system in the building, analysis of variants - independent work - work control	3
Se7	The presentation: 1. Domestic hot water installations Calculation of the demand and heat losses for domestic hot water 2. Energy recovery in domestic hot water systems Building modeling: - selection of the domestic hot water system in the building, variant analysis - independent work - work control	3
Se8	The presentation: 1. Cooling systems. Calculation of the energy demand for cooling. 2. Protection of buildings against overheating. 3. Cold storage systems Building modeling: - selection of the cooling system in the building, analysis of variants, selection of the method of energy storage - independent work - work control	3
Se9	The presentation: 1. Building energy performance. Calculation of total heating and cooling energz demand. Heat accumulation. Calculation of total monthly and annual heat losses 2. Discussion of the passive house standard PHI (Passive House Institute) and nZEB (net-zero). Building modeling: - independent work - work progress control	3

Se10	The presentation: 1. Building energy performance. Calculation of the Final Energy factor. Calculation of total monthly and annual heat losses. 2. Renewable energy sources: photovoltaic systems: classification, calculation, design, BIPV (Building Integrated Photovoltaics), PV / T (Photovoltaic Thermal) Building modeling: - renewable and non-renewable heat sources - independent work - work progress control	3
Se11	The presentation: 1. Overview of the methods of energy production. Calculation of the Primary Energy factor. 2. Renewable energy sources: air and ground source heat pumps, wind and geothermal energy, heat pumps, solar collectors Building modeling: - eqCO2 operational energy emission - independent work - work progress control	3
Se12	The presentation: 1. eqCO2 emissions. Ecological footprint of the building. Built-in energy calculation. Introduction to environmental analysis and LCA (Life Cycle Assessment) 2. The use of ecological materials in construction Building modeling: - financial costs of maintaining the building - independent work - work progress control	3
Se13	Consultations, work progress control	3
Se14	Consultations, work progress control	3
Se15	Presentation of final projects and analysis	3

TEACHING TOOLS
N1. Workshops - in the field of energy simulations using dedicated software   N2. Analytical work   N3. A multimedia presentation with elements of a problem lecture   N4. Individual and group consultations   N5. Presentation of projects

ASSESSMENT OF ACHIEVEMENT OF LEARNING OUTCOMES

Evaluation (F – forming (during semester), C –	Number of learning outcome	Method of assessing the achievement of learning outcome

concluding (at semester end)		
F1	A.W1 B.W5 B.U3	Assessment of the performed energy simulation of the building, a_1=0,7
F2	A.W1 B.W5 A.U7 B.U3 B.U4 A.S1	Assessment of the performed energy optimization of the building, a_2=0,3
C = a_1F1+ a_2F2		

BASIC AND ADDITIONAL LITERATURE

BASIC LITERATURE:

[1] Walshaw, E., *Understanding Passivhaus. A simple guide to Passivhaus detailing and design,* Wakefield 2020.

[2] Nesi, F., *Passivhaus*, Santarcangelo 2017.

[3] Bere, J., *An Introduction to Passive House*, London 2014.

[4] Lewis, S., *PHPP Illustrated: A Designer's Companion to the Passive House Planning Package*, London 2017

[5] Moskovitz, J.T., *The Greenest Home: Superinsulated and Passive House Design*, New York, 2013

[6] Brackney, L., *Building Energy Modeling with OpenStudio*, Berlin 2018

[7] https://bigladdersoftware.com/epx/docs/9-2/essentials/title.html

[8] https://energyplus.net/documentation

[9] https://support.sefaira.com/hc/en-us

[10] Mahmoud, R., Kamara, J.M., Burford, N., *An Analytical Review of Tools and Methods for Energy Performance Simulation in Building Design*, 36th CIB W78 2019 Conference, 2019, pp. 1008-1021, https://www.researchgate.net/publication/340004256_An_Analytical_Review_of_Tools_and_Methods_for_Energy_Performance_Simulation_in_Building_Design

ADDITIONAL LITERATURE:

[1] Traynor, J., *EnerPHit: A Step by Step Guide to Low Energy* Retrofit, London 2019.

[2] Cotterell, J., Dadeby, A., *The Passivhaus Handbook. A practical guide to constructing and retrofitting buildings for ultra-low energy performance*, Cambridge 2012

[3] Garg, V., *Building Energy Simulation*, London 2017

[4] Crawley, D., Lawrie, L., Winkelmann, C., Buhl, W.F., Huang, Y.J., Pedersen, O., Strand, R.K., Liesen, J., Fisher D.E., Witte, M.J., Glazer, J., *EnergyPlus: creating a new-generation building energy simulation program*, "Energy and Buildings", 2001, pp.319-331

[5] Abdullah, A., Aksamija, A., Cross., B., *Whole Building Energy Analysis: A Comparative Study of Different Simulation Tools and Applications in Architectural Design*, "ACEEE Summer Study on Energy Efiiciency in Buildings", 2014, pp. 11.1-11.12

[6] Paramita, B., Rabbani, B.A., Sari, D. C. P., Energy Optimization on Preliminary Design of The Botani Museum using Sefaira, "International Journal of Engineering and Advanced Technology (IJEAT)", 2019, pp. 2614-2618

[7] Amalia, M., Paramita, B., Minggra, R., Koerniawan, M.D., *Efficiency Energy on Office Building in South Jakarta*, "IOP Conf. Series: Earth and Environmental Science", 2020, pp.1-6, https://iopscience.iop.org/article/10.1088/1755-1315/520/1/012022/meta

[8] Oduyemi, O., Okoroh, M., *Building performance modelling for sustainable building design*, "International Journal of Sustainable Built Environment", 2015, pp. 461-469,

https://www.sciencedirect.com/science/article/pii/S2212609015300078/pdfft?md5=e57a7419d
e8b7e734f3f720275440012&pid=1-s2.0-S2212609015300078-main.pdf

[9]   Hamid, M.F.A., Ramli, N.A., Kamal, N.M.F.S.N.M., *An Analysis of Energy Performance of a
Commercial Building Using Energy Modeling,* 2017 IEEE Conference on Energy
Conversion (CENCON)*,* 2017, pp. 105-110,
https://ieeexplore.ieee.org/abstract/document/8262467

COURSE SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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