STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Sustainable Buildings**		Code **1010101141010135024**
Field of study **Sustainable Building Engineering First-cycle**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 4**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **30** Classes: **-** Laboratory: **15** Project/seminars: **15**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences**		ECTS distribution (number and %) **4 100%**

Responsible for subject / lecturer:

dr inż. Katarzyna Ratajczak
email: katarzyna.m.ratajczak@put.poznan.pl
tel. 61 647-5824
Faculty of Civil and Environmental Engineering
ul. Piotrowo 5 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	- basics of architectural design - building physics - general construction.
2	**Skills**	- skills acquired in the subjects: architectural design, building physics, - knowledge of the use of computer programs including: Excel, Word, SketchUp, - ability to evaluate the effects on the movement of heat in buildings
3	**Social competencies**	- awareness of the need to constantly update and supplement knowledge and skills. - responsibility for decisions

Assumptions and objectives of the course:

Acquiring knowledge and skills in the field of new generation buildings, environmentally friendly, energy-efficient and economically optimal, including the genesis of sustainable construction, its definitions, energy standards of buildings and certification

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. knows the energy standards of buildings and their evolution - [KSB_W10]
2. knows basic computational programs for the assessment and design of energy-efficient buildings - [KSB_W12]
3. has knowledge in the field of building development from an energetic point of view - [KSB_W18]
4. has knowledge in the field of energy and ecological analysis of a building in the lifecycle and global costs - [KSB_W21]
5. has knowledge in the field of energy assessment of buildings in Poland (energy performance of buildings), including final and primary energy balance as well as CO2 emission - [KSB_W27]
6. has knowledge in the field of environmental assessment of buildings: LEED, BREEAM - [KSB_W27]
7. has knowledge in the area of thermal comfort and air quality in buildings of high energy standard - [KSB_W28]

Skills:

1. knows how to the calculation parameters of a building in various energy standards: passive, energy-saving, nZEB - [KSB_U05]
2. knows how to determine the parameters and assess the thermal comfort of the room (determine PMV and PPD indicators) and how to determine the requirements for air quality and assess the air quality based on applicable standards and regulations, use thermography to assess the quality of the building - [KSB_U08]
3. is able to calculate details and building components (partitions, thermal bridges), is able to design a building with low energy with programs for modeling passive buildings PHPP and designPH - [KSB_U09]
4. is able calculate energy balance while creating the internal comfort in building facilities and for elements and systems used in built environment - [KSB_U14]
5. knows how to perform economic calculations of the profitability of an energy-efficient building for different energy standards - [KSB_U16]
6. knows how to calculate the energy performance of a building - [KSB_U20]
Social competencies:
1. has the ability to critically evaluate the results of his work (design and laboratory report) and is responsible for the results obtained and their interpretation - [KSB_K02, KSB_K08]
2. is aware of the nesecity of developing and expends of his knowledge in the field of constantly changing technologies in construction - [KSB_K05]
3. is able to convey information about sustainable construction in a clear and communicative way in a multimedia presentation, including communicating this knowledge to others in an understandable way - [KSB_K06, KSB_K07]

Assessment methods of study outcomes

Written exam covering the scope of issues presented during the lecture - open and closed (test) questions of multiple choice.

Project - the evaluation includes the execution of a project task in the form of a report on the simulations carried out, including the adoption of the building to higher energy standards and the energy assessment of the proposed solutions and presentation of the results in the form of the evaluated presentation.

Verified in the report is: completeness of analyzes performed, presentation of results in a clear and transparent form, clarity and completeness of applications, diligence and aesthetics of the report.

Checked in the presentation is: selection of presented variants, completeness and clarity of applications, quality of presentation, used vocabulary.

Laboratories - the assessment includes initial test (tests of initial knowledge) before each laboratory exercise, and a report on the experiments carried out.

The report should present the methodology of measurements, applied measuring devices, results and conclusions, location of applications in the aspect of sustainable construction.

The following information will be assessed in the report: completeness of information, presentation of results, completeness of applications, aesthetics and diligence.

Evaluation of lectures

Passing the exam based on the following point criterion:

Passing from 51% of obtained points

51-60% - 3.0

61-70% - 3.5

71-80% - 4.0

81-90% - 4.5

From 91% - 5.0

The possibility of adjusting thresholds in accordance with the study regulations

- continuous assessment on each class (rewarding activity).

Evaluation of projects

The rating for the project is a weighted average of the assessment for the completed report (project) - weight 60% and evaluation for the presentation - weight 40%.

Passing from 51% of obtained points

51-60% - 3.0

61-70% - 3.5

71-80% - 4.0

81-90% - 4.5

From 91% - 5.0

Laboratory assessment

The grade for the laboratories is the average of the pass ratings, increased or decreased by a maximum of 1.0 depending on the quality of the report containing reports on all experiments. If you fail to pass, you should write an improvement covering the subject of all exercises. It concerns both initial information and messages that should have been taken out of the classroom.

Passing over 55% of obtained points

56-65% - 3.0

66-75% - 3.5

76-85% - 4.0

86-95% - 4.5

From 96% - 5.0

Course description

lectures

History of sustainable construction, definitions.

Sustainable construction in Poland and in the world.

Energy standards of buildings and their evolution: NF15, NF40, passive buildings, nZEB, bioclimatic buildings

Thermal comfort and air quality in buildings with a high energy standard.

The method of achieving different building standards and methods of design calculations, including partitions and components, technical equipment and energy sources.

Methods of energy assessment of buildings, comprehensive and partial (building integrity, thermal imaging camera, assessment of thermal bridges, thermal comfort, air quality).

Energy certification of buildings in Poland (energy characteristics), including the concepts of utility, final and primary energy, fuel consumption, and carbon dioxide emissions.

Certification of green buildings used in Europe and in the world: LEED, BREEM.

Building assessment in the LCC life cycle.

Building assessment using the global cost method.

Software supporting the simulation and design of energy-efficient buildings.

projects

Analysis and simulations of the building in various energy standards using the designPH simulation and design software for passive buildings. To implement the basic building variant - meeting the requirements of technical conditions that should be met by buildings and their location, and then adaptation of the building to higher energy standards. In addition, thermal bridge analyzes based on available software will be carried out.

Laboratories

1. Introductory classes - discussion of the scope of classes, providing materials necessary to perform the exercises
2. Topic 1: assessment of the physical air quality in the room and outside - air quality measurements in the scope of comfort indicators (PMV, UTCI) and air quality parameters (concentration of carbon dioxide), discussion of results, analysis of the results in terms of standards and regulations.
3. Topic 2: Assessment of the environmental impact of heat sources - measurement of the concentration of pollutants emitted by two heat sources: a gas boiler and a biomass boiler. Comparison of the results with literature data on the pollution emitted by the combined heat and power plants.
4. Topic 3: thermal imaging camera as a device used to assess the building.

Teaching methods:

Informative and problem lecture using a multimedia presentation - used at the lecture and at the initial laboratory classes.

Project and problem method - used in design classes.

Laboratory method (experiment) and experimental method - used in laboratory classes.

Basic bibliography:

1. www.passivehouse.com, www.pibp.pl, www.cbp.put.poznan.pl
2. Paul Appleby: Integrated Sustainable Design of Buildings. Wyd. Earthscan Publ. 2010
3. Nick V. Baker: The Handbook of Sustainable Refurbishment. Wyd. Earthscan Publ. 2010
4. Lenz B. i in., Sustainable building services. Principles, Systems, Concepts, Detail Green Book, Munich 2011
5. Givoni B., Climate Considerations in Building and Urban Desig, John Wiley & Sons 1998

Additional bibliography:

1. Harvey Danny L.D.: A Handbook on Low-Energy Buildings and District-Energy Systems. Earthscan London 2007
2. Tymkow P. i inni: Building Services Design for Energy Efficient Buildings. Earthscan London and New York 2013
3. Voss K., Musall E., Net zero energy buildings. International project of carbon neutrality in buildings, Detail Green Book Munich 2013
4. Parsons K., Human Thermal Environments, CRC Press Inc. 2014
5. Humphreys M., Adaptive Thermal Comfort: Foundations and Analysis, Routledge 2015

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures (contact hours)	30
2. Participation in laboratory classes (contact hours)	15
3. Participation in design classes (contact and practical hours)	15
4. Participation in consultations related to the implementation of the education process (contact hours)	10
5. Participation in the exam (contact hours)	2
6. Preparation for the laboratory classes (independent work)	10
7. Preparation for the exam (independent work)	10
8. Preparation for thedesign classes and presentation (independent work and practical hours)	15

Student’s workload

Source of workload	hours	ECTS

Total workload	107	4
Contact hours	72	3
Practical activities	45	1