Attachment no. 5 to ZW 16/2020

Attachment no. **32** to studies program

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| **FACULTY OF ARCHITECTURE****COURSE SYLLABUS**Course title in Polish: **Nowoczesne technologie**Course title in English: **Modern Technologies**Specialization (if applicable): **Architecture and Urban Planning**Profile (if applicable): **Architecture and Urban Planning**Level and form of studies: **2nd level, full-time**Semester: **2**Course type: **obligatory**Course code: **AUA117729W**Group of courses: **NO** |

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|  | **Lecture** | **Tutorial** | **Laboratory** | **Project** | **Seminar** |
| Number of hours of organized classes in University (ZZU) | **15** |  |  |  |  |
| Number of hours of total student workload (CNPS) | **25** |  |  |  |  |
| Form of crediting | **Crediting with grade** |  |  |  |  |
| For group of courses mark (X) final course |  |  |  |  |  |
| Number of ECTS points | **1** |  |  |  |  |
| including number of ECTS points for practical (P) classes  |  |  |  |  |  |
| including number of ECTS points for direct teacher-student contact classes or other people conducting classes (BU) | **0,8** |  |  |  |  |

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| **PREREQUISITES RELATED TO KNOWLEDGE, COMPETENCES AND SOCIAL SKILLS** |
| **No prerequisites.** |

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| **COURSE OBJECTIVES** |
| **C1** familiarizing students with modern technologies related to construction, in the field of design, construction and use of buildings.**C2** having the ability to evaluate and critically evaluate the technologies being developed.**C3** having the ability to create and design the path of development of new technologies. |

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| **COURSE LEARNING OUTCOMES** |
| **Relating to knowledge:*** + 1. The graduate knows and understands structural, constructional and engineering problems associated with designing buildings.
		2. The graduate knows and understands issues related to the physics, technology and functions of buildings to the extent that ensures the comfort of their utilization and protection against atmospheric agents.

1.1.7) The graduate knows and understands methods and measures for the implementation of ecologically responsible and sustainable design and the protection and conservation of the surrounding environment.1.1.9) The graduate knows and understands principles, solutions, structures and building materials used in complex engineering tasks related to architectural and urban design.B.W1. The graduate knows and understands advanced theory of architecture and urban planning that is useful in formulating and solving complex tasks in the field of architectural and urban design and spatial planning, as well as development trends and current directions in architectural and urban design.B.W5. The graduate knows and understands advanced issues of construction, technology and building services engineering, structures and physics of buildings, including key complex issues in architectural and urban design and spatial planning.B.W7. The graduate knows and understands theoretical basis of scientific reasoning and research to the extent that is useful in performing complicated design tasks and in interpreting scientific studies in the scientific discipline of architecture and urban planning.**Relating to competences:**1.2.1) The graduate is able to use the experience acquired during studies to critically analyze the conditions and formulate conclusions for designing in a complex, interdisciplinary context.B.U1. The graduate is able to use integrate advanced knowledge in various fields of science, including history, history of architecture, history of art and protection of cultural goods, and spatial management when solving complex engineering tasks.B.U2. The graduate is able to use recognize the importance of non-technical aspects and effects of an architect’s design work, including its impact on the cultural and natural environment, and take responsibility for his or her technical decisions in the environment and for transmitting the cultural and natural heritage to the next generations.B.U4. The graduate is able to use formulate opinions in the form of a critical analysis related to architecture and present and synthetically describe the ideological basis for the design.**Relating to social skills:**1.3.4) The graduate is ready to learn all life long, among others, by enrolling in doctoral and post-graduate programs or participating in other forms of education.1.3.5) The graduate is ready to inspire others to learn and organize the educational process.B.S1. The graduate is ready to formulate information and opinions and inform the society about the achievements of architecture and urban design, their complex determinants, and other aspects of an architect’s professional work. |

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| **PROGRAMME CONTENT** |
| **Form of classes - lectures** | **Number of hours** |
| Lec 1 | Scope of the lecture, evaluation requirements, literature. Introduction. | 1 |
| Lec 2 | Modern technologies of constructing buildings:3D printing of buildings:- frame printers: Winsun, Totalkuston, Huashang Tengda, Gensler,- robotic arm printers: Apis Cor, MIT, Constructions 3D,- mobile printers: printing robots, MUPPete, extraterrestrial applications (NASA's 3D-Printed Habitat Challenge),Constructing with drones and autonomous robotic devices: FBR, Madi Home, Ero Robot, DimRob, SAM, ROB Technologies, HAL, FORTIS, TERMES. | 2 |
| Lec 3 | Modern technologies of building construction:- foldign buildings,- kinetic buildings, interactive facades,- autonomous buildings,- bionic architecture,- arcology, Earthship, passive buildings (PHI, nZEB). | 2 |
| Lec 4 | Modern technologies in the production and distribution of renewable energy sources:- air and ground heat pumps (with probes, horizontal), water and gas heat pumps,- wind and geothermal energy,- solar radiation energy, solar collectors,- photovoltaic systems: classification, calculation, design, BIPV (Building Integrated Photovoltaics), PV / T (Photovoltaic Thermal)- hydrogen cells, biomass, algae facades,- Peltier plates,- surface cooling and heating. | 2 |
| Lec 5 | Modern technologies in energy storage:- with the use of working media, specific heat, phase changes (PCM), chemical reactions,cold storage systems. | 2 |
| Lec 6 | Modern materials:- ecological materials with a low carbon footprint (carbon architecture),- metals: metallic foam, aluminum foam, magnetic fluid, thermal bi-metals,- concrete: transprant concrete, Eco-cement, catalytic concrete, fly-ash concrete, light-reactive, recycled, self-healing concrete, textile concrete,- other materials: nanogel, transparent ceramics, light-reactive polymer, inflated EFTE foil, kinetic glass, capillary glass, glass with polycarbonate inserts, carbon fibers, memory foam,- interactive materials, materials with a variable state of aggregation, - vacuum materials, airgel. | 2 |
| Lec 7 | Modern installation technologies:- examples of ventilation systems with heat recovery, active and passive systems, solar chimneys,- trigeneration- free cooling,- BMS,- heat recovery from domestic hot water,- air ground heat exchangers (with membrane, with no membrane),- technological waste heat (white certificates),- diffused ventilation with heat recovery (air supply-exhaust with heat recovery). | 2 |
| Lec 8 | Space architecture as an example of a self-sufficient and sustainable housing habitat:- short history of orbital habitats (e.g. polar bases, Apollo, MIR, Salute),- contemporary implementations, simulations, missions (e.g. ISS, Shenzhou, Tiangong, Biosphere 2, MELiSSA, Moon Palace 1, HI-SEAS, Mars 500, MDRS, Lunares),- transport (weight optimization),- use of local raw materials (ISRU, Regolith), innovative material technologies (Glass Fiber Reinfored Sulfur Concrete, Mycelium, Water Walls) and habitat construction (3D printing, magnetic assemble, myco-architecture),- construction (fixed, folded, inflated - examples), life support systems (LSS, BLSS, CELSS,), protective systems (LPS), waste management systems, anthropocentric design,- habitat location (polar, orbital, planetary). Strategies for selecting a location for various conditions. | 2 |
|  | **Total hours** | **15** |

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| **TEACHING TOOLS** |
| **N1** - Informative lecture with elements of problem lecture.**N2** - Multimedia presentations.**N3** - Case studies.**N4** - Problem discussions.**N5** - Tasks on a given topic. |

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| **ASSESSMENT OF ACHIEVEMENT OF LEARNING OUTCOMES** |
| **Evaluation** (F – forming (during semester), C – concluding (at semester end) | Number of learning outcome | Method of assessing the achievement of learning outcome |
| F1 | 1.1.1)1.1.4)1.1.7)1.1.9)B.W1.B.W5.B.W7.1.2.1)B.U1.B.U2.B.U4.1.3.4)1.3.5)B.S1. | Test |
| **C = 100%F1** |

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| **BASIC AND ADDITIONAL LITERATURE** |
| **basic LITERATURE:**1. *Odnawialne źródła energii w architekturze*, Lisik, A. (red), Gliwice 2002.
2. Chwieduk, D., Jaworski ,M., *Energetyka Odnawialna w Budownictwie. Magazynowanie Energii,* Warszawa 2018.
3. *Poradnik w zakresie poprawy*, Ministerstwo Inwestycji i Rozwoju.
4. Sowa, J., i in., *Budynki o niemal zerowym zużyciu energii,* Warszawa 2017.
5. Brownell, B., *Transmaterial. A Catalog of Materials That Redefine Our Physical Environment,* New York 2011.
6. Hauplik-Meusburger, S., Bannova, O., *Space Architekcture Educatios for Engineers and Architects,* Basel 2016.
7. Trzaska, M., *Nanomateriały w budownictwie i architekturze,* Warszawa 2019.
8. Marchwiński, J., Zielonka-Jung, K., *Współczesna architektura proekologiczna,* Warszawa 2014.

**additional LITERATURE:**1. Meusner, P., *Moon. Architectural Guide,* Berlin 2019.
2. Leach, N., *Space Architecture: The New Frontiers for Design Research,* Hoboken 2014.
3. Sherwood, B., Howe, A.S., *Out of This World: The New Field of Space Architecture,* Reston 2009.
4. Zubrin, R., Wagner, R., *Czas Marsa. Dlaczego i w jaki sposób musimy skolonizować Czerwoną Planetę?*,Warszawa 1996.
5. Meusner, P., *Galina Balashova: Architect of the Soviet Space Programme, Berlin 2015.*
6. Heppenheimer, T. A., *Podbój kosmosu. Historia programów kosmicznych*, Warszawa 1997.
7. Tytko, R., *Urządzenia i systemy energetyki odnawialnej*,Kraków 2020.
8. Foit, H., *Zastosowanie odnawialnych źródeł ciepła w ogrzewnictwie i wentylacji*,Gliwice 2013.
9. Klugmann-Radziemska, E., *Odnawialne źródła energii. Przykłady obliczeniowe,* Gdańsk 2018.
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| **COURSE SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)** |
| **dr inż. arch. Kajetan Sadowski**kajetan.sadowski@pwr.edu.pl |