**Subject description**

Faculty of Architecture, WUT 2020, **Architecture** studies

**Architecture for Society of Knowledge** speciality

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| **TECHNIQUES INTEGRATION** | **MSc level**  | **semester 3** |
| Classes:**lecture****seminar** | Hours/semester**15****15** | Student’s workload hours:**16** | Status:**obligatory**Level:**Advanced****Context: workshop** |  ECTS:**2** |
| Exam:**yes** |

# Unit delivering this subject: Katedra Projektowania Architektonicznego Pracownia Projektowania Architektonicznego Wspomaganego Komputerem

# Subject coordinator: arch. Sławomir Kowal

**Teachers:** mgr inż. arch. Agata Pasternak

**Learning outcomes and subject delivery methods**

**Objective of the course:**

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| After completing the course, students know the latest trends in architecture, urban planning and design of the subject using other scientific achievements in other fields of science, such as robotics, electronics, kinetics, computer science and others. Students learn to design on the borderline of disciplines and interfere with different methods of thinking and acting to create a multi-faceted design process. Thanks to the inclusion of seminar classes in the Ex3 design studio, students have the opportunity to apply the acquired knowledge and skills in the field of integration of techniques in the design of a specific facility. They learn to analyse and evaluate project assumptions. |

**General description of the course:**

The classes are designed to bring the participants closer to the aspects of integration of techniques in the field of architecture, urban planning and product design. The lecture includes the following thematic blocks:

Lecture 1 - Introduction to the subject of technology integration. Choosing the subject of student presentations (conference articles and examples of projects implemented using the discussed integration techniques in architecture).

Lecture 2 - Convergence or integration. Students’ presentations consultations.

Lecture 3 - Robotics as Mobility and as a Tool. Students’ presentations consultation.

Lecture 4 - Optimization - introduction. Students’ presentations part 1. Discussion.

Lecture 5 - Genetic Algorithms - theory and practice. Students’ presentations part 2. Discussion.

The seminar is intensive workshop block based on the content presented during the lectures. Seminar task combines with the Experimental Project 3, which uses the integration of architecture with robotics and digital fabrication. Students' task is to create a multi-target optimisation strategy for a selected feature of the project using the genetic algorithm. Presentation should consist of the following material: the goal of optimization and its meaning; description of the adjustment function formula; description of the genotype and range of values ​​that particular genotype can reach; specification of the factor completing the optimization process; the most essential code fragments; object optimization progress - selected intermediate states together with the adjustment function value to the chosen optimization goal.

**Learning outcomes:**

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| **No. of the outcome/ area** | **Description** |
| **Knowledge** |  |
| W\_01 | Student has detailed knowledge of the fields of study related to architectural design, in particular, electronics, robotics, mechatronics, and IT. |
| W\_02 | Student knows development trends and the most important new achievements in architecture, urban planning and related fields. |
| W\_03 | Student knows the basic methods, techniques, tools and materials used to solve complex design tasks on the verge of architecture and other fields of science. |
| **Skills** |  |
| U\_01 | Student can plan, carry out experiments, including computer simulations, optimisation procedures, interpret the obtained results and conclusions. |
| U\_02 | Student uses advanced simulation and analytical technologies to formulate and solve design tasks with a high degree of complexity. |
| U\_03 | Student can - when formulating and solving project tasks - integrate knowledge in the field of architecture design and related non-technical aspects |
| U\_04 | Student can communicate using various techniques in a professional and another environment, also in another language. |
| **Social competences** |  |
| KS\_01 | Student cooperates and works in a group, fulfilling different roles. |
| KS\_02 | Student acts and thinks creatively. |

**Learning contents:**

Lecture:

* Introduction to the terms Architectronic, Robotics, Mechatronics
* Knowledge about the integration of mechatronics, robotics, digital fabrication and optimisation techniques with the design process in architecture
* Presentation of projects and the latest scientific research from the verge of architecture and other fields of science
* Introduction to the basics of optimisation techniques in architecture and tools for solving complicated optimisation problems (in particular Genetic Algorithms) and examples of applications in architectural design, urban planning and product design.

Seminar:

* Learning to formulate complex optimisation goals and to shape the "adjustment function" in architectural projects
* Parameters controlling the optimisation process using Genetic Algorithms (recording of parameters in the form of genes, size of the population and initial population, level of mutation, techniques of gene crossing, factors terminating optimisation)
* Familiarizing with programs that enable the preparation of genetic algorithms
* Scientific integration of optimisation with the design process
* Developing methods for judging conducted experiments

**Teaching methods and forms :**

Classes are carried out in two parallel modules:

1. The course consists of five three-hour meetings, during which the aspects of robotics, digital fabrication, kinetics, simulation, optimisation and computerisation in the architectural design process are presented. Students prepare presentations in groups based on a selected conference paper on the integration of techniques and one case study. Prepared materials are presented during classes and discussed in the group forum. All lecture materials (delivered by lecturers and students) are shared on the e-learning platform.

2. The seminar exercise is integrated with the classes conducted during the Experimental Project 3 - ROBO studio and is organised in the form of workshops. Students divided into groups, work on the optimisation procedure of the project developed during ROBO studio. The task is to design and formulate an optimisation procedure using the Genetic Algorithm. The results of their work are part of the final project presentation. The effects of the work of individual groups (presentations and procedures) are shared on the e-learning platform.

**Method of testing the learning outcomes:**

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| **Outcome number** | **Way of testing** |
| **Knowledge** |  |
| W\_01 | Group presentation - part concerning a conference paper; Exam |
| W\_02 | Group presentation - part concerning the example of a completed project; Exam |
| W\_03 | Exam |
| **Skills** |  |
| U\_01 | Seminar task - correctness of the formulation of the optimisation procedure |
| U\_02 | Seminar task - impact on the final effect of the project, |
| U\_03 | Seminar task - the correctness of the choice of the optimised aspect and the adequately constructed matching function |
| U\_04 | Seminar task - the quality of the final presentation |
| **Social competences** |  |
| KS\_01 | Lecture - work in a group, evaluation of individual presentations. |
| KS\_02 | Seminar task - work in a group, assessment based on the observation of the person conducting the work during the workshop in the form of a workshop and consultation |

**Literature**

* Bentley, P. 2011. Digital Biology. How nature is transforming our technology and our lives.
* Frazer, J., 1995. An Evolutionary Architecture. London, Architectural Association Publications.
* Thompson, D’. 1961 abridged edition. {original 1917} On Growth and Form. Cambridge, Cambridge University Press.
* http://www.grasshopper3d.com/group/galapagos
* <http://ieatbugsforbreakfast.wordpress.com>