Subject description

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

Architecture for Society of Knowledge speciality

DIGITAL FABRICATION		**ASK2-KT-Df**	**MSc level**	**semester 2**
classes: **seminar** **laboratory**	hours/semester **30** **15**	Student's own workload hours: **25**	Status: **obligatory** Level:	ECTS: **3** Exam: **no**

Unit delivering this subject: Katedra Projektowania Architektonicznego
Pracownia Projektowania Architektonicznego Wspomaganego Komputerem
Subject coordinator: dr inż. arch. Krzysztof Koszewski
Teacher: mgr inż. arch. Marcin Strzała

Learning outcomes and subject delivery methods

Objective of the course:

After completing the course, students have knowledge of digital fabrication techniques and rapid prototyping. They know the basic principles of classification of digital fabrication techniques and are able to categorise techniques, materials that can be processed, basic model features, the degree of accuracy or the necessary modification of the model and the limitations of individual techniques belonging to particular categories. After passing through three lab tasks, students have the skills to create models for fabrication using specific digital fabrication techniques. Students are able to prepare the file in the right scale, level of accuracy, size and save it in the proper digital file format. They are able to adapt the form of the designed object to the capabilities of a given technology, to predict the method of production and post-processing of a given model, the amount of time needed for designing, manufacturing and final processing of models.

General description of the course:

Seminar - presentation by the teacher of basic information about the content of the subject's education. Introducing students to the latest developments in the field of digital fabrication, rapid prototyping methods, and file-to-factory process. Presentation of available CAM techniques, their specificity, technical parameters, limitations and possibilities with particular reference to the possibility of use in architectural design, furniture and product design and as a tool for educating architects. More detailed discussion of the techniques used by students during laboratory classes. As part of developing knowledge in the field of digital fabrication, students are tasked with preparing a presentation in the form of films/podcasts in groups, on one of the proposed topics. Progress in the work on the presentations is consulted with the teacher during the classes, and the final result is presented on the group forum, discussed and evaluated. The starting materials, presentations of the lecturer and student-prepared presentations are made available to all course students on the e-learning platform.

Laboratory:

Laboratory task 1: 3d printing –lecturer presentation of the technique used in the task, its possibilities and limitations, presentation of objects made using the discussed device. Discussion of the topic, presentation of inspiration. Discussing the individual steps necessary to prepare the model using the 3d printing technique (in our case FDM printers). Paying attention to the aspect of the correctness of the prepared mesh, ways to verify the correctness of the prepared model, discussion of the possible size and minimum thickness of individual elements. Preparation of a digital file containing the printed model (format: .stl).

Working time: 1 week + fabrication of the form

Laboratory task 2: CNC milling - familiarising students with the CNC milling technique using a 2.5 axial machine. Discussing the accuracy, working field of the machine and possibilities of shaping the form of the object. Paying special attention to the possibility of material collision with the machine and the machine itself (leaving a safe material thickness at the bottom of the mould). Discussing how to prepare moulds for castings and materials used for them. Presentation of the topic of laboratory task and inspiration.
Working time: 1 week + fabrication of the form

Laboratory task 3: laser cutter - presentation ways of transformation of a freely shaped 3d solid into elements possible to be fabricated using a laser cutter (or other), such as panelling, rib structure, cross-section method, folding. Discussing the special role of assembly of the components of the model - generation of connectors, latches, profiles that support components in the relevant relations. Discussing the importance of the material, time needed for its treatment and its properties. Discussion of the laboratory task and presentation of inspiration. Presentation of how to generate the correct model elements using the 3d modeller. Discussing the distribution of the components of the model on the plane, their marking and laying on the size of the material. Providing students with ready-made scripts, discussing available computer programs to help you prepare the right files to cut.
Working time: 2 weeks + fabrication and assembly of the model.

Learning outcomes:

No. of the outcome/ area	Description
Knowledge	
W_01	Student has detailed theoretical knowledge related to the issues of fabrication and production of architectural models and forms using numerically controlled machines.
W_02	Student has knowledge of recent trends in the field of architecture and digital fabrication, rapid prototyping and digital fabrication development trends.
W_03	Student presents knowledge about methods and techniques used in prototyping and production of architectural elements.
Skills	
U_01	Student can acquire information from literature, databases and other properly selected sources. Student is able to integrate the obtained information, make their interpretation and critical assessment, as well as draw conclusions and fully substantiate opinions.
U_02	Student communicates using various techniques in a professional environment and delivers collected information in the form of a podcast.
U_03	Student evaluates the usefulness and the possibilities of using new developments in digital fabrication in process of design and implementation in architectural objects.
U_04	Student develops a spatial design form, according to the given specification, and implement this project using appropriate methods, techniques and tools.
Social competences	
KS_01	Student cooperates and works in a group, fulfilling different roles.
KS_02	Student acts and thinks creatively.

Learning contents:

- Awareness of available digital fabrication technologies and their integration methods
- Knowledge of recent trends in the field of architecture and digital fabrication
- Awareness of digital fabrication techniques development trends
- Classification of digital fabrication techniques according to the material's method of treatment
- Ability to shape the concept of the prototype
- Ability of appropriate technique choice to fabricate an object
- Awareness of the principles of digital fabrication devices operation, data formats and control protocols

- Ability to prepare proper prototype fabrication documentation
- Development of methods for assessing the effects of work

Teaching methods and forms :
Classes are conducted on two corresponding planes:

1. The seminar shall present materials prepared by the instructors, factual content collected by participants, and papers comprising of the outcomes of exercises conducted in parallel. All data presented during the seminar shall expand the knowledge base on methods of prototyping and experience in this field. The database, in the form of WIKI hypertext, shall be built in a network environment.

2. The laboratory sessions shall take teams of participants through successive phases of the preparing of a spatial prototype (from defining initial conditions, through concepts for fabrication, developing documentation, learning equipment operation, and post-processing, all the way to a critical assessment of results). Each phase requires completion of laboratory exercises and description of the effect in a seminar paper.

Method of testing the learning outcomes:

Outcome Number	Way of testing
Knowledge	
W_01	Seminar - podcast final presentation, individual consultations.
W_02	Seminar - podcast final presentation, individual consultations.
W_03	Seminar - podcast final presentation, individual consultations. Laboratory - implementation of particular tasks.
Skills	
U_01	Seminar - podcast final presentation, a substantive value of the presented materials, the range of subject's presentation, quality of the collected materials, correct way to describe references to literature and presented projects.
U_02	Seminar - podcast final presentation, visual value of presentation, communication skills.
U_03	Seminar - podcast final presentation, a substantive value of the presented materials, critical assessment of collected data.
U_04	Laboratory - correctness evaluation of prepared files, functionality correctness of fabricated objects.
Social competences	
KS_01	Seminar -an assessment based on the contribution of the student to the group work.
KS_02	Laboratory - the creativity of the proposed forms and solutions.

Literature:
Basic:

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- Iwamoto, L. (2009). *Digital Fabrications: Architectural and Material Techniques (Architecture Briefs).* New York: Princeton Architectural Press.
- Kieran, S. i Timberlake, J. (2004). *Refabricating architecture: how manufacturing methods are poised to transform building construction.* New York: McGraw-Hill.
- Kolarevic, B. (Red.). (2003). *Architecture in the Digital Age: Design and. Manufacturing.* London: Spon Press – Taylor & Francis Group.
- Lefteri, C. (2007). *Making it : manufacturing techniques for product design.* London: Laurence King Publishing.

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- Seely, J. C. (2004). *Digital Fabrication in the Architectural Design Process.* Master of Science in Architecture Studies, Massachusetts Institute of Technology, Cambridge, MA.
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