COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced Design Technologies 1 [S2Arch2E>ZTP1]

Course

Field of study
Architecture

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

-student has basic knowledge of the principles of safe use of computer equipment, -student has basic knowledge of graphics programs -student is able to obtain information from literature, databases and other properly selected sources, -student is able to integrate information, interpret it, and draw conclusions and justify opinions, -student correctly identifies and resolves dilemmas related to the performance of the profession - the student has basic skills related to the use of BIM modeling tools and GIS tools. - student understands and applies in practice the principles of information modeling of cubic objects - the student has basic practical and theoretical knowledge of visual programming

Course objective

1. The purpose of the course is to provide the basis of up-to-date knowledge: theoretical and practical in the field of computer-aided design including Building Information Modeling (BIM), Geographic Information Systems (GIS) and artificial intelligence in architectural design. 2. In the course of the subject, the basics of knowledge on computer-aided design in the context of the architectural workshop are presented. During the course of the classes, specific design-graphic tasks are carried out to acquire knowledge specific to the discussed subject matter on modern computer-aided design workshop. Prelude to their performance are classes introducing the use of individual design applications

Course-related learning outcomes

Knowledge:
Knows and understands advanced numerical analysis methods, tools, CAD techniques necessary for preparing design concepts in the multi-industry digital BIM design environment.
Understands the importance of inter-industry cooperation, being aware of the information requirements of BIM methodology set at the design and construction stages in the investment process.
Knows and understands the interdisciplinary nature of architectural design using CAD software and the need to integrate knowledge from other fields, as well as its application in the design process in cooperation with specialists in these fields using BIM standards.
Knows and understands the methods of digital inventory of cultural and material heritage using modern digital inventory, modeling, archiving and analysis techniques, with particular emphasis on the HBIM methodology.
Knows and understands advanced chalenges of construction, building technologies and installations, structures and building physics as the basis for the coordination process.
Knows and understands the complex issues of interoperability and the need to exchange data at various scales using CAD and GIS software in architectural, urban and planning design using computer instruments;
Knows and understands the methods of digitizing the results of conceptual work and communicating design ideas using digital multimedia.

Skills:
Is able to assess the usefulness of advanced digital methods and tools, including those based on AI, for solving engineering tasks of varying complexity, typical for architecture, urban planning and spatial planning, and select and apply appropriate computer methods and tools in design (BIM, GIS);
Is able to think creatively and act, taking into account the complex and multi-faceted conditions of design activity in the CAD environment.
Is able to express their own artistic concepts in architectural and urban design using digital means of expression;
Is able to integrate data sets obtained from various sources and, using appropriate software, interpret and critically analyze them in detail and draw conclusions from them, as well as formulate and justify opinions and demonstrate their relationship with the design process, defining and meeting information requirements for digital building models;
Is able to select software for current design requirements and use appropriately selected advanced computer simulations, analyses and information technologies supporting architectural and urban design, as well as critically evaluate the obtained results and their usefulness in design and draw constructive conclusions;

Social competences:
Is ready to effectively use imagination, intuition, creative attitude and independent thinking to solve complex design problems using available tools using artificial intelligence, machine learning and computer analysis;
Is ready to take responsibility for shaping the natural environment and cultural landscape, including preserving the heritage of the region, country and Europe, taking into account the requirements of disciplines related to architecture through conscious and purposeful use of the analytical potential of digital methods.
Is ready for reliable self-assessment, formulating constructive criticism regarding the use of computer techniques and methods, as well as accepting criticism of the solutions presented by him, responding to criticism in a clear and objective manner, also using arguments referring to available scientific achievements and creative and constructive use of criticism.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

- Lectures:
Formative assessment:
1. Assessment of the online subtest (50% percentage of correct answers = pass). Completion of the test is mandatory.
2. Assessment of the colloquium at the end of the semester in the form of a written test to test knowledge. (50% percentage of correct answers = pass). Attendance at the credit test is mandatory.

Summative assessment:
The average of the grades obtained in the semester:
online subtest : (20%)
written final test : (80%)
Attendance at lectures does not affect the grade.
- Laboratories:
Summative evaluation:
- 10% class attendance
- 90% grade for the term paper
Method of scoring the term paper:
1. accessibility of content development - 30%
2. quality of graphic elaboration - 30%
3. exhaustiveness of the topic - 30%
4. defense of the work - 10%
Adopted grading scale: 2,0; 3,0; 3,5; 4,0; 4,5; 5,0
Grading rules: In order to pass the subject, the student actively participates in classes and the percentage of absences does not exceed the limit established by the provisions of the study regulations.

Programme content

The course focuses on advanced aspects of computer-aided design in the architect's work, with particular emphasis on Building Information Modeling (BIM) technology and artificial intelligence (AI) with elements of automation and generative methods.

Course topics

During the lectures examples of the use of modern advanced computer instruments are discussed (20% of teaching hours). Theoretical foundations of computer-aided design are also presented (20% of teaching hours). Issues related to a wide range of software applications in investment and design processes (design, coordination, construction, presentation of data and concepts) are discussed, including those related to historic buildings and cultural assets (HBIM and others) (45 teaching hours). Engineering and architectural practice is discussed in relation to the presented IT issues. Attention is also drawn to the important role played by IT techniques in the field of coordination and exchange of design data in various scales BIM, GIS (15% of teaching hours). The issues discussed are of a nature that is the basis for students' own creative explorations, in direct reference to laboratory exercises in the subject. Lectures are also a theoretical introduction to practical classes held as part of laboratory exercises. It is planned to invite external speakers in order to expand the issues presented during the lectures with elements of expert practical knowledge.
Laboratory course:
Meeting 1 - introduction to the subject matter of the class, presentation of the class schedule and the form and conditions for passing the course
Meeting 2 - Presentation of practical aspects related to open formats in BIM
Meeting 3 - Automation in architectural design
Meeting 4 - Artificial intelligence in architectural design
Meeting 5 - Presentation and discussion of term paper topics
Meetings 6 - 13 - Group work, implementation of term paper topics
Meetings 14 - 15 - Presentations of term papers, discussion.

Teaching methods

1. illustrated overview lecture - multimedial presentation.
2. performance of experiments with the use of software that is illustrated project problems after prior instruction; project method: project - practical; analysis of cases / discussion / solving problem tasks.
3. ekursy.put.poznan.pl (didactic and remote learning support system).

Bibliography

Basic:
Bernstein P., Machine Learning: Architecture in the age of Artificial Intelligence, RIBA Publishing, Londyn 2022.
Holzer, D., The Bim Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and

Construction , John Wiley & Sons Inc, Hoboken 2016
Kensek, K., Building Information Modeling, Routledge, Abington 2014
Sacks, R., Eastman, C., Lee, G., Teicholz, P., BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, 3rd Edition, John Wiley & Sons Inc, Hoboken 2008

Additional:
1. Abouelkhier, N.; Shafiq, M.T.; Rauf, A.; Alsheikh, N. Enhancing Construction Management Education through 4D BIM and VR: Insights and Recommendations. Buildings 2024, 14, 3116
2.BuildingSmart, IFC 4.3.2.0 specification, https://ifc43-docs.standards.buildingsmart.org/.
3. BuildingSmart, BIM Collaboration Format (BCF), https://technical.buildingsmart.org/standards/bcf/.
4. BuildingSmart What is Information Delivery Specification (IDS), https://www.buildingsmart.org/what-is-information-delivery-specification-ids/.
5. Carrasco C., Lombillo I., Balbás F., Aranda J., Villalta K., Building Information Modeling (BIM 6D) and Its Application to Thermal Loads Calculation in Retrofitting, Buildings 2023, 13(8), 1901
6. Deutsch R., BIM and Integrated Design. Strategies for Architectural Practice, The American Institute of Architects, Wiley and Sons Ins, Hoboken, New Jersey, 2011
7. Linbergh Van,: Intellectual Property and Open Source. A Practical Guide to Protecting Code, O'Reilly 2008
8. Milgram P. i Kishino A. F. ;Taxonomy of mixed reality visual displays, IEICE Transactions on Information Systems, Vol E77-D, No.12, December 1994
9. Siewczyński B., The urban context in digital, variable space, w: Architecture, context, resposibility, red. Bonenberg A.
10. Stallman R.M., Free Software, free Society, Free Software Foundation, Boston 2002
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Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00