| Course title | BIM Technologies and Digital Construction (ECTS 5) |
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| **Topic/module code** | Determined by the higher education institution |
| Semesters in which the course is taught | According to the curriculum |
| Assigned instructor | Assigned by the department |
| Language of instruction | Uzbek |
| Course type | Elective |
| Study hours (including independent study) | **Total hours – 150.**<br>Classroom hours – 60.<br>Lecture hours – 30.<br>Laboratory hours – not provided for in the curriculum.<br>Practical class hours – 30.<br>Independent study – 90 hours. |
| ECTS | **5** |
| Course aims and objectives / learning outcomes | **Aim of the course:**<br>To develop students' theoretical knowledge, practical skills and professional competencies in the effective use of BIM (Building Information Modeling) technologies and digital construction tools in the design, construction and operation of buildings and structures.<br>**Objectives of the course:**<br>– to teach the essence, development, advantages and areas of application of BIM technologies in construction;<br>– to explain the life cycle of a construction project and the role of the information model in it;<br>– to teach how to work with a 3D information model, parametric objects and model data;<br>– to master the principles of coordinating architectural, structural and building services (MEP) models;<br>– to develop skills in detecting, analysing and resolving clashes;<br>– to provide knowledge of 4D (time) and 5D (cost) BIM approaches;<br>– to teach the fundamentals of IFC, openBIM and the Common Data Environment (CDE);<br>– to describe the capabilities of drones, laser scanning, photogrammetry, IoT and digital monitoring tools;<br>– to develop skills in using the information model at the construction, operation and maintenance stages.<br>**Learning outcomes:**<br>1. Is able to explain the basic concepts, principles, stages of development and areas of application of BIM technologies in construction.<br>2. Is able to explain the possibilities of using the information model at the stages of a construction project's life cycle.<br>3. Is able to distinguish between the geometric and non-geometric data, parametric objects and attributes of a BIM model.<br>4. Has the skills to create an initial 3D information model of a building or structure and to assign parametric data to its elements.<br>5. Is able to use methods for combining and coordinating architectural and structural models and detecting clashes.<br>6. Is able to generate plans, elevations, sections, specifications and element schedules from the model.<br>7. Is able to apply the principles of data exchange in IFC format and of managing project files and versions in a CDE.<br>8. Is able to analyse the construction sequence on the basis of 4D BIM, and quantity and cost data on the basis of 5D BIM.<br>9. Is able to explain the functions of drones, laser scanning, IoT and monitoring technologies on a digital construction site.<br>10. Has the skills to prepare and present a BIM mini-project for a typical construction project. |
| Course content (topics) | **I. Main theoretical part (Lectures)**<br>Topic 1: Introduction to BIM technologies. The concept of BIM and its stages of development.<br>Topic 2: The life cycle of a construction project and the role of BIM technologies.<br>Topic 3: BIM methodology and the structure of the information model.<br>Topic 4: Participants, roles and collaboration in the BIM process.<br>Topic 5: BIM software and the digital working environment.<br>Topic 6: Fundamentals of parametric modelling and object properties. |

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| | Topic 7: Developing the architectural information model of a building.<br>Topic 8: Creating models of structural and building services systems.<br>Topic 9: Coordination of BIM models and clash analysis.<br>Topic 10: openBIM, the IFC format and data exchange.<br>Topic 11: The Common Data Environment (CDE) and project information management.<br>Topic 12: 4D BIM – modelling construction schedules.<br>Topic 13: 5D BIM – managing quantities and construction costs.<br>Topic 14: The digital construction site: drones, laser scanning, photogrammetry and IoT.<br>Topic 15: Use of BIM in operation, and digital twin technologies.<br>**II. Guidelines and recommendations for organizing laboratory classes.**<br>Laboratory classes are not provided for in the curriculum.<br>**III. Guidelines and recommendations for practical classes**<br>In practical classes, students use BIM software to build a model of a typical building step by step, enter parametric data into model elements, coordinate the project disciplines, and extract drawings and schedules from the model. Practical work is carried out in a computer classroom or an appropriate digital laboratory.<br>**Recommended practical topics:**<br>1. Preparing the initial brief and file structure for a BIM project.<br>2. Setting up the project environment, units of measurement, levels and grids in BIM software.<br>3. Creating the main elements of the architectural model of a building.<br>4. Working with parametric objects and element properties.<br>5. Modelling the structural elements of a building.<br>6. Adding building services (MEP) elements to the model.<br>7. Extracting plans, elevations, sections and schedules from the model.<br>8. Checking the model and identifying information inconsistencies.<br>9. Creating a federated model from the architectural and structural models.<br>10. Detecting and classifying clashes and preparing a report.<br>11. Exporting and importing the model in IFC format.<br>12. Managing files, versions and comments in a CDE.<br>13. Visualizing the sequence of construction works based on 4D BIM.<br>14. Quantity take-off of elements from the model and an introduction to 5D BIM.<br>15. Preparing and presenting the final BIM mini-project.<br>**IV. Independent study and independent work.**<br>Independent study is aimed at deepening students' knowledge of BIM technologies and developing their skills in working with digital resources, independent analysis and completing project assignments. Independent work is carried out in traditional or electronic form as recommended by the instructor.<br>**Recommended independent study topics:**<br>1. The emergence of BIM technologies and international experience.<br>2. A comparative analysis of CAD and BIM approaches.<br>3. The use of BIM in the life cycle of a construction project.<br>4. The information content of a BIM model and parametric data.<br>5. Comparing the capabilities of BIM software tools.<br>6. Participants and information exchange in a BIM project.<br>7. openBIM, IFC and cross-format data exchange.<br>8. The Common Data Environment (CDE) and project document management.<br>9. Clashes in BIM models and their prevention.<br>10. 4D BIM and the planning of construction works.<br>11. 5D BIM and construction cost management.<br>12. The application of drones and photogrammetry in construction.<br>13. Laser scanning and the digitization of existing buildings.<br>14. IoT sensors and digital monitoring of the construction site.<br>15. Final BIM mini-project and presentation for a typical building. |
| Student assessment | Assessment of students' knowledge is based on the level of mastery of the course material during the semester, practical assignments, independent study work and the results of the final assessment.<br>Assessment in the course is carried out in accordance with the current internal regulations and assessment procedures of the higher education institution. The following are taken into account in assessment:<br>– participation in lectures and mastery of theoretical knowledge;<br>– the quality of creating a BIM model, working with parameters and completing assignments in practical classes;<br>– independent study assignments, analytical work and presentations;<br>– the content, model quality, completeness of information and defence of the final BIM mini-project.<br>The final assessment evaluates the student's knowledge of BIM terms and principles, ability to explain the workflow of working with a model, analyse practical results and make independent decisions. |

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| Examination requirements | The student must have mastered the theoretical concepts of BIM technologies and digital construction and completed the practical class and independent study assignments.<br>The student must be able to explain the structure and parameters of a BIM model, know the stages of creating a model of a typical building, and demonstrate practical skills in extracting drawings and schedules from the model and coordinating models.<br>Requirements for admission to the final assessment, attendance of classroom sessions and academic debt are determined on the basis of the current internal regulations of the higher education institution. |
| Recommended literature | *1. Eastman, C., Teicholz, P., Sacks, R., Liston, K. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers. Wiley.*<br>*2. Hardin, B., McCool, D. BIM and Construction Management: Proven Tools, Methods, and Workflows. Wiley.*<br>*3. Smith, D.K., Tardif, M. Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers. Wiley.*<br>*4. ISO 19650 series of standards. Organization and digitization of information about the built environment and digital information management.*<br>*5. buildingSMART International. Official technical materials on IFC (Industry Foundation Classes) and openBIM.*<br>*6. Official training materials on Autodesk Revit and Autodesk Construction Cloud.*<br>*7. Official training materials on Graphisoft Archicad and Tekla Structures.*<br>*8. https://www.buildingsmart.org/*<br>*9. https://www.iso.org/*<br>*10. Current national construction regulations, ShNQ and QMQ.* |