General Information	
University	National University of Architecture and Construction of Armenia
Course title	**3D modeling**
Course/Module code	Geoinformation Technologies
Course type	Mandatory
Year of Study	1st Year
Term/Semester	2nd Semester
Credits awarded	5 (ECTS), 40 hours
Degree	PhD
Enrollment status	Full-Time
Prerequisites and co-requisites (if applicable):	• Engineering geodesy • Photogrammetry • GIS basics
Lecturer's details	
Name, surname	Anush Margaryan, Stepan Khachatryan
Academic title	Associate Professor
Contact details	Email: anush,.margaryan.89@mail.ru
Office hours and consultation schedule	
Course Structure	
Type (compulsory/ optional):	Compulsory
Course Goal	The aim of the course is to develop students' knowledge of 3D modeling methods, to acquire skills in working with 3D modeling technologies, to import the obtained data into a 3D software environment, to process them and to obtain 3D models. Importing the obtained data into the GIS software environment, mastering editing and analysis works. To acquire 3D data visualization and mapping skills in a given environment.
Learning Outcomes	Students will be able to. • describe methods, technologies of 3D modeling • perform photogrammetry • present methods for processing the received data, • obtain a point cloud of specified objects, 3D models, • process and archive received data using appropriate software packages • integrate various data sources, including LiDAR, DEMs, and satellite imagery, into 3D GIS models and perform spatial analyses.

	• Students will acquire skills in creating visually compelling 3D maps, interactive visualizations, and 3D scenes for communicating geospatial information effectively.
Course contents	1. Introduction: 3D modeling, the essence and features of modeling, modeling systems. 2. Air and ground surveying, unmanned aircraft sytems, scanning technologies, using in modeling. 3. The principle of measuring UAS, drones and cameras, features. Methods of data collection, input into the software environment, processing, formation and balancing of the point cloud, obtaining an orthomosaic and 3D model, export. 4. The essence of scanning systems, features and principles of measurement, areas of application. The influence of external conditions on the accuracy of laser scanning. Classification of errors in laser scanning results. 5. The operating procedure of laser scanners, the principle and process of measurement. Advantages and disadvantages of scanning. Entering scanned data into the software environment, processing, linking and exporting data into the appropriate format. 6. GIS Fundamentals Review: Recap of core GIS principles, spatial data, and coordinate systems. 7. Data Sources for 3D Modeling:LiDAR data: Acquisition, processing, and interpretation.Digital Elevation Models (DEMs) and digital terrain models (DTMs).Satellite and aerial imagery for 3D mapping. 8. 3D Data Structures:Volumetric data representation.TIN (Triangulated Irregular Network) models.Grid-based 3D data structures. 9. 3D Visualization Techniques:Creating 3D maps and scenes.Techniques for terrain visualization and modeling.3D symbology and cartographic principles. 10. GIS Software for 3D Modeling:Practical use of GIS software (e.g., ArcGIS 3D Analyst, QGIS 3D) for 3D modeling.Workflow development for 3D analysis. 11. 3D Data Integration and Analysis:Combining 3D data with traditional 2D GIS data.Spatial analysis in three dimensions.Building 3D models of urban environments and geodesy. 12. Advanced 3D Techniques:Extruding 2D features into 3D objects.3D modeling of buildings, roads, and infrastructure. 13. Applications of 3D GIS:Urban planning and design. Geodesy application. 14. Geospatial Data Visualization.Techniques for effective 3D data visualization.Creating interactive 3D web maps.Visual storytelling using 3D GIS. 15. Ethical and Legal Considerations:Privacy and security concerns in 3D data collection and visualization. 16. Intellectual property rights and data ownership.

Assessment methods and criteria	1. Assignments and Projects: • **Criteria:** Accuracy and quality of 3D models, effective use of GIS software, and problem-solving skills. • **Assessment:** Students complete assignments and projects that involve creating 3D models of geospatial data. Their work is evaluated based on the correctness and precision of the models and their ability to address spatial problems. 2. Exams and Quizzes: • **Criteria:** Knowledge of 3D modeling concepts, understanding of GIS software tools, and spatial analysis skills. • **Assessment:** Regular quizzes and exams test students on theoretical knowledge, practical skills, and their capacity to apply 3D modeling techniques in GIS. 3. Final Project and Portfolio: • **Criteria:** Application of 3D modeling skills to solve a real-world problem, presentation, and portfolio quality. • **Assessment:** The final project involves students applying their 3D modeling expertise to address a specific geospatial challenge. Their work is evaluated for its quality, problem-solving effectiveness, and inclusion in a 3D GIS portfolio.
Recommended textbooks and links (in order of relevance):	1. Комиссаров А.В. Теория и технология лазерного сканирования для пространственного моделирования территорий. – Новосибирск: «Сибирский государственный университет геосистем и технологий», 2016. - 278с. 2. Середович В.А., Комиссаров А.В., Широкова Т.А. Наземное лазерное сканирование. – Новосибирск: СГГА, 2009. – 261 с.: ISBN 978-5-87693-336-2. 3. Wilfried Linder Digital Photogrammetry, A practical course, Springer., 2009. 4. "3D Analysis and Visualization of Spatial Data" by Boris Krasnoperov and Ismael Colomina: *This book provides a comprehensive introduction to 3D spatial analysis and visualization techniques in GIS. It covers topics such as 3D modeling, terrain analysis, and 3D data visualization.* 5. "3D Geoinformation Science: The Selected Papers of the 3D GeoInfo 2014" edited by Martin Breunig and Alias Abdul-Rahman: *This edited volume includes contributions from leading experts in the field of 3D geoinformation science. It covers a wide range of topics related to 3D modeling and analysis in GIS.* 6. "Geographic Information Systems and Science" by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind:

	While this book is a comprehensive introduction to GIS in general, it includes sections on 3D GIS and spatial analysis. It's a valuable resource for understanding the broader context of 3D modeling in GIS. 7. "3D Modeling in the Spatial Sciences" by Chris Rizos and Steve Oliver: *This book focuses on 3D modeling techniques and their applications in various spatial sciences, including GIS. It covers 3D data sources, modeling methods, and visualization.* 8. "GIS and Multicriteria Decision Analysis" by Jacek Malczewski: *While primarily about decision analysis in GIS, this book discusses 3D modeling as part of the decision-making process. It's a useful resource for understanding how 3D modeling fits into spatial decision support systems.* 9. "3D Analysis and Visualization in a GIS Environment" by Keith C. Clarke: *This book delves into advanced 3D analysis and visualization techniques using GIS software. It's suitable for those looking to explore more advanced topics in 3D modeling.*