

## SYLLABUS

### 1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Civil Engineering
1.3	Department	Civil Engineering and Management
1.4	Field of study	Civil Engineering
1.5	Cycle of study	Master of Science
1.6	Program of study/Qualification	ARTIFICIAL INTELLIGENCE IN CONSTRUCTION ENGINEERING AND MANAGEMENT
1.7	Form of education	Full time
1.8	Subject code	3.00

### 2. Data about the subject

2.1	Subject name			Integration of AR, VR methods in CAD design and analysis				
2.2	Course responsible/lecturer			Sef lucrări Dr. ing. PLESA LUMINIȚA – <a href="mailto:Luminita.molnar@ccm.utcluj.ro">Luminita.molnar@ccm.utcluj.ro</a>				
2.3	Teachers in charge of seminars			Sef lucrări Dr. ing. PLESA LUMINIȚA – <a href="mailto:Luminita.molnar@ccm.utcluj.ro">Luminita.molnar@ccm.utcluj.ro</a>				
2.4	Year of study	I	2.5	Semester	1	2.6	Assessment	E
2.7		Subject category		Formative category			DS	
		category		Optionality			DI	

### 3. Estimated total time

3.1 Number of hours per week	3	of which	3.2 Course	1	3.3 Seminar		3.3 Laboratory	2	3.3 Project	
3.4 Total hours in the curriculum	42	of which	3.5 Course	14	3.6 Seminar		3.6 Laboratory	28	3.6 Project	
3.7 Individual study:										
(a) Manual, lecture material and notes, bibliography										30
(b) Supplementary study in the library, online and in the field										15
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										20
(d) Tutoring										12
(e) Exams and tests										6
(f) Other activities										
3.8 Total hours of individual study (summ (3.7(a)...3.7(f)))					83					
3.9 Total hours per semester (3.4+3.8)					125					
3.10 Number of credit points					5					

### 4. Pre-requisites (where appropriate)

4.1	Curriculum	Not applicable.
4.2	Competence	Not applicable.

### 5. Requirements (where appropriate)

5.1	For the course	- Course in electronic format.
5.2	For the applications seminar / laboratory/ project	- Work in groups of students (2-3 students), run in rotation on laboratory equipment. Individual assignments.

## 6. Specific competences

Professional competences	<p>C3.1 Assimilation of information and knowledge regarding the inspection and presentation of CAD models using VR and AR technologies.</p> <p>C3.2 The course aims to integrate VR and AR methods in CAD design and analysis. In the course, students will learn how to prepare a CAD model for VR exposure using Blender software and introduce these models into VR scenarios, where they can be studied virtually. By deepening these methods, the aesthetic quality of the designed models can be improved.</p>
Cross competences	<p>CT1 Respecting the principles, norms and values of the code of professional ethics by approaching a rigorous, efficient and responsible work strategy in solving problems and making decisions.</p> <p>CT2 The application of communication techniques and efficient work in a multidisciplinary team, on various hierarchical levels, within the work group - specific project management.</p>

## 7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	Assimilation of information and knowledge regarding the inspection and presentation of CAD models using VR and AR technologies
7.2	Specific objectives	The purpose of the discipline is to provide concrete information related to the presentation of CAD models using VR and AR technologies, using AutoCAD, Blender and the Unity platform.

## 8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
1. Introduction of the concept of inspection and presentation in VR and AR	1	- Classic thematic presentation, - Presentation using a projector, - Presentation using VR Headsets - Interactive course with student participation on pre-announced topics	
2. Presentation of the concept of an asset and libraries for them.	1		
3. Inspection of model using AR	1		
4. Inspection of model using VR	1		
5. Generating CAD models in AutoCAD Autodesk	1		
6. Transferring CAD assets to the software Blender	1		
7. Applying materials to models	1		
8. Exporting assets from software Blender	1		
9. Introduction to Unity	1		
10. Assembly of assets in a scene	1		
11. Working with Lighting and other visual effects	1		

12. Animation and Scripting	1		
13. Exporting an application for VR	1		
14. Exporting an application for AR	1		
Bibliography			
<div>1. Software AutoCAD, <a href="https://www.autodesk.com/">https://www.autodesk.com/</a></div> <div>2. Software Blender, <a href="https://www.blender.org/">https://www.blender.org/</a></div> <div>3. Unity platform, <a href="https://unity.com/">https://unity.com/</a></div> <div>4. Alc�nia Z. S., Miguel M. F., Daniel P. R., Oct�vio P. M. (2010) 3D and VR models in Civil Engineering education: Construction, rehabilitation and maintenance, Automation in Construction, Volume 19, Issue 7, Pages 819-828</div> <div>5. Yaodong S., Xi C., Zichen H., Dexi T., Lihong C., Changdong Z., Li L., Qian Z. (2018) Application of Virtual Reality Technique to Civil Engineering, Advances in Computer Science Research, volume 86</div> <div>6. A.Z. Sampaio, P.G. Henriques, C.O. Cruz, (2009) Interactive models used in civil engineering education based on virtual reality technology, HSI09, 2nd International Conference on Human System Interaction, Engineering Faculty, University of Catania, Catania, Italy, pp. 171-176</div>			
8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
1. Designing Cad model	2	Conversation, Exposure, Individual experiments Activity applications using VR Headsets (VR goggles), Working in groups, Carrying out the activity through teamwork.	
2. Uploading CAD models to an online library	2		
3. Inspection of model in AR	2		
4. Inspection of model in VR	2		
5. Preparing CAD models in AutoCAD Autodesk for export	2		
6. Transferring CAD assets to the software Blender	2		
7. Applying materials to models using Blender	2		
8. Exporting assets from Blender	2		
9. Installing the software Unity and creating the first project	2		
10. Assembly of assets in a scene	2		
11. Applying with Lighting and other visual effects	2		
12. Animation and Scripting	2		
13. Exporting an application for VR	2		
14. Exporting an application for AR	2		
Bibliography			
<div>1. Software AutoCAD, <a href="https://www.autodesk.com/">https://www.autodesk.com/</a></div> <div>2. Software Blender, <a href="https://www.blender.org/">https://www.blender.org/</a></div> <div>3. Unity platform, <a href="https://unity.com/">https://unity.com/</a></div> <div>4. Alc�nia Z. S., Miguel M. F., Daniel P. R., Oct�vio P. M. (2010) 3D and VR models in Civil Engineering education: Construction, rehabilitation and maintenance, Automation in Construction, Volume 19, Issue 7, Pages 819-828</div> <div>5. Yaodong S., Xi C., Zichen H., Dexi T., Lihong C., Changdong Z., Li L., Qian Z. (2018) Application of Virtual Reality Technique to Civil Engineering, Advances in Computer Science Research, volume 86</div> <div>6. A.Z. Sampaio, P.G. Henriques, C.O. Cruz, (2009) Interactive models used in civil engineering education based on virtual reality technology, HSI09, 2nd International Conference on</div>			

**9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field**

The content of the subject is updated and improved following repeated participation of teachers in working meetings with production specialists and employers, workshops, or exchange of best practices with colleagues from other university institutions.

The content of the subject is in line with the structure of similar courses at other universities and covers the fundamental aspects needed by civil engineers.

**10. Evaluation**

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Aggregate knowledge	Final evaluation of theoretical knowledge Grade: C (grading from 1 to 10, grid test, written test)	60%
10.5 Seminars /Laboratory/Project	Evaluation of laboratory works	Checking the correctness of laboratory works	40%
10.6 Minimum standard of performance			
<ul style="list-style-type: none"> <li>• knowledge of specific terms;</li> <li>• the acquisition of theoretical knowledge from the course;</li> <li>• participation in the coursework is a condition for entry to the examination.</li> <li>• Theory (grade T); Papers (grade L) <math>N=0,60T+0,40L</math>;</li> <li>• Credit condition: <math>T \geq 5</math>, <math>L \geq 5</math>.</li> </ul> <p>OBS: When determining the final grade, the student's involvement during the semester will also be considered.</p>			

Date of filling in:		Title Surname Name	Signature
20.06.2024	Lecturer	Sef lucrări Dr. ing. PLESA LUMINIȚA	
	Teachers in charge of application	Sef lucrări Dr. ing. PLESA LUMINIȚA	

Date of approval in the department .....

\_\_\_\_\_28.06.2024\_\_\_\_\_

Head of department

Conf. dr. ing. CLAUDIU ACIU

Date of approval in the faculty .....

\_\_\_\_\_12.07.2024\_\_\_\_\_

Dean

Prof. dr. ing. DANIELA LUCIA MANEA