SYLLABUS

Virtual Reality

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babes-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Computer Science
1.4. Field of study	Computer Science
1.5. Study cycle	Licence
1.6. Study programme/Qualification	Computer Science
1.7. Form of education	Full time

2. Information regarding the discipline

2.1. Name of the discipline	**Virtual Reality**					Discipline code	**MLE5061**
2.2. Course coordinator					Assoc. prof. Rareş Florin Boian, Ph.D.		
2.3. Seminar coordinator					Assoc. prof. Rareş Florin Boian, Ph.D.		
2.4. Year of study	3	2.5. Semester	5	2.6. Type of evaluation	C	2.7. Discipline regime	Optional

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	**5**	of which: 3.2 course	**2**	3.3 seminar/laboratory/project	**3**
3.4. Total hours in the curriculum	70	of which: 3.5 course	28	3.6 seminar/laboratory/project	**42**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					6
Additional documentation (in libraries, on electronic platforms, field documentation)					10
Preparation for seminars/labs, homework, papers, portfolios and essays					10
Tutorship					2
Evaluations					2
Other activities:					
3.7. Total individual study hours	**30**				
3.8. Total hours per semester	**100**				
3.9. Number of ECTS credits	**4**				

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	

5. Conditions (if necessary)

5.1. for the course	
5.2. for the seminar /lab activities	

6.1. Specific competencies acquired [1]

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

Professional/essential competencies	• advanced programming skills in high-level programming languages • use of software tools in an interdisciplinary context
Transversal competencies	• application of organized and efficient work rules, of responsible attitudes towards the didactic-scientific field, to bring creative value to own potential, with respect for professional ethics principles and norms • use of efficient methods and techniques to learn, inform, research and develop the abilities to bring value to knowledge, to adapt at the requirements of a dynamical society and to communicate efficiently in Romanian language and in an international language

6.2. Learning outcomes

Knowledge	• The graduate has knowledge related to programming, mathematics, engineering and technology and has the skills to use them to create complex information technology systems. • The graduate has adequate knowledge related to the use of integrated development environments for creating large complex applications.
Skills	• The graduate has the ability to observe and obtain information from various sources. • The graduate has the ability to develop, design and create new applications, systems or products using best practices of the field.
Responsibility and autonomy:	• The graduate has the necessary skills for computer program design and software systems analysis. • The graduate has the necessary skills to develop GUI applications using architectural templates suitable for specific user interaction applications.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Introducing the students to virtual reality environment programming. The students should learn the following concepts: general structure of a virtual reality application, human interaction with the virtual environment using input devices, modelling (visual, physical, tactile, and force), and character animation. In the end the students should be able to create a multi-sensory, interactive virtual reality application.
7.2 Specific objective of the discipline	• Virtual model representation • General architecture of a virtual reality application • Object position and orientation specification methods • Transform matrices • Interacting with external sensors and devices • Optimization techniques • Physical based modelling

8. Content

8.1 Course	Teaching methods	Remarks
Weeks 1 - 3 1. Introduction to virtual environments, input/output devices, state of the art 2. Scene definition 3. Ray tracing	Exposition: presentation, explanations, practical examples, demonstrations, case-study discussions	
Weeks 4 - 6 4. Virtual object modeling (geometric primitives, custom build geometries) 5. Virtual reality application architecture 6. Position and orientation representation (position vector, Euler angles, orientation matrix, 7. Unity introduction 8. Scene graph (reference frames, node hierarchy, node types, light nodes, fog)	Exposition: presentation, explanations, practical examples, demonstrations, case-study discussions	
Weeks 7 - 10 9. Unity examples 10. Unity examples 11. Scene optimizations (level of details, textures, cell-segmentation)	Exposition: presentation, explanations, practical examples, demonstrations, case-study discussions	
Weeks 11 - 14 12. Collision detection 13. Simulating spatial phenomena (fog, smoke, fire, fluids) 14. Physics engines 15. Character animation	Exposition: presentation, explanations, practical examples, demonstrations, case-study discussions	
Bibliography 1. Steven M. LaValle, Virtual Reality, Cambridge University Press, 2023 2. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley-IEEE Press, 2024 3. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, ACM Books, 2015 4. Phil Jones, Tess Osborne, Virtual Reality Methods: A Guide for Researchers in the Social Sciences and Humanities, Policy Press, 2022 5. Steve Marschner, Peter Shirley, Fundamentals of Computer Graphics, A K Peters/CRC Press, 2021 6. Paris Buttfield-Addison, Jon Manning, Tim Nugent, Unity Game Development Cookbook: Essentials for Every Game, O'Reilly Media, 2019		
8.2 Seminar / laboratory	Teaching methods	Remarks
1-3. Ray tracing and geometrical concepts	Explanation, examples, dialog, case-studies	
4-6. Semester project	Explanation, examples, dialog, case-studies	
7. Project grading	Discussion	
Bibliography 1. Unity 6.2 User Manual, https://docs.unity3d.com/6000.2/Documentation/Manual/UnityManual.html		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- By learning the theoretical and methodological concepts and addressing the practical aspects of the Virtual Reality course, students acquire a body of knowledge consistent, consistent with partial competencies required for possible occupations provided in Grid 1 - RNCIS
- The course complies with IEEE and ACM Curriculla Recommendations for Computer Science studies.
- The course curriculum exists in universities and faculties in Romania
- The course content is very well appreciated by software companies whose employees and graduates of this course

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	The level of knowledge and understanding of the course subjects	Project evaluation	40%
	Problem solving		
10.5 Seminar/laboratory	Ability to solve practical problems, specific to the course subjects, on the computer in a given amount of time	Semester project evaluation	50%
	Lab activity		
10.6 Minimum standard of performance			
• Minimum 5 in the final grade			

11. Labels ODD (Sustainable Development Goals)[2]

Not applicable.

Date:
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Signature of course coordinator

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Signature of seminar coordinator

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Date of approval:
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Signature of the head of department

Assoc.prof.phd. Adrian STERCA

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable*.".