Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Departament	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time
1.8 Codul disciplinei	56.40

2. Data about the subject

2.1 Subject name	*Digital Graphics*				
2.2 Course responsible/lecturer	Lecturer Eng. Iulia Adina ŞTEFAN, PhD				
2.3 Teachers in charge of applications	Lecturer Eng. Iulia Adina ŞTEFAN, PhD				
2.4 Year of study	4	2.5 Semester	2	2.6 Assessment *(E/C/V)*	C
2.7 Type of subject	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DS
	DI – compulsory, DO – elective, Dfac – optional				DO

3. Estimated total time

3.1 Number of hours per week	3	of which:	Course	2	Seminar		Laboratory		Project	1
3.2 Number of hours per semester	125	of which:	course	28	Seminar		Laboratory		Project	14

3.3 Individual study	
(a) Manual, lecture material and notes, bibliography	30
(b) Supplementary study in the library, online and in the field	20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	30
(d) Tutoring	1
(e) Exams and tests	1
(f) Other activities:	1

3.4 Total hours of individual study (sum of (3.3(a)…3.3(f)))	83
3.5 Total hours per semester (3.2+3.4)	208
3.6 Number of credit points	5.0

4. Pre-requisites (where appropriate)

4.1 Curriculum	Algebra, Calculus, CAD in automation OOP knowledge in a high-level programming language as C++, C#, java or similar
4.2 Competence	C1.1 Using the concepts, theories and methods of the fundamental sciences in systems engineering for professional communication

5. Requirements (where appropriate)

5.1. For the course	A minimum 60 sits room, PC and video projector, whiteboard/blackboard/smart board, flipchart, markers, a room to comply the regulation related to the pandemic restrictions, if needed
5.2. For the applications	A minimum 20 sits lab room, 17 PC's, video projector, whiteboard/blackboard/smart board, flipchart, markers, a room to comply the regulation related to the pandemic restrictions, if needed

6. Specific competences

6.1 Professional competences	**C1** Operating with basic concepts of mathematics, physics, measurement science, mechanical, chemical, electrical engineering in systems engineering field.

	C2 Operating with basic concepts of computer science, information technology and communication
	C3 Operating with fundamentals of control engineering, process modelling, simulation, identification and analysis methods, and computer aided design.
	C4 Design, implementation, testing, operation and maintenance of systems with generic and dedicated equipment, including computer networks for control engineering and applied informatics
6.2 Cross competences	**CT2** Identifying the roles and the responsibilities in a multicompetent team, taking decisions and delegating tasks by applying professional networking techniques and effective teamwork techniques. D1: Project management D2: Practical placement D3: Sport D4: Foreign languages D5: Research and development activity

7. Course objectives

7.1 General objective	The specific concepts, theory and scientific fundamentals methods usage in digital graphics, defined in the technological context of a continuous development of the virtual or/and online environments, both, the human and applications participants
7.2 Specific objectives	At the end of the lecture, the students are able to recognize, identify and apply: - specific parameters, functions, libraries, and frameworks for OpenGL applications development: OpneGL, WebGL, VR&AR - fundamental algorithms for digital processing - real time rendering, - animations - IoT based solutions identification using graphical processing and libraries.

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Introduction toward the applications domains	2	Interactive lectures, brainstorming, discovery learning, cooperative learning, reasoning, learning in pairs, debates, video / or online on Teams platform	Depending on general health context, the lectures will take place online, on Teams platform.
Intro: OpenGL ES , Vulkan, OpenGL, WebGL. OpenGL pipeline, GLSL Language, Shader programs usage	2		
Polygons – Clipping. Surfaces	2		
Textures and texturing: definitions, specific parameters and functions. Multiple texturing. Procedural Textures. Filters. Teoretical aspects: 2D (linear) transformations. 3D (cubical) transformations. Coordinate Systems	2		
Light sources/Shadowing	2		
3D&Virtual Reality concepts: intro. Equipment's.	2		
3D: scene manipulation. Coordination systems. The usage of integrated resources: Prefabs, GameObjects, Colliders, etc.	2		
Predefined components usage to set-up and implementing the Player movements	2		
VR Project Set-up. Configurarea unui proiect VR. Grabbables. Sockets. Interactors and Interactables	2		
AR: intro. Equipment	2		
Development resources and platforms. AR basic example for Unity	4		
Graphical components in web pages (XML, SVG, Flash, WebGL)	2		
Bibliography 1. Casey Hardman, Game Programming with Unity and C#, Apress, 2020			

2. Unity Manual, https://docs.unity3d.com/Manual/index.html, last visited: June 2024
3. Unity VR Documentation, https://learn.unity.com/course/create-with-vr, last visited: June 2024
4. Bert Convy, Metaverse for Beginners, 2020, Printed in Great Britain by Amazon
5. Unity, AR development in Unity, https://docs.unity3d.com/Manual/AROverview.html, last visited: June 2024
6. Mark Segal, Kurt Akeley,The OpenGL R Graphics System: A Specification ,Version 4.6 ,Core Profile, May 14, 2018
7. Farhad Ghayour and Diego Cantor, Real-Time 3D Graphics with WebGl2, Packt Publishing, 2018
8. Hussain Frahaan, Learn OpenGL, Packt Publishing, 2018
9. David Wolff, OpenGL 4 Shading Language cookbook, third Edition, Pack Publising, 2018
10. Graham Sellers, Richard S. Wright, Nicholas Haemel, OpenGL SuperBible Seventh Edition Comprehensive Tutorial and Reference, Ed. Addison-Wesley, 2016, ISBN-13: 978-0672337475
11. D. Salomon, The Computer Graphics Manual, Springer, 2011, ISBN 9780857298850
12. Samuel R. Buss, 3D Computer Graphics A Mathematical Introduction with OpenGL, ISBN: 9780521821032, 2003
13. Erin Pangilinan &all, Creating Augumented and Virtusal Realities, O'Reilly, 2019
14. P. Shirley, S. Marschner, Fundamentals of Computer Graphics 3rd ed., 2009
15. Tomas Akenine-Moller Eric Haines, Naty Hoffman, Real-Time Rendering, Third Edition, ISBN-13: 978-1568814247, 2008,
16. Peter Shirley Michael Ashikhmin, Steve Marschner ,Fundamentals of Computer Graphics, 2009, ISBN-13: 978-1568814698
17. Alan Watt, 3D Computer Graphics (3rd Edition), ISBN-13: 978-0201398557, 1999,
18. https://www.khronos.org/registry/webgl/specs/latest/2.0/
19. http://www.w3.org/TR/2011/REC-SVG11-20110816/
20. WebGL Docs, https://registry.khronos.org/webgl/specs/latest/2.0/, last visited June 2024
21. ThreeJS Docs, https://threejs.org/docs/, last visited June 2024

8.2 Aplications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Teams definitions. Projects/homework presentations **for education**: functional requirements, architecture definition	1	Interactive lecture, brainstorming, discovery learning, cooperative learning, argumentation, pair learning, debate, video exemplification	In case of force majeure, the application classes will be held online on the Teams platform
Assets definition (e.g.: Blender or other framework or game engine)	2		
Functional requirements implementation (using Unity, Visual studio or other)	4		
Equipment and VR&AR usage. Unity. VR Basic example Unity. AR Basic example	4		
Functional Testing. Homework/Project evaluation	1		
Graphical components in web pages (XML, SVG, Flash, WebGL, Three.js)	1		
Motion sensors and the graphical transposition of motion based on the information taken from the sensors. Introducing an IoT basic application	1		

Bibliography
1. Casey Hardman, Game Programming with Unity and C#, Apress, 2020
2. Unity Manual, https://docs.unity3d.com/Manual/index.html, last visited: June 2024
3. Unity VR Documentation, https://learn.unity.com/course/create-with-vr, last visited: June 2024
4. Mark Segal, Kurt Akeley,The OpenGL R Graphics System: A Specification ,Version 4.6 ,Core Profile, May 14, 2018,
5. Hussain Frahaan, Learn OpenGL, Packt Publishing, 2018
6. David Wolff, OpenGL 4 Shading Language cookbook, third Edition, Pack Publishing, 2018
7. Graham Sellers, Richard S. Wright, Nicholas Haemel, OpenGL SuperBible Seventh Edition Comprehensive Tutorial and Reference, Ed. Addison-Wesley, 2016, ISBN-13: 978-0672337475
8. Dave Shreiner, Graham Sellers , John M. Kessenich, Bill M. Licea-Kane, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3 (8th Edition) , 2013
9. WebGL Docs, https://registry.khronos.org/webgl/specs/latest/2.0/, last update August 2022
10. ThreeJS Docs, https://threejs.org/docs/, u last visited: June 2024

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

The graduated attendees should be able to generate a representative animation for the functionality of a designed small scale application, similar to desktop games or web based graphics, using dedicated libraries and tools.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Assessment of knowledge through a test based on the knowledge gained following participation in the course	Written exam / online exam using Teams	40%
Seminar	-	-	-
Laboratory	-	-	-
Project	Examination of the skills and knowledge acquired through the participation in the laboratory. Projects or homeworks presentation	Practical presentation or online presentation using Teams	60%
Minimum standard of performance: Written exam rank >= 5 and practical presentation rank >= 5. The projects will be delivered with the completed code and a video presentation that will be publically displayed on the teacher's webpage, with anonymous authoring or not, by choise.			

Date of filling in: 15.06.2024		Title Firstname NAME	Signature
	Course	Lecturer Eng. Iulia Adina ȘTEFAN, PhD	
	Applications	Lecturer Eng. Iulia Adina ȘTEFAN, PhD	

Date of approval by the Department Board Automation	Head of Departament Prof.dr.ing. Honoriu VĂLEAN
_____	
Date of approval by the Faculty Council Automation and Computer Science	Dean Prof.dr.ing. Mihaela Dînsoreanu
_____	