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			Eng. Nicolae Viorel COSTEA		
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.
Virtual reality and equipment. Designated platforms for AR and VR application development. Presentation of rResources and requirements for the projects	3		
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	6		
Light sources/Shadowing	3		
VR concepts. Frameworks, examples, and other resources.	6		
Graphical components in web pages (XML, SVG, Flash, WebGL)	4		

Bibliography
1. Mark Segal, Kurt Akeley,The OpenGL R Graphics System: A Specification ,Version 4.6 ,Core Profile, May 14, 2018
2. Farhad Ghayour and Diego Cantor, Real-Time 3D Graphics with WebGl2, Packt Publishing, 2018
3. Hussain Frahaan, Learn OpenGL, Packt Publishing, 2018
4. David Wolff, OpenGL 4 Shading Language cookbook, third Edition, Pack Publising, 2018
5. Graham Sellers, Richard S. Wright, Nicholas Haemel, OpenGL SuperBible Seventh Edition Comprehensive Tutorial and Reference, Ed. Addison-Wesley, 2016, ISBN-13: 978-0672337475

6. D. Salomon, The Computer Graphics Manual, Springer, 2011, ISBN 9780857298850
7. Samuel R. Buss, 3D Computer Graphics A Mathematical Introduction with OpenGL, ISBN: 9780521821032, 2003
8. Erin Pangilinan &all, Creating Augumented and Virtusal Realities, O'Reilly, 2019
9. P. Shirley, S. Marschner, Fundamentals of Computer Graphics 3rd ed., 2009
10. Tomas Akenine-Moller Eric Haines, Naty Hoffman, Real-Time Rendering, Third Edition, ISBN-13: 978-1568814247, 2008,
11. Peter Shirley Michael Ashikhmin, Steve Marschner ,Fundamentals of Computer Graphics, 2009, ISBN-13: 978-1568814698
12. Alan Watt, 3D Computer Graphics (3rd Edition), ISBN-13: 978-0201398557, 1999,
13. https://www.khronos.org/registry/webgl/specs/latest/2.0/
14. http://www.w3.org/TR/2011/REC-SVG11-20110816/
15. WebGL Docs, https://registry.khronos.org/webgl/specs/latest/2.0/, ultima actualizare 6 august 2022
16. ThreeJS Docs, https://threejs.org/docs/, ultima accesare: septembrie 2022
17. Unity Manual, https://docs.unity3d.com/Manual/index.html, ultima accesare: septembrie 2022
18. Unity VR Documentation, https://learn.unity.com/course/create-with-vr, ultima actualizare 16 iunie 2022.

8.2 Aplications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Equipment and VR&AR usage. Ar Example	1	Case study, directed learning , learning through discovery, learning directed , learning in teams.	Depending on general health context, the lectures will take place online, on Teams platform.
Motion sensors and the graphical transposition of motion based on the information taken from the sensors. Introducing an IoT basic application	1		
Unity. Basic example VR	1		
Teams definitions. Projects/homework presentations: functional requirements, architecture definition	1		
Assets definition (e.g.: Blender or other framework or game engine)	2		
Functional requirements implementation (using Unity, Visual studio or other)	4		
Functional Testing. Homework/Project evaluation	1		
Graphical components in web pages (XML, SVG, Flash, WebGL, Three.js)	2		

Bibliography
1. Mark Segal, Kurt Akeley,The OpenGL R Graphics System: A Specification ,Version 4.6 ,Core Profile, May 14, 2018,
2. Hussain Frahaan, Learn OpenGL, Packt Publishing, 2018
3. David Wolff, OpenGL 4 Shading Language cookbook, third Edition, Pack Publishing, 2018
4. Graham Sellers, Richard S. Wright, Nicholas Haemel, OpenGL SuperBible Seventh Edition Comprehensive Tutorial and Reference, Ed. Addison-Wesley, 2016, ISBN-13: 978-0672337475
5. 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
6. WebGL Docs, https://registry.khronos.org/webgl/specs/latest/2.0/, ultima actualizare 6 august 2022
7. ThreeJS Docs, https://threejs.org/docs/, ultima accesare: septembrie 2022
8. Unity Manual, https://docs.unity3d.com/Manual/index.html, ultima accesare: septembrie 2022
9. Unity VR Documentation, https://learn.unity.com/course/create-with-vr, ultima actualizare 16 iunie 2022.

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	30%
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	70%
Minimum standard of performance: Written exam rank >= 5 and practical presentation rank >= 5			

Date of filling in: 15.03.2023		Title Firstname NAME	Signature
	Course	Lecturer Eng. Iulia Adina ȘTEFAN, PhD	
	Applications	Eng. Nicolae Viorel COSTEA	

Date of approval by the Department Board ……..   Head of Departament …….
                                                        Prof.dr.ing. Honoriu VĂLEAN

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Date of approval by the Faculty Council ……………   Dean
                                                        Prof.dr.ing. Liviu Cristian MICLEA

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