Valid for academic year: 2019-2020

COURSE DESCRIPTION

1. Program details

University	"Lucian Blaga" University of Sibiu
Faculty	Engineering Faculty
Department	Department of Computer Science and Electrical and Electronics Engineering
Main field of study	Computer Engineering and Information Technology
Level of education	Research Master
Specialization	Advanced Computing Systems

2. Course details

Course title	Advanced Computer Graphics			
Course code	Type of course	Year of study	Semester	Number of credits
mACS.203.SO	compulsory	1	2	3
Evaluation type	Type of course (FD=fundamental discipline.; DD=domain discipline; SD=specialized discipline; CD=complementary discipline)			
Exam	SD			
Course instructor	Associate Professor eng. Rodica Baciu PhD			
Seminar/lab/project instructor	Associate Professor eng. Rodica Baciu PhD			

3. Estimated time

Course duration in the curriculum – number of hours per week				
Lecture	Seminar	Lab	Project	Total
1		1		**2**
Course duration in the curriculum - Total of hours curriculum				
Lecture	Seminar	Lab	Project	Total ($NOAD_{sem}$)
14		14		**28**

Distribution of hours for individual study	No. hours
Individual study using course handbooks, bibliography and notes	10
Additional documentation in library and on specialized electronic platforms	4
Preparing seminars / labs, homework, essays and portfolios	10
Tutoring	2
Exam preparation	2
Total hours for individual study ($NOSI_{sem}$)	28
Total hours per semester ($NOAD_{sem} + NOSI_{sem}$)	**56**

4. Prerequisites (if applicable)

curriculum	Programming Languages, Linear Algebra, Analytical and Differential Geometry, Physics, Data Structures, Algorithms Analysis and Design, Computer Assisted Graphics, Image Processing

competencies	• Using OpenGL library • Programming in C++

5. Conditions (if applicable)

course materials	Powerpoint presentation, written books
sem/lab/project materials	CD with practical applications

6. Specific competences acquired

Professional competence	The implementation of a high level OpenGL application. The designing and acceleration of complex graphic applications.

7. Objectives (based on the specific grid for the accumulated competences)

General objective	This advanced course demonstrates sophisticated and novel computer graphics programming techniques, implemented in C using the widely available OpenGL library. The course explains the concepts and demonstrates the techniques required to generate images of greater realism and utility.
Specific objectives	The course helps students achieve two goals: • They gain a deeper insight into computer graphics concepts and OpenGL functionality, • They expand their "tool-box" of useful OpenGL techniques.

8. Contents

Course		No. hours
Course 1,2	**Modelling** Decomposition and Tessellation. Generating Model Normals. Triangle stripping. Capping Clipped Solids with the Stencil Buffers. Constructive Solid Geometry with the Stencil Buffers.	2 hours
Course 3	**Geometry and Transformations** Stereo Viewing. Depth of field. The Z Coordinate and Perspective Projection.	1 hours
Course 4,5	**Texture Mapping** Mipmap Generation. Filtering. Anisotropic Texture Filtering. Paging Textures. Billboards. Texture Coordinate Generation. Colour Coding and Contouring. Projective Textures. 3D Textures. Line Integral Convolution with Texture. Procedural Texture Generation.	2 hours
Course 6	**Blending** Compositing. Advanced Blending. Blending with the Accumulation Buffer.	1 hours
Course 7	**Antialiasing** Line and Point Antialiasing. Polygon Antialiasing. Antialiasing with Textures. Antialiasing with the Accumulation Buffer.	1 hours
Course 8	**Lighting** Phong Shading. Light Maps. Other Lighting Models. Global Illumination. Choosing Materials Properties.	1 hours
Course 9	**Scene Realism** Motion Blur. Depth of Field. Reflections and Refractions. Creating	1 hours

	Shadows.	
Course 10	**Transparency** Screen-Door Transparency. Alpha Blending. Sorting. Using the Alpha Function. Using Mulisampling.	1 hours
Course 11	**Natural Phenomena** Smoke. Vapour Trails. Fire. Explosions. Clouds. Water. Light Points. Other Atmospheric Effects. Particle Systems.	1 hours
Course 12	**Image Processing** The Pixel Transfer Pipeline. The Framebuffer and Per-Fragment operations. Colours and Colour Spaces. Convolutions. Image Warping.	1 hours
Course 13	**Using the Stencil Buffer** Dissolve with Stencil. Decaling with Stencil. Finding Depth Complexity with the Stencil Buffer. Compositing Images with Depth.	1 hours
Course 14	**Line Rendering Techniques** Wireframe Models. Hidden Lines. Haloed Lines. Silhouette Edges.	1 hours
	Total course hours:	14
Laboratory		No. hours
Lab 1	Constructive Solid Geometry with the Stencil Buffers in OpenGL.	1 hours
Lab 2	Computing the Transforms in OpenGL.	1 hours
Lab 3	Billboards.	1 hours
Lab 4	How to Project a Texture in OpenGL.	1 hours
Lab 5	Spectral Synthesis. Turbulence.	1 hours
Lab 6	Blending with the Accumulation Buffer in OpenGL.	1 hours
Lab 7	Antialiasing with the accumulation Buffer.	1 hours
Lab 8	2D Texture Light Maps. 3d Texture Light Maps.	1 hours
Lab 9	Modelling Material Smoothness.	1 hours
Lab 10	Motion Blur.	1 hours
Lab 11	Planar Reflections and Refraction Using the Stencil Buffer.	1 hours
Lab 12	Creating Shadows.	1 hours
Lab 13	Transparency.	1 hours
Lab 14	The Imaging Subset in OpenGL.	1 hours
	Total lab hours:	14

Teaching methods

At course: Course, Explication, Conversation, At laboratory: Exercise, Explication, Conversation.	Language of instruction	English

References

Recommended reading	Baciu, R., Volovici,D., *Sisteme de prelucrare grafică*, Editura Microinformatica, Cluj-Napoca 1999.
	Baciu, R., *Programarea aplicaţiilor grafice 3D cu OpenGL*, Editura Albastră, Cluj-Napoca, 2005.
	Baciu, R., *Advanced Computer Graphics- Advanced Computer Graphics using OpenGL*, Editura Techno Media, Sibiu, 2012 (I.S.B.N. 978-606-616-074-2) (459 slide-uri).

More references	Hearn, Donald, Backer,M. Pauline, *Computer Graphics*, Prentice-Hall, Inc, Englewood Cliffs, New Jersy, 1986
	David Blythe (Silicon Graphics) and Tom McReynolds (Gigapixel), Advanced Graphics Programming Techniques Using OpenGL, SIGGRAPH 2000 Course 32 (http://www.bluevoid.com/opengl/sig00/advanced00/notes/notes.html)
	Foley,J., A.vanDame, Feiner, S.K., Hughes, J.F., *Computer Graphics: principles and practice*, Addison Wesley Publishing Company, second edition, 1993.
	OpenGL Architecture Rewiew Board, OpenGL Reference Manual, Addison-Wesley, Menlo Park, 1993. (http://www.glprogramming.com/blue/)
	Neider, J., Davis, T., Woo, M., OpenGL Programming Guide, Addison-Wesley, Menlo Park, 1993. (http://www.glprogramming.com/red/)
	Mark Segal, Kurt Akeley, The OpenGL Graphics System: A Specification, Silicon Graphics, 1992-2002 (https://www.opengl.org/documentation/specs/version1.1/glspec1.1/)
	Richard S. Wright, Jr., Benjamin Lipchak, Nicholas Haemel, *OpenGL Superbible 4th ed.*: comprehensive tutorial and reference, Addison Wesley Publishing Company, 2007

9. Linking course content with expectations of the epistemic community representatives, professional associations and employers' representatives in the field related to the program

Knowledge of the principles of programming a graphical applications and knowledge of how to use the OpenGL library will allow graduates to adapt to the requirements of employers and others graphics libraries or programming environment.

10. Evaluation

Type	Evaluation criteria	Evaluation methods	Percentage in final grade	Obs.*
Course	comprehensive final examination	Oral exam	30%	RFE
Lab	small programming exercises	Oral evaluation	20%	REP, RFE
	one OpenGL project	Oral evaluation	50%	REP, RFE
Minimum standard of performance				
The student must implement an application using OpenGL.				

(*) REP – required for exam participation; nREP – not required for exam participation; RFE – required for final evaluation.

Date of completion: 18.10.2019
Date of approval in the Department:…….

	Position, title, first name, surname	Signature
Course instructor	Assoc.Prof. Eng. Rodica BACIU, Ph.D.	
Head of department	Prof. Eng. Daniel VOLOVICI, PhD	

Address: Str. Emil Cioran, nr. 4
Sibiu, 550025, România
e-mail: inginerie@ulbsibiu.ro
web: inginerie.ulbsibiu.ro

Tel: +40 (269) 217 928
Fax: +40 (269) 212 716