National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Computer Science

Computer Graphics

Course Code:	CS 361	**Semester:**	7th
Credit Hours:	3+1	**Prerequisite Codes:**	
Instructor:	Anjuman Shaheen Noor	**Class:**	BSSE
Office:	---	**Telephone:**	-
Lecture Days:	Tue, Wed, Fri	**E-mail:**	Noor.anjuman@gmail.com
Class Room:	-	**Consulting Hours:**	-
Lab Engineer:	Ali Musa	**Lab Engineer Email:**	ali.musa@seecs.edu.pk
Knowledge Group:	CS Core	**Updates on LMS:**	Weekly

Course Description:

In this course we will study the basic building blocks of computer graphics and learn how to use them to create models, animations and solve real world problems. We will study the entire programmable graphics pipeline and students will learn to write shaders for GPU. Assignments will augment the class lectures. To ensure the development of the necessary competencies, assigned homework includes the development of program solutions to problems of adequate complexity and relevance.

Course Objectives:

On successful completion of this course students will be able to: Create drawing primitives, transform objects and concatenate transformations, create complex 3D scenes, animate and transform 3D objects, perform texture mapping and illuminate environments, and write shaders for GPU.

Course Learning Outcomes (CLOs):	
Upon completion of the course, it is expected that you will be able to:	**BT Level***
1. Describe the computer graphics constructs and algorithms for rendering.	C2
2. Develop programs to implement 3D scenes.	C5
3. Articulate where computer graphic algorithms fit in the provision of computer-based solutions.	C4
4. Use modern tools and technologies to develop CG algorithms	C4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain	

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

PLOs/CLOs	CLO1	CLO2	CLO3	CLO4	Emphasis Level
PLO 1 (Computing Knowledge)	×				1
PLO 2 (Problem and Requirement Analysis)			×		3
PLO 3 (Design, Implementation and Evaluation of Solutions)		×			2
PLO 4 (Individual and Team Work)					
PLO 5 (Professional and ethical Responsibility)				×	1
PLO 6 (Communication)					
PLO 7 (Local and Global Computing Impact Analysis)					
PLO 8 (Lifelong Learning)					
PLO 9 (Modern tool usage)					
PLO 10 (Design Choices and Tradeoffs Analysis)					
PLO 11 (Adherence to Design and Development Principles)					
PLO 12 (Project Management)					

Mapping of CLOs to Assessment Modules and Weightages (In accordance with NUST statutes)

Assessments/CLOs	CLO1	CLO2	CLO3
Theory: 75% Tentative			
• Quizzes: 15%	×		×
• Assignments: 15%		×	
• OHT-1: 15%	×	×	
• OHT-2: 15%		×	×
• End Semester Exam: 40%	×	×	×
Practical: 25% Tentative			
• Labs Assignments: 70%		×	
• Semester Project: 30%		×	×
Total : 100 %			

To be filled in at the end of the course.

Books:

Text Book:
- Edward Angel and Dave Shreiner: Interactive Computer Graphics with WebGL, 2014

Reference Books:
- Hearn and Baker; Computer Graphics with Open GL, 2010
- Kouichi Matsuda and Rodger Lea; WebGL Programming Guide: 2013
- Jos Dirksen; Learning Three.js: The JavaScript 3D Library for WebGL, 2013

Topics to be Covered:

1. Graphics Pipeline	2. Transformation and Animations
3. Viewing	4. Lighting and Shading
5. Texture Mapping	6. Blending and Ray Tracing
7. Primitive Drawing Algorithms	8. Clipping and Hidden Surface Removal

9. Volume Rendering

Lecture Breakdown:

Week No.	Topics	Assessment	Remarks
1	Lecture 1: introduction Lecture 2: graphics pipeline Lecture 3: programming in webGL Lab 01		
2	Lecture 4: algebra and mathematical foundation Lecture 5: transformations Lecture 6: animations Lab 02		
3	Lecture 7: 3D scene setup Lecture 8: projections in computer graphics Lecture 9: camera for 3d scene Lab 03		
4	Lecture 10: theory of lights Lecture 11: types of lights Lecture 12: illumination and color Lab 04		
5	Lecture 13: shading in WebGL Lecture 14: interpolation Lecture 15: material Lab 05		
6	**OHT-1**		
7	Lecture 16: basics of textures Lecture 17: texture mapping Lecture 18: texture mapping Lab 06		
8	Lecture 19: blending of shades Lecture 20: fog for realistic environments Lecture 21: shadow mapping Lab 07		
9	Lecture 22: Bresenham Line drawing Lecture 23: mid point algorithms Lecture 24: mid point algorithms Lab 08		
10	Lecture 25: color filling Lecture 26: color filling Lecture 27: line clipping Lab 09		
11	Lecture 28: polygon clipping Lecture 29: hidden surface removal: z-buffer Lecture 30: hidden surface removal: a-buffer Lab 10		
12	**OHT-2**		
13	Lecture 31: physics engines Lecture 32: collision detection Lecture 33: game development tools Lab 11		
14	Lecture 34: design of games Lecture 35: curves		

	Lecture 36: surfaces Lab 12
15	Lecture 37: image manipulation for graphics Lecture 38: marching squares Lecture 39: marching cubes Lab 13
16	Lecture 40: volume rendering Lecture 41: illustration Lecture 42: information visualization Lab 14
17	Lecture 43: high level WebGL development libraries Lecture 44: high level WebGL development libraries Lecture 45: revision Lab 15
18	**ESE**

Lab Experiments:	
Lab 01:	Basic WebGL Scene
Lab 02:	Writing Shaders
Lab 03:	Transformations
Lab04:	Viewing
Lab 05:	Lighting
Lab 06:	Texture Mapping
Lab 07:	Blending and Fog
Lab 08:	Shadows
Lab 09:	Implementation of primitive algorithms
Lab 10:	Implementation of primitive algorithms
Lab 11:	Hidden surface removal
Lab 12:	Curves
Lab 13:	Marching Cubes
Lab 14:	Three.js
Lab 15:	Project Demos

Tools / Software Requirement:
WebGL enabled browser. Sublime Text

Grading Policy:	
Quiz Policy:	The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor's discretion.
Assignment Policy:	In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.
Lab Conduct:	The labs will be conducted for three hours every week. A lab handout will be given in advance for study and analysis The lab handouts will also be placed on LMS. The students are to submit their results by giving a lab report at the end of lab for evaluation. However, students will also be evaluated by oral viva during the lab.
Plagiarism:	SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.