NATIONAL UNIVERSITY OF SAN MARCOS

FACULTY OF MATHEMATICAL SCIENCES

SYLLABUS

1. GENERAL INFORMATION

1.1 Course name	:	Computer graphics
1.2 Code	:	CS251
1.3 Academic Program	:	Scientific Computing
1.4 Credits	:	3
1.5 Prerrequisites	:	CS210. Algorithms and Data Structures. (4^{th} Sem)
1.6 Type of Course	:	Mandatory
1.7 Area of Studies	:	Estudios Generales
1.8 Number of Weeks	:	16
1.9 Hours per week	:	1 HT; 4 HP;
1.10 Cycle	:	I
1.11 Learning modality	:	Face to face
1.12 Academic Period	:	2026-I
1.13 Semester Start Date	:	
1.14 Semester End Date	:	

2. PROFESSORS

Meetings after coordination with the professor

3. INTRODUCTION TO THE COURSE

Computer Graphics is a fundamental area of Computer Science that focuses on the mathematical and computational techniques for generating and manipulating images. This course provides students with the foundations of 2D and 3D modeling, rendering pipelines, and the physical principles of light and color, enabling them to develop high-performance visual applications, simulations, and interactive systems.

4. GOALS

- Understand the graphics pipeline and coordinate system transformations.
- Implement rendering algorithms for realistic and real-time visualization.
- Apply mathematical modeling to create and manipulate 3D objects.

5. COMPETENCES

No items for this table

6. TOPICS

Unit 1: Fundamental Concepts of Graphics and Interactive Techniques (16 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Overview of computer graphics pipeline and interactive systems • Basic rendering concepts: rasterization, ray tracing, shading models • Color theory and color spaces • Coordinate systems and transformations • Basic interaction techniques: input devices, event handling • Advanced rendering concepts: global illumination, physically based rendering • Graphics hardware and acceleration techniques • Human perception and visual cognition	• Explain the basic stages of the computer graphics pipeline [Explain] • Describe basic rendering techniques such as rasterization and ray tracing [Describe] • Apply color theory to design visually effective graphics [Apply] • Implement coordinate transformations for 2D and 3D graphics [Implement] • Design basic interactive applications using common input devices and event handling [Design] • Compare advanced rendering techniques such as global illumination and physically based rendering [Compare] • Analyze the role of graphics hardware in accelerating rendering tasks [Analyze] • Explain how human perception influences graphics and interaction design [Explain]
Readings : [**Marschner2021**], [**Hearn2014**]	

Unit 2: Applied Rendering and Techniques (16 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Rasterization algorithms: scan conversion, antialiasing • Ray tracing: acceleration structures, sampling, shading • Texture mapping and filtering • Shading models: Lambertian, Phong, BRDF • Advanced techniques: shadow mapping, environment mapping, deferred rendering	• Implement rasterization algorithms for primitive rendering [Implement] • Implement basic ray tracing with acceleration structures [Implement] • Apply texture mapping and filtering techniques to enhance visual realism [Apply] • Compare different shading models and their applications [Compare] • Implement advanced rendering techniques such as shadow mapping or deferred rendering [Implement]
Readings : [**Marschner2021**], [**Hearn2014**], [**Angel2014**]	

Unit 3: Geometric Modeling (16 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Geometric representations: polygons, curves, surfaces, implicit forms • Modeling techniques: splines, subdivision surfaces, constructive solid geometry • Procedural modeling and generation • Geometric algorithms: intersection, distance, decomposition	• Describe different geometric representations and their trade-offs [Describe] • Implement modeling techniques such as spline curves or subdivision surfaces [Implement] • Create procedural models using algorithms or rules [Create] • Apply geometric algorithms to solve problems like intersection testing or mesh processing [Apply]
Readings : [**Marschner2021**], [**Angel2014**]	

Unit 4: Visualization (16 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Principles of data visualization: perception, cognition, and effective encoding • Types of visualizations: scientific, information, geographical • Visualization techniques for multivariate, temporal, and hierarchical data • Interactive visualization and exploration • Evaluation of visualization effectiveness	• Apply principles of perception and cognition to design effective visualizations [Apply] • Select appropriate visualization techniques for different data types and tasks [Evaluate] • Implement interactive visualizations for data exploration [Implement] • Evaluate the effectiveness of a visualization using empirical methods [Evaluate]
Readings : [**Marschner2021**]	

Unit 5: Shading and Advanced Rendering (12 hours)	
Competences Expected:	
Topics	**Learning Outcomes**
• Advanced shading: physically based shading, subsurface scattering • Global illumination: radiosity, photon mapping, path tracing • Real-time rendering techniques: level of detail, culling, occlusion • GPU programming and shaders	• Implement advanced shading models for realistic materials [Implement] • Compare global illumination algorithms and their trade-offs [Compare] • Optimize real-time rendering using techniques like level of detail and culling [Create] • Develop GPU shaders for custom rendering effects [Create]
Readings : [**Marschner2021**], [**Angel2014**]	

7. WORKPLAN

7.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

7.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

7.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

8. EVALUATION SYSTEM

********* EVALUATION MISSING ********

9. BASIC BIBLIOGRAPHY