National University of Engineering (UNI)
School of Computer Science
Syllabus 2024-II

1. COURSE

FI201FCCS. Computational Physics (Mandatory)

2. GENERAL INFORMATION

2.1 Course	:	FI201FCCS. Computational Physics
2.2 Semester	:	2^{nd} Semester.
2.3 Credits	:	3
2.4 Horas	:	2 HT; 2 HP;
2.5 Duration of the period	:	16 weeks
2.6 Type of course	:	Mandatory
2.7 Learning modality	:	Face to face
2.8 Prerrequisites	:	FI101FCCS. Physics I. (1^{st} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course applies the principles of physics to computational problems, with an emphasis on light, wave propagation, collisions, and energy transfer. These concepts are essential in areas such as computer graphics, physical simulations, and video game development.

5. GOALS

- Understand the physical principles relevant to computing.
- Apply these principles to solve specific computational problems.
- Implement physics-based algorithms for simulations and computer graphics.

6. COMPETENCES

1) Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions. (Assessment)

6) Apply computer science theory and software development fundamentals to produce computing-based solutions. (Assessment)

AG-C07) Computing Knowledge: Applies appropriate knowledge of mathematics, science, and computing. (Assessment)

AG-C09) Solution Design and Development: Designs, implements, and evaluates solutions for complex computing problems. (Assessment)

AG-C12) Applies computer science theory and software development fundamentals to produce computer-based solutions. (Assessment)

7. TOPICS

Unit 1: Optics and Light Propagation (10 hours)	
Competences Expected: 1,6,AG-C07,AG-C12	
Topics	**Learning Outcomes**
• Nature of light. • Reflection and refraction. • Lenses and mirrors. • Interference and diffraction. • Illumination models (e.g., Phong, Blinn-Phong).	• Describe the properties of light and its propagation. [Familiarizarse] • Apply the laws of reflection and refraction. [Usar] • Implement illumination models in computer graphics. [Evaluar]
Readings : [YF18], [Hec17]	

Unit 2: Collisions and Energy Transfer (8 hours)	
Competences Expected: 1,6,AG-C07,AG-C12	
Topics	**Learning Outcomes**
• Impulse and linear momentum. • Elastic and inelastic collisions. • Conservation of energy in collisions. • Deformation of elastic meshes (e.g., mass-spring model).	• Apply the principles of conservation of linear momentum and energy in collisions. [Familiarizarse] • Model the deformation of elastic meshes due to impact. [Usar] • Implement collision simulations in a computational environment. [Evaluar]
Readings : [YF18], [Tay05]	

Unit 3: Rigid Body Mechanics (8 hours)	
Competences Expected: 1,6,AG-C07,AG-C12	
Topics	**Learning Outcomes**
• Rotation of rigid bodies. • Moment of inertia. • Torque and rotational kinetic energy.	• Describe the rotation of rigid bodies. [Familiarizarse] • Calculate the moment of inertia. [Usar] • Apply the equations of rotational dynamics. [Evaluar]
Readings : [YF18], [Tay05]	

Unit 4: Fluid Dynamics (6 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Basic principles of fluid dynamics. • Viscosity. • Laminar and turbulent flow.	• Describe the properties of fluids. [Familiarizarse] • Explain the concepts of viscosity and laminar/turbulent flow. [Usar] • Solve simple fluid dynamics problems. [Evaluar]
Readings : [YF18]	

Unit 5: Thermodynamics (6 hours)	
Competences Expected: 1,6,AG-C07	
Topics	**Learning Outcomes**
• Laws of thermodynamics. • Heat transfer.	• State the laws of thermodynamics. [Familiarizarse] • Describe the mechanisms of heat transfer. [Usar]
Readings : [YF18]	

Unit 6: Physical Simulation (10 hours)	
Competences Expected: 1,6,AG-C07,AG-C12	
Topics	**Learning Outcomes**
• Numerical methods for physical simulation. • Verlet integration. • Collision detection. • Particle systems. • Constraints and solvers.	• Implement basic numerical methods for physical simulation. [Familiarizarse] • Use Verlet integration to simulate motion. [Usar] • Implement collision detection algorithms. [Evaluar]
Readings : [Tay05]	

8. WORKPLAN

8.1 Methodology

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

8.2 Theory Sessions

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

8.3 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.

9. EVALUATION SYSTEM

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

10. BASIC BIBLIOGRAPHY

[Tay05] John R. Taylor. *Classical Mechanics*. University Science Books, 2005.

[Hec17] Eugene Hecht. *Optics*. Pearson, 2017.

[YF18] Hugh D. Young and Roger A. Freedman. *University Physics with Modern Physics*. Pearson, 2018.