**National University of Engineering (UNI)**
School of Computer Science
Syllabus 2026-I

## 1. COURSE

AI365. Advanced Generative AI Models (Mandatory)

## 2. GENERAL INFORMATION

| | | |
|---|---|---|
| **2.1 Course** | : | AI365. Advanced Generative AI Models |
| **2.2 Semester** | : | $9^{th}$ Semester |
| **2.3 Credits** | : | 4 |
| **2.4 Horas** | : | 2 HT; 4 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** | : | AI264. Deep Learning. ($7^{th}$ Sem) |

## 3. PROFESSORS

Meetings after coordination with the professor

## 4. INTRODUCTION TO THE COURSE

This course explores modern generative models (GANs, Diffusion Models, LLMs) for multimodal content creation, covering both mathematical foundations and practical applications with ethical considerations for synthetic media.

## 5. GOALS

- Implement image/text/video generation pipelines
- Design AI-assisted editing systems
- Evaluate synthetic content risks

## 6. COMPETENCES

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

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

**2)** Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline. (Assessment)

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

**4)** Recognize professional responsabilities and make informed judgments in computing practice based on legal and ethical principles. (Usage)

**AG-C02)** Ethics: Applies ethical principles and commits to professional ethics and standards of computing practice. (Usage)

## 7. TOPICS

| **Unit 1: Generative Fundamentals (12 hours)** | |
|---|---|
| **Competences Expected: 6,AG-C12** | |
| **Topics** | **Learning Outcomes** |
| • GANs theory (minimax, Wasserstein)<br>• Autoregressive models (PixelCNN, Transformers)<br>• Evaluation metrics (FID, Inception Score) | • Train basic GANs [Usar]<br>• Analyze generation failure modes [Evaluar] |
| **Readings :** [Goo+14] | |

| **Unit 2: Diffusion Models (24 hours)** | |
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| **Competences Expected: 2,AG-C09** | |
| **Topics** | **Learning Outcomes** |
| • Diffusion processes (forward/reverse)<br>• Stable Diffusion and latent architectures<br>• Control techniques (ControlNet, LoRA) | • Implement diffusion samplers [Usar]<br>• Fine-tune for domain-specific generation [Evaluar] |
| **Readings :** [SSE23], [Rom+22] | |

| **Unit 3: Synthetic Media Ethics (8 hours)** | |
|---|---|
| **Competences Expected: 4,AG-C02** | |
| **Topics** | **Learning Outcomes** |
| • Deepfakes and misinformation<br>• Copyright in generated content<br>• Authenticity marking (C2PA, watermarking) | • Detect synthetic content [Familiarizarse]<br>• Implement traceability systems [Usar] |
| **Readings :** [SSE23] | |

## 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


[Goo+14] Ian Goodfellow et al. “Generative Adversarial Networks”. In: *NeurIPS*. 2014.

[Rom+22] Robin Rombach et al. “High-Resolution Image Synthesis with Latent Diffusion Models”. In: *CVPR* (2022).

[SSE23] Jascha Sohl-Dickstein, Yang Song, and Stefano Ermon. *Diffusion Models: A Comprehensive Practical Guide*. AI Press, 2023.