

Branch Name:	Bachelor of Technology (Computer Engineering / Information Technology)
Program Code:	ET103/ET105
Course Title:	Elective -IV Practical: Generative Artificial Intelligence Practical
Course Code:	2ET1030706P
Pre-requisite Course:	Basic of Machine Learning and Artificial Intelligence

Course Objectives: The objectives of generative artificial intelligence are designed to equip students with the ability to create, rather than just analyze, complex data patterns. By the end of this course, students will be able to understand the fundamentals of generative AI, master modern generative models (GANs, VAEs, Transformers, Diffusion, and Flows), develop practical AI applications, and apply ethical and responsible AI practices.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	SEE		CCA		SEE		CCA						
	L	T	P	Total	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
1	-	-	2	2	-	-	-	-	10	25	10	25	50

List of Experiments:

S. N.	Practical Exercise
1	Dimensionality Reduction with Autoencoders: Build a vanilla Autoencoder to compress and reconstruct the MNIST/CIFAR-10 dataset, Visualizing the bottleneck (latent space).
2	Variational Autoencoder for Image Generation: Implement a VAE with the reparameterization trick, Generating new handwritten digits by sampling from the learned latent distribution.
3	Deep Convolutional GAN: Implement a Generator and Discriminator network to create synthetic images (e.g., fashion items/human faces), Handling the minimax loss and monitoring training stability.
4	Image-to-Image Translation with CycleGAN: Use a pre-trained CycleGAN to perform style transfer (e.g., turning a daytime photo into a nighttime photo or a photo into a painting), Understanding cycle-consistency loss without paired training data.
5	Character-level Text Generation: Implement a simplified Transformer (decoder-only) to predict the next character in a body of text (e.g., Shakespeare), Self-attention layers and positional encoding.
6	Prompt Engineering & Retrieval-Augmented Generation: Build a system using LangChain and a Vector Database (like ChromaDB or Pinecone) to answer questions based on a specific PDF document, Reducing "hallucinations" in LLMs by providing external context.
7	Parameter-Efficient Fine-Tuning: Take a pre-trained model (Llama/Mistral) and fine-tune it on a specific dataset (medical FAQs) using LoRA, Fine-tuning large models using minimal GPU memory.
8	Denoising Diffusion Probabilistic Model: Implement the forward (noising) and reverse (denoising) processes on a 1D/2D toy dataset, Understand iterative Gaussian denoising for data generation.
9	Text-to-Image Synthesis with Stable Diffusion: Use the diffusers library to generate images from complex text prompts. Experiment with "Negative Prompts" and "Guidance Scale.", Understanding the role of the CLIP text encoder and the U-Net.
10	Deepfake Detection & Ethics Lab: Use a pre-trained model to detect manipulated images or text (AI-generated vs. Human-written), Exploring the ethical implications of synthetic media.

Reference Books:

1. Generative Deep Learning by David Foster, O'Reilly Media
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, MIT Press
3. Hands-On Generative AI with Transformers by Savonix & Arunkumar, Packt

List of Open-Source Software/learning website:

1. <https://developers.openai.com/cookbook>
2. <https://www.cloudskillsboost.google/paths/118>
3. <https://huggingface.co/learn/nlp-course>
4. <https://course.fast.ai/>
5. <https://docs.langchain.com/oss/python/langchain/overview>

Course Outcomes (CO):

Course Outcomes	Description	Bloom's Taxonomy Level
CO1	Explain the mathematical principles of latent space and generative theory.	Understanding (2)
CO2	Implement VAEs and GANs for image generation and style transfer.	Applying (3)
CO3	Analyze the architecture of Transformer-based models and LLMs.	Analyze (4)
CO4	Develop text-to-image or text-to-text systems using pre-trained APIs.	Create (6)
CO5	Evaluate the ethical implications and biases in generated content.	Evaluate (5)
CO6	Design and integrate Generative AI models to solve real-world applications.	Create (6)

Mapping of CO with PO and PSO:

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	-	-	-	-	-	-	-	-	-	L	M	-	-	-
CO2	H	M	H	M	H	-	-	-	-	-	-	-	H	H	-	-
CO3	H	H	H	M	M	-	-	-	-	-	-	M	M	H	-	-
CO4	M	H	H	H	H	-	-	-	-	-	-	M	H	H	-	-
CO5	-	-	-	-	-	H	-	-	-	-	-	M		L	-	-
CO6	H	M	-	-	-	-	-	H	-	-	-	L	M	-	-	-

H: High, M: Medium, L: Low