

<b>INSTITUTE</b>	<b>FACULTY OF TECHNOLOGY</b>
<b>PROGRAM</b>	<b>BACHELOR OF TECHNOLOGY (COMPUTER ENGINEERING)</b>
<b>SEMESTER</b>	<b>7</b>
<b>COURSE TITLE</b>	<b>GENERATIVE ARTIFICIAL INTELLIGENCE</b>
<b>COURSE CODE</b>	<b>01CE0724</b>
<b>COURSE CREDITS</b>	<b>4</b>

**Objective:**

- 1 Students will gain an understanding of generative AI, its various models, and real-world applications. They will learn about transformer-based models for text generation and their role in natural language processing. The course will also cover AI techniques for generating images and other creative content. Additionally, students will explore methods to evaluate AI-generated outputs and examine the ethical and legal challenges of using generative AI responsibly.

**Course Outcomes:** After completion of this course, student will be able to:

- 1 Describe the fundamental concepts of generative AI and differentiate between discriminative and generative models
- 2 Implement transformer-based models for text generation
- 3 Apply generative AI techniques for image synthesis using VAEs, GANs, and Diffusion Models
- 4 Analyze AI-generated content using standard evaluation metrics
- 5 Evaluate ethical and legal considerations in deploying generative AI models

**Pre-requisite of course:**Python Programming, AIML Basics

**Teaching and Examination Scheme**

<b>Theory Hours</b>	<b>Tutorial Hours</b>	<b>Practical Hours</b>	<b>ESE</b>	<b>IA</b>	<b>CSE</b>	<b>Viva</b>	<b>Term Work</b>
3	0	2	50	30	20	25	25

<b>Contents : Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
1	<b>Introduction to Generative AI</b> Introduction to Generative AI, Generative vs. Discriminative Models,, Bayesian Models (Naive Bayes, Hidden Markov Models),, Deep Learning Models (VAEs, GANs, Diffusion Models, Transformers, Real-World Applications, Challenges & Ethical Considerations, Introduction to Evaluation Metrics.	8

<b>Contents : Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
2	<b>Generative Models for Text</b> Transformer-Based Language Models, Encoder-Decoder Architectures, Attention Mechanisms in NLP, Text Generation using Transformer Models, Zero-shot, One-shot, Few-shot Learning, Prompt Engineering & Optimization, Evaluation Metrics for Text Generation	8
3	<b>Generative Models for Images</b> Variational Autoencoders (VAEs), Latent Space Representation, Generative Adversarial Networks (GANs), DCGAN, CycleGAN, StyleGAN, Diffusion Models – Stable Diffusion, DDPMs, Applications (Image Inpainting, Super-Resolution, Face Generation), Evaluation Metrics for Image Generation	9
4	<b>AI-Generated Art, Music, and Games</b> AI-Generated Art (Neural Style Transfer, DeepDream), AI in Music (MuseGAN, OpenAI Jukebox), AI in Game Development (Deep Q-Learning, Proximal Policy Optimization), Challenges & Biases in Creative AI, Evaluation Metrics	9
5	<b>Open-Source Models &amp; Deployment</b> Open-Source Generative Models, Fine-Tuning Pretrained Models, Deploying AI Models, Ethical & Legal Considerations, Model Evaluation & Interpretability	8
<b>Total Hours</b>		<b>42</b>

#### Suggested List of Experiments:

<b>Contents : Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
1	<b>Practical 1</b> Comparing Generative and Discriminative Models	2
2	<b>Practical 2</b> Building a Variational Autoencoder for Data Generation	2
3	<b>Practical 3</b> Text Completion using Transformer-Based Models	2
4	<b>Practical 4</b> AI-Powered Story Generation	2
5	<b>Practical 5</b> Text Generation with Fine-Tuned Models	2
6	<b>Practical 6</b> Prompt Engineering for Optimized AI Responses	2
7	<b>Practical 7</b> Creative Writing with AI-Powered Poetry Generation	2
8	<b>Practical 8</b> Generating Images with Deep Generative Models	2
9	<b>Practical 9</b> Image Inpainting using AI	2

### Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
10	<b>Practical 10</b> Parameter Evaluation of LLM Models	2
11	<b>Practical 11</b> Design a RAG models	2
12	<b>Practical 12</b> AI-Powered Art Generation with Style Transfer	2
13	<b>Practical 13</b> Music Generation using AI Models	2
14	<b>Practical 14</b> Deploying Generative AI Models as Web Applications	2
<b>Total Hours</b>		<b>28</b>

### Textbook :

- 1 Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition, 2023

### References:

- 1 RAG-Driven Generative AI: Build Custom Retrieval Augmented Generation Pipelines with LlamaIndex, Deep Lake, and Pinecone, RAG-Driven Generative AI: Build Custom Retrieval Augmented Generation Pipelines with LlamaIndex, Deep Lake, and Pinecone, Denis Rothman, Packt Publishing, 2024
- 2 Generative AI on AWS, Generative AI on AWS, Chris Fregly and Antje Barth, O'Reilly Media, 2023
- 3 Introduction to Generative AI, Introduction to Generative AI, Numa Dhamani and Maggie Engler., Manning Publications, 2023
- 4 Generative Artificial Intelligence: What Everyone Needs to Know, Generative Artificial Intelligence: What Everyone Needs to Know, Jerry Kaplan, Oxford University Press, , 2023
- 5 Deep Learning, Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016
- 6 Denoising Diffusion Probabilistic Models (DDPMs), Denoising Diffusion Probabilistic Models (DDPMs), Jonathan Ho, Ajay Jain, Pieter Abbeel, NeurIPS, 2020

### Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
0.00	0.00	35.00	35.00	30.00	0.00

**Instructional Method:**

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

**Supplementary Resources:**

- 1 <https://www.coursera.org/learn/generative-ai-with-llms>
- 2 <https://www.coursera.org/learn/generative-ai-for-everyone>
- 3 <https://www.youtube.com/watch?v=95G5j2FW5aM>
- 4 <https://www.analyticsvidhya.com/blog/2024/01/ultimate-list-of-generative-ai-resources/>
- 5 <https://www.youtube.com/watch?v=mEsleV16qdo>
- 6 <https://www.deeplearning.ai/courses/generative-ai-for-everyone/>
- 7 <https://www.igmguru.com/machine-learning-ai/generative-ai-training>