

INSTITUTE	FACULTY OF TECHNOLOGY
PROGRAM	BACHELOR OF TECHNOLOGY (COMPUTER ENGINEERING)
SEMESTER	7
COURSE TITLE	GENERATIVE ADVERSIAL NETWORKS
COURSE CODE	01CE0727
COURSE CREDITS	3

Objective:

- 1 Generative Adversarial Networks (GANs) are an advanced class of deep learning models used for data generation, image synthesis, and representation learning. GANs consist of two neural networks trained in an adversarial manner to generate realistic data samples. This course aims to provide students with a strong foundation in generative modelling, GAN architectures, training mechanisms, and practical applications. Students are expected to understand the working principles of GANs and implement basic models using Python.

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

- 1 Understand the fundamentals of generative models and adversarial learning.
- 2 Explain the architecture and working of Generator and Discriminator networks.
- 3 Apply GAN models for image generation and data augmentation.
- 4 Analyze different variants of GANs and compare their performance.
- 5 Understand challenges, ethical concerns, and real-world implications of GAN technology.

Pre-requisite of course:NA

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction to Generative Mo Overview of Artificial Intelligence and Deep Learning with emphasis on data-driven systems,, iffERENCE between discriminative and generative models with simple examples, basic understanding of probability distributions and data generation concepts,, introduction to generative models and their importance, detailed introduction to Generative Adversarial Networks including basic idea and motivation, applications of GANs in real-world scenarios such as image generation, data synthesis, and creative systems.	6

Contents : Unit	Topics	Contact Hours
2	GAN Architecture and Training Basic architecture of Generator and Discriminator networks, role and functionality of each component in GANs, concept of adversarial learning explained using simple game-based analogy, minimax game formulation with intuitive explanation rather than mathematical depth,, commonly used loss functions in GANs and their purpose, complete GAN training process including data flow, feedback mechanism, and convergence behavior, overview of GAN training workflow and common training steps	10
3	Variants of GANs Introduction to different variants of GANs developed to improve performance and stability,, Deep Convolutional GAN (DCGAN) architecture and advantages for image data,, Conditional GAN (cGAN) and its use for labeled data generation, Wasserstein GAN (WGAN) and its basic idea for improving training stability, CycleGAN with simple explanation of image-to-image translation, comparative discussion of GAN variants based on architecture, application, and limitations	8
4	Applications of GANs Use of GANs for image generation and image-to-image translation tasks, application of GANs for data augmentation to improve machine learning model performance, role of GANs in healthcare and medical imaging such as disease detection and image enhancement, application of GANs in cyber security for anomaly detection and attack simulation, creative and industrial applications of GANs in art, design,Media, and content creation.	10
5	Challenges and Ethical Issues Common challenges in GAN training such as training instability, non-convergence, and mode collapse, methods for evaluating GAN performance using simple qualitative and quantitative measures, ethical concerns related to misuse of GAN-generated content, security threats including deepfakes and misinformation, social impact and responsibility of GAN developers, future research directions focusing on stability, efficiency, and Responsible use of GANs.	8
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Practical 1 Study of basic concepts of Generative Models and detailed understanding of Generative Adversarial Networks architecture and working principle	2
2	Practical 2 Design and implementation of a simple Generator neural network model using Python and basic dense layers	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
3	Practical 3 Design and implementation of a simple Discriminator neural network model for binary classification using Python	2
4	Practical 4 Implementation of a complete basic GAN architecture by combining Generator and Discriminator models	2
5	Practical 5 Training of basic GAN model on a small subset of MNIST dataset with limited epochs	2
6	Practical 6 Implementation of Deep Convolutional GAN (DCGAN) using lightweight convolution layers for image generation	2
7	Practical 7 Implementation of Conditional GAN (cGAN) for labeled image generation using simple dataset	2
8	Practical 8 Visualization and analysis of generated images using Python libraries such as Matplotlib	2
9	Practical 9 Application of GAN model for simple image data augmentation to improve dataset diversity	2
10	Practical 10 Evaluation of GAN performance using basic qualitative comparison and loss monitoring	2
11	Practical 11 Study and implementation of GAN loss functions including Generator and Discriminator loss	2
12	Practical 12 Analysis of GAN training challenges such as mode collapse and instability using experimental results	2
13	Practical 13 Development of a mini-GAN-based image generation project using lightweight architecture	2
14	Practical 14 Preparation of practical report including result analysis, observations, and conclusion of GAN experiments	2
Total Hours		28

Textbook :

- 1 Generative Adversarial Networks, Goodfellow et al., NeurIPS, 2014

References:

- 1 DCGAN,, DCGAN,, Radford et al, ICLR, 2018
- 2 Wasserstein GAN, Wasserstein GAN, Arjovsky et al, ICML, 2017

References:

- 3 CycleGAN, CycleGAN, Zhu et al, ICCV, 2017

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	40.00	30.00	30.00	0.00

Instructional Method:

- 1 Course delivery through classroom teaching, demonstrations, and practical sessions
- 2 Continuous internal evaluation through assignments and practical work
- 3 End semester examination for theory and practical evaluation
- 4 Use of supplementary online resources such as MOOCs and virtual laboratories

Supplementary Resources:

- 1 <https://www.coursera.org/learn/generative-adversarial-networks>.
- 2 <https://paperswithcode.com/method/gan>.
- 3 <https://www.tensorflow.org/tutorials/generative>.