LNMIIT, Jaipur Department of Computer Science & Engineering	LNMIIT The LNM Institute of Information Technology

Course Code: CSE4201	Course Title: Generative Adversarial Networks			Programme: B. Tech. (CSE)
Type of Course: Program Elective	Prerequisites: ● Programming in Python ● Probability and Statistics			Total Contact Hours: 40
Year/Semester: 4/Odd	Lecture Hrs/Week: 3	Tutorial Hrs/Week: 0	Practical Hrs/Week: 0	Credits: 3

Learning Objective:

Generative Adversarial Networks (GANs) are powerful deep learning tools that have attracted exciting applications such as synthesis of realistic faces and arts. This course provides insights into how to develop applications using GANs. This is a research-based course and knowledge of machine learning or deep-learning is desirable for the students taking this course. The basic understanding of Keras and Tensorflow is also desirable. The course is divided into five units. The first unit provides an introduction to the course. The second unit discusses an overview of deep-learning tools. The third unit introduces two famous Deep Generative Models, namely Generative Adversarial Networks (GANs) and Variational Autoencoders (VAE). In the fourth unit, we dive into GANs and discuss key concepts needed to develop applications. Finally, the fifth unit discusses the exciting real-world applications and advanced topics such as Deep Generative Models for Graph Neural Networks.

Prerequisites of the course:

- Programming in Python
- Probability and Statistics

Course outcomes (COs):

On completion of this course, the students will have the ability to:		Bloom's Level
CO-1	**Understand** basic concepts needed for learning Deep Generative Models.	2
CO-2	**Apply** Deep Generative Models for real-world problems.	3
CO-3	**Understand** major components and key concepts of GANs.	2
CO-4	**Examine** practical challenges and recent advancements in GANs.	4
CO-5	**Evaluate** the performance of GAN models for various applications.	5
CO-6	**Design** applications of GANs in Keras and Tensorflow.	6

Course Topics	Lecture Hours	
UNIT – I (Introduction)	1	CO1
1.1 Course description and overview	1	

UNIT – II (Basic Tools)	**8**	**CO1**
1.1 Probability and Linear Algebra.	**2**	
1.2 Overview of Deep Learning, Deep Feedforward Networks, Convolutional Networks, Regularization for Deep Learning.	**4**	
1.3 Deep Learning with Keras and Tensorflow	**2**	
UNIT – III (Introduction to Deep Generative Modeling)	**6**	**CO2**
1.1 Deep Generative Modeling, Variational Autoencoders (VAE), Generative Adversarial Networks (GANs)	**6**	
UNIT-IV (GAN Architectures, Training, and Evaluation)	**10**	**CO3,CO4**
1.1 GAN Architectures (Unconditional, Conditional, Multi-scale).	**3**	
1.2 GAN Challenges, Oscillating loss, Mode Collapse	**3**	
1.3 Wasserstein GAN and WGAN-GP	**2**	
1.4 Controllable Generation and Evaluation	**2**	
UNIT-V (Applications of GANs and Advanced Topics)	**15**	**CO5,CO6**
1.1 Image-to-Image Translation (pix2pix)	**2**	
1.2 Denoising, Super-resolution, Inpainting.	**3**	
1.3 Neural Style Transfer, Style GAN	**3**	
1.4 Graph Neural Networks and DGM for Graphs	**3**	
1.5 Advantages and disadvantages of GANs.	**2**	
1.6 The Future of Generative Modeling	**2**	

Textbook References:

Text Book:

1. *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play*. Book By David Foster, O'Reilly Publication 2019.

Reference books:

1. *Dive into Deep Learning*: Book by Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola.
2. *Deep Learning.* Book by Ian Goodfellow and Yoshua Bengio and Aaron Courville, The MIT Press, Link*: https://www.deeplearningbook.org/*
3. *Graph Representation Learning.* Book by William L. Hamilton.

Additional Resources:

1. MIT 6.S191 Introduction to Deep Learning. Link: http://introtodeeplearning.com/
2. Stanford CS236G Generative Adversarial Networks (GANs). Link: https://cs236g.stanford.edu/
3. The Deep Learning Revolution. Book by Terry Sejnowski.
4. Deep Learning by MIT Press Essential Knowledge Series.

Evaluation Method	
Item	**Weightage (%)**
Assignment 1	5
Assignment 2	5
Quiz 1	5
Quiz 2	5
Project Phase 1	15
Project Phase 2	25
Midterm	15
End-Term	25

*Please note, as per the existing institute's attendance policy the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% lectures will be debarred from the End Term/Final/Comprehensive examination.

CO and PO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2										1		1
CO2	3	2	3										1	1	3
CO3		1	2											1	1
CO4			1	2									1		2
CO5		2	2	3									1	1	2
CO6	3		3		2	1							1	1	3

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Updated By: Indra Deep Mastan