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

Programme: B. Tech. (CSE)	Course Title: Generative Adversarial Networks and Its Applications			Course Code: CSExxxx
Type of Course: Program Elective	Prerequisites: Deep Learning for Computer Vision Computer Programming Deep Learning Probability & 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.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		Bloom's Level
CO-1	**Identify** problems that could be solved using Deep Generative Models.	1
CO-2	**Understand** major components and key concepts of GANs.	2
CO-3	**Understand** practical challenges when working with GANs.	2

CO-4	**Understand** recent advancements in GANs.	**2**
CO-5	**Analyze** and **apply** GAN models for image synthesis tasks.	**3, 4**
CO-6	**Design** applications of GANs	**6**

Course Topics	Lecture Hours	
UNIT – I (Introduction)	**1**	**1**
1.1 Course description, overview and applications of GANs	**1**	
UNIT – II (Basic Tools)	**8**	**8**
1.1 Probability and Linear Algebra.	**2**	
1.2 Overview of Deep Learning, Deep Feedforward Networks, Convolutional Networks, Optimization, Regularization for Deep Learning.	**4**	
1.3 Deep Learning with Pytorch/Keras/Tensorflow	**2**	
UNIT – III (Introduction to Deep Generative Modeling)	**6**	**6**
1.1 Deep Generative Modeling, Variational Autoencoders (VAE), Generative Adversarial Networks (GANs)	**6**	
UNIT-IV (GAN Architectures, Training, and Evaluation)	**10**	**10**
1.1 GAN Architectures (Unconditional, Conditional, Multi-scale).	**3**	
1.2 GAN Challenges, Oscillating loss or non-convergence, Mode Collapse	**3**	
1.3 Wasserstein GAN and WGAN-GP	**2**	

1.4 Controllable Generation and Evaluation: Inception Score (IS), Fréchet Inception Distance (FID)	**2**	
UNIT-V (Applications of GANs and Advanced Topics)	**15**	**15**
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	**2**	
1.5 Text-to-Image Synthesis	**2**	
1.6 Advantages and disadvantages of GANs.	**2**	
1.7 The Future of Generative Modeling	**1**	

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. *"GANs in Action" by Jakub Langr and Vladimir Bok*
4. *Graph Representation Learning.* Book by William L. Hamilton.

Additional Resources:

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

Evaluation Method	
Item	**Weightage (%)**
Assignments/Quiz	20
Midterm	15
End-Term	25
Project	40

*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		3													1
CO2		2											1		1
CO3				2									1		2
CO4		1													2
CO5	2	2		2									2	1	2
CO6	2		3										2	2	3

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Approved By: