PVP20

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(Autonomous) Kanuru, Vijayawada-520007

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (Data Science)

IV B. Tech – I Semester

GENERATIVE ARTIFICIAL INTELLIGENCE

Course Code	**20DS4701A**	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE (Data Science)	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	ML, DL
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Describe the principles, architectures, applications, and ethical considerations of generative AI models to understand their designs.	**L2**
CO2	Apply core generative architectures such as AutoEncoders, VAEs, and Transformers to develop basic generative models for vision and language tasks.	**L3**
CO3	Use large language models and diffusion-based generative architectures to develop real-world solutions in natural language processing and image synthesis.	**L3**
CO4	Analyze the design, performance, and applicability of generative models including Transformers, LLMs, and Diffusion Models for multimodal AI tasks.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High,2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2												
CO2	3											3	
CO3	3										2	3	
CO4		3									2		3

Syllabus

Unit No	**Contents**	**Mapped CO**
I	**Foundations of Generative AI**: Introduction to Generative Deep Learning, Generative vs. Discriminative Modelling, Historical Perspective of Generative AI, Overview of Large Language Models (LLMs), Applications, Limitations, and Risks of Generative AI, Pre-training and Transfer Learning Techniques, Ethics, Bias and Fairness in Generative AI	CO1
II	**Core Generative Architectures:** Role of AutoEncoders in Unsupervised Learning, AutoEncoder Architecture and Types, Variational Autoencoders (VAEs) and Probabilistic Generative Modelling, Applications of VAEs in Generative Tasks, Introduction to Generative Adversarial Networks(GANs), Introduction to Evaluation Metrics for Generative Models(e.g., FID, BLEU, ROUGE)	CO1, CO2, CO4

III	**The Transformer Architecture:** The Evolution to Transformers, The Transformer Architecture and its core components, Self-Attention, Multi-Head Attention, Positional Encoding, Vision Transformers (ViT), Transformer Applications	CO1, CO2, CO4
IV	**Large Language Models (LLMs):** Introduction to Large Language Models, BERT Architecture and Pre-training objectives, Fine-tuning BERT for NLP Tasks, Introduction to GPT and its Variants, T5 (Text-to-Text Transfer Transformer), Applications in Text Generation, and other LLM applications	CO1, CO3, CO4
V	**Advanced Generative Models:** Introduction to Diffusion Models, Forward and Reverse Diffusion Process, The Reparameterization Trick, Denoising Diffusion models, UNet Architecture in Diffusion Models, Transformer-Based Image Generative Models: DALL·E2	CO1, CO3, CO4

Learning Resources

Text Books

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, 2nd Edition, 2023, O'Reilly Media.
2. Deep Learning, Ian Good fellow, Yoshua Bengio, and Aaron Courville, 2nd Edition, 2016, MIT Press.

References

1. Fairness and Machine Learning: Limitations and Opportunities; Author(s) Solon Barocas, Moritz Hardt, Arvind Narayanan, 2023, MIT Press
2. Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way by Virginia Dignum, 1st Edition, 2021, MIT Press

E-Recourses and other Digital Material

1. https://www.analyticsvidhya.com/blog/2023/04/what-is-generative-ai/
2. https://www.analyticsvidhya.com/blog/2023/07/beginners-guide-to-build-large-language-models-from-scratch/
3. Hugging Face: For pre-trained models, datasets, and tutorials (https://huggingface.co/)
4. Distill.pub: For interactive, in-depth articles on ML concepts(https://distill.pub/)
5. https://www.cloudskillsboost.google/paths/118/course_templates/536/video/520739
6. https://www.cloudskillsboost.google/paths/118/course_templates/536/video/520739
7. https://www.ibm.com/think/topics/generativeai#:~:text=Gen%20AI%20models%20focus%20on,best%20time%20to%20climb%20Mt.
8. https://www.ibm.com/think/topics/variational-autoencoder
9. Attention Is All You Need : https://arxiv.org/abs/1706.03762
10. https://jalammar.github.io/illustrated-transformer/
11. https://huggingface.co/blog/bert-101