# COURSE HANDOUT

Generative Artificial Intelligence (COM-801)

CSE- 8th SEMESTER

ACADEMIC YEAR (2024-2025)

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| Course Code | Course Name | Course Type | Cd | L | T | P | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sessional | Final Exam | Total |
| COM-801 | Generative Artificial Intelligence | Core | 3 | 3 | 0 | 0 | 50 | 100 | 150 |

**COURSE OUTCOMES**

| At the end of the course the student will be able to: | |
|---|---|
| CO1 | Explain the foundational concepts of Generative Artificial Intelligence. |
| CO2 | Analyze various AI based generative models and their applications. |
| CO3 | Describe GANs and their applicability to various unsupervised learning problems. |
| CO4 | Evaluate RNNs and LSTM models for sequential processing in Natural Language Processing. |
| CO5 | Explore use of pre-trained language models including metrics for evaluating generative models. |

**Section-A**

**Unit 1:** Introduction: Overview of Generative AI (GenAI) and its applications in various domains, Understanding the difference between generative and discriminative models, Taxonomy of generative models, GenAI modalities mappings.

(10 Hrs)

**Unit 2:** Generative Models: Fundamentals and Techniques, Introduction to basic generative models (Gaussian Mixture Models (GMMs) and Hidden Markov Models (HMMs)), Latent Variable Models, Statistical Language Models (SLM),Role of encoder and decoder networks**.**

(10 Hrs)

**Unit 3:**. Generative Adversarial Networks (GANs): Introduction to GANs and the GAN framework, Generator-discriminator adversarial training process, Variants of GANs: Conditional GANs, Wasserstein GANs. Autoregressive Models (PixelCNN and PixelRNN architectures for image generation).

(10 Hrs)

**Section-B**

**Unit 4:** Sequence Generation and Transformers: Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) cells, Introduction to Transformers: Motivation for Transformers and their advantages over RNNs, Transformer architecture: self-attention and feed-forward layers, multi-head attention mechanism.

(10 Hrs)

**Unit 5:** Language Generation with Transformers: Using pre-trained language models like GPT (Generative Pre-trained Transformer), Conditional language generation, Metrics and techniques for evaluating generative models.

(10 Hrs)

**Textbooks**

| S.No | Name of the Books | Name of the Author | Publisher Name | Edition (Pub.Yr.) |
|---|---|---|---|---|
| 1 | Generative AI with python | Joseph Babcock, Raghav Bali | Packt | 1st (2021) |
| 2. | ChatGPT for Thought Leaders and Content | Dr. Gleb Tsipursky | Intentional Insights | 1st (2023) |

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|---|---|---|---|---|
| | Creators: Unlocking the Potential of Generative AI for Innovative and Effective. | | | |

**Reference Books**

| S.No | Name of the Books | Name of the Author | Publisher Name | Edition (Pub.Yr.) |
|---|---|---|---|---|
| 1 | Exploring Deepfakes | Bryan Lyon (Author), Matt Tora | Packt Publishing | 1st (2023) |

| COURSE PLAN | | |
|---|---|---|
| **Unit-I Introduction to Gen AI** | | |
| **S.No** | **Topics** | **Recommended Books** |
| 1 | Overview of Generative AI (GenAI) and its applications in various domains | Book 1, Ch.1 |
| 2 | Understanding the difference between generative and discriminative models | Book 1, Ch.1 |
| 3 | Taxnomy of generative models, | Book 1, Ch.1 |
| 4 | GenAI modalities mappings. | Book 2, Ch.2 |
| **Unit-II Generative Models** | | |
| 5 | Fundamentals and Techniques | Book 1, Ch.2 |
| 6 | Introduction to basic generative models (Gaussian Mixture Models (GMMs) | Book 1, Ch.2 |
| 7 | Hidden Markov Models (HMMs)) | Book 1, Ch.1 |
| 8 | Latent Variable Models | Book 2, Ch.2 |
| 9 | Statistical Language Models (SLM) | Book 2, Ch.2 |
| 10 | Role of encoder and decoder networks. | Book 2, Ch.2 |
| **Unit-III Generative Adversarial Networks (GANs)** | | |
| 11 | Introduction to GANs and the GAN framework | Book 2, Ch.2 |
| 12 | Generator-discriminator adversarial training process | Book 2, Ch.2 |
| 13 | Variants of GANs: Conditional GANs | Book 2, Ch.2 |
| 14 | Wasserstein GANs | Book 2, Ch.2 |
| 15 | Autoregressive Models | Book 2, Ch.2 |
| 16 | PixelCNN and PixelRNN architectures for image generation. | Book 2, Ch.2 |
| **Unit-IV Sequence Generation and Transformers** | | |
| 17 | Recurrent Neural Networks (RNNs) | Book 2, Ch.3 |
| 18 | Long Short-Term Memory(LSTM) | Book 1, Ch.1 |
| 19 | Gated Recurrent Unit (GRU) cells | Book 1, Ch.4 |
| 20 | Introduction to Transformers | Book 2, Ch.3 |
| 21 | Motivation for Transformers and their advantages over RNNs | Book 1, Ch.3 |
| 22 | Transformer architecture | Book 2, Ch.3 |
| 23 | Self-attention and feed-forward layers | Book 1, Ch.3 |

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|---|---|---|
| 24 | multi-head attention mechanism. | Book 1, Ch.3 |
| | **Unit-V** Language Generation with Transformers | |
| 25 | Using pre-trained language models like GPT (Generative Pre-trained Transformer), | Book 2, Ch.8 |
| 26 | Conditional language generation | Book 1, Ch.8 |
| 27 | Metrics and techniques for evaluating generative models | Book 2, Ch.8 |

**ADDITIONAL WEB RESOURCES**

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|---|---|
| 1. | **MOOC: Introduction to Artificial Intelligence**<br>https://www.coursera.org/learn/generative-ai-with-llms |
| 2. | **NPTEL: https://www.cloudskillsboost.google/course_templates/536** |

**GRADING AND ASSESSMENT**

- **Sessional Test**: 20 marks
- **Assignment**: 20 marks
- **Attendance**: 10 marks
- **Final Examination**: 100 marks

**COURSE POLICIES**

- **Attendance**: Minimum 75% attendance is mandatory to appear in the final examination of the course.
- **Academic Integrity**: MIET's academic integrity policies apply. Plagiarism will not be tolerated.
- **Late Submissions**: Assignments and projects must be submitted by the specified timelines.

**FACULTY INFORMATION**

- **Office Hours**

  Tuesday(12:05 PM - 12:55 PM)
  Friday (12:05 PM - 12:55 PM)

- **Contact Information**
  azra.cse@mietjammu.in