Gen Ai Course Syllabus

**Week 1**

* + Basic Understanding of Ai Vs ML Vs DL
  + What is ML?
  + When and where to use?
  + Bias-Variance Trade off
  + Underfitting vs Overfitting
  + Evaluation Metrics (Accuracy, Precision, Recall, F1, ROC-AUC, RMSE, MAE)
  + Supervised Learning
  + Unsupervised Learning

**Week 2**

**2. Deep Learning (DL) Topics**

* 1. **Basics**

2.1.1: Neural Networks (Perceptron, MLP)

2.1.2: Activation Functions (ReLU, Sigmoid, Tanh, Softmax)

2.1.3: Loss Functions (MSE, Cross-Entropy, Hinge Loss)

2.1.4: Optimizers (SGD, Adam, RMSprop)

* 1. **Architectures**

2.2.1:CNNs (Convolutional Neural Networks) → Image processing

2.2.2: RNNs (Recurrent Neural Networks)

2.2.3: LSTMs & GRUs

2.2.4: Attention Mechanism

2.2.5: Transformers (Encoder, Decoder, Self-Attention)

**Week 3**

**3. Natural Language Processing (NLP) Topics**

* 1. **Preprocessing**

3.1.1: Text preprocessing: tokenization, stemming, lemmatization, Stopwords. Regex, HTML Strip

3.1.2: Stop-word Removal, POS tagging, Named Entity Recognition (NER)

3.1.3: POS Tagging, Word embeddings: Word2Vec, GloVe, FastText

3.1.4: N-grams & language models

3.1.5: Bag of Words (BoW), TF-IDF

**Week 4 & 5**

**4. RAG (Retrieval-Augmented Generation)**

4.1.1: Query → Retrieve → Generate workflow

4.1.2: Vector Databases (FAISS, Pinecone, Weaviate)

4.1.3: Chunking & Embedding strategies

4.1.4: Advanced RAG (multi-hop retrieval, agentic RAG)

**Week 6 & 7**

**5. Agentic AI Core**

5.1.1: Agents explained: **Plan → Decide → Act → Reflect → Learn**

5.1.2: Memory in agents (short-term, long-term, vector memory)

5.1.3: Tools & function calling (APIs, DBs, search, file systems)

5.1.4: Planning patterns:

* + **ReAct (Reason+Act)**
  + **Plan-and-Execute**
  + **Tree-of-Thought (ToT)**
  + **Self-Reflective Agents**

5.1.5: Multi-agent collaboration (specialist roles: researcher, writer, critic)

**Frameworks & Tooling**

* **LangChain** (agents, tools, memory, RAG integration)
* **CrewAI** (multi-agent collaboration, task delegation)
* **LlamaIndex** (agent runners, data connectors)
* **Microsoft AutoGen** (agent conversations)
* **MCP (Model Context Protocol)** for tool discovery & standardization

**Advanced GenAI + Agents**

* Combining RAG with Agents (RAG-as-a-Tool for agents)
* Multi-hop reasoning (chaining retrieval + reasoning steps)
* Agent orchestration patterns (hub-spoke, supervisor-worker)
* Tool orchestration (SQL agents, web browsing agents, code execution)
* Multimodal Agents (text + image + audio + video)

**Week 8**

**Reliability & Safety**

* Preventing hallucinations (grounding, self-checking, retrieval)
* Error handling (tool retries, fallbacks, safety loops)
* Guardrails for agents (prevent misuse of tools, prompt injection defense)
* Evaluation: task success, factual accuracy, latency, cost efficiency

**6. Deployment & Ops**

* Packaging agents (Docker, FastAPI, Flask)
* Deploying on **Azure OpenAI, AWS Bedrock, GCP Vertex AI**
* Monitoring agents (LangSmith, Weights & Biases)
* Cost management strategies for LLMs
* Scaling multi-agent systems in production