Curriculum Framework

Post Graduate Diploma in Computer Application

As per NEP 2020 and Learning Outcomes-based National Curriculum Framework

(Aligned with NCrF and NHEQF)

Effective From Academic Year 2026-2027

GUJARAT VIDYAPITH: AHMEDABAD

Curriculum Framework of Post Graduate Diploma in Computer Application

Published by:

Dr. Himanshu Patel

Registrar

Gujarat Vidyapith

Near Income Tax Office, Ashram Road, Ahmedabad - 380009.

From the Desk of Vice Chancellor…

Dear All,

Any curriculum, at any level, must be firmly grounded in the objectives and goals that an educator or an educational institution aspires to achieve for its students. A course that trains students to solve mathematical equations must be very different from one that teaches them how to play a musical instrument, practice yoga, or conduct social research. Each subject requires its own methods, activities, and learning goals, which is why curriculum design is so important.

Therefore, curriculum is of utmost importance, as it determines how teachers and students will spend their time—in laboratories, in clinical practice, in creative endeavors, or in interactive lectures. It also reflects what a class, a department, a school, or an institution value; what it defines as its mission; and what it expects its graduates to accomplish. In this sense, the curriculum is the map that guides the essentials of learning from the classroom level to the institutional level.

The true success of any curriculum must be judged by its ability to achieve its intended objectives. It is a test of how well an institution—or an individual teacher—understands and articulates those objectives, and how effectively a pathway is created for students to attain success as defined by them. Curriculum is, in fact, a continuous chain of activities designed to translate broad educational goals into concrete practices, learning materials, and observable changes in behavior. A lesson plan, for instance, is curriculum at the classroom level, answering the critical questions: *What do I want my students to know? How can I engage them meaningfully? How will I measure what they have learned?*

For a society to achieve its educational aspirations, the curriculum must be both functional and relevant to its needs. Through careful management of curriculum, effective use of resources, and policies that bring systemic improvements, education can move society toward a more promising future. Indeed, curriculum is the very foundation of any academic institution—without it, the institution would lose its purpose and direction.

At Gujarat Vidyapith, established by Mahatma Gandhi in 1920 with its rich cultural and educational heritage, we remain committed to these ideals, and we work with well-defined objectives to prepare our students for a brighter academic and social future.

It gives me immense pride and joy to announce the unveiling of the latest curriculum of Gujarat Vidyapith. This curriculum has been carefully designed in alignment with the objectives and guiding principles of the National Education Policy (NEP) 2020. I take this opportunity to place on record my deep appreciation for the efforts of the teaching faculty of Gujarat Vidyapith, the Members of the Board of Studies, and the Members of the Academic Council. Their dedication and vision have given shape to this comprehensive neo-curriculum, which will guide our students and our institution toward continued excellence.

With best wishes,

Dr. Harshad Patel
Vice Chancellor
Gujarat Vidyapith

Curriculum Framework

Post Graduate Diploma in Computer Application

Effective From Academic Year 2026-2027

Department of Computer Science

Faculty of Information, Communication and Technology

Gujarat Vidyapith

Board of Studies

Chairperson:

Prof. Ajay Parikh
Professor & Dean, Faculty of Information, Communication and Technology, Gujarat Vidyapith, Ahmedabad.

External Experts:

1) **Prof. Rajeev Wankar**
   Professor, University of Hyderabad

2) **Prof. Nilesh Modi**
   Professor, Babasaheb Ambedkar Open University

Members from the Department:

1) **Prof. Dhiren Patel**
   Professor, Faculty of Information, Communication and Technology, Gujarat Vidyapith, Ahmedabad.

2) **Dr. Neepa Shah**
   Associate Professor, Faculty of Information, Communication and Technology, Gujarat Vidyapith, Ahmedabad.

3) **Mr. Kamaleshkumar Salunke**
   Assistant Professor, Faculty of Information, Communication and Technology, Gujarat Vidyapith, Ahmedabad.

4) **Dr. Ruchita Shah**
   Assistant Professor, Faculty of Information, Communication and Technology, Gujarat Vidyapith, Ahmedabad.

PROGRAMME STRUCTURE							
Course Code	Course Name	Hours			Credit	Evaluations	
		Theory	Practical	Total		CCE	TEE
SEMESTER-1							
266010243013	Python Ecosystem for AI Applications- Lab Based	0	60	60	2	40	60
266010243014	Prompt Engineering - Principles & Patterns	30	0	30	2	40	60
266010243015	Large Language Models: Concepts, APIs, and Application Development	30	0	30	2	40	60
266010243016	Cloud Computing with AI Applications	30	0	30	2	40	60
266010343017	Case Studies in Generative AI - Real-World Applications	0	90	90	3	40	60
266010243018	Lab Based on Prompt Engineering - Principles & Patterns	0	60	60	2	40	60
266010243019	Lab Based on Large Language Models: Concepts, APIs, and Application Development	0	60	60	2	40	60
266010243020	Lab Based on Cloud Computing with AI Applications	0	60	60	2	40	60
266020343021	MOOC- Programming with Generative AI Appendix-A	45	0	45	3	40	60
-	Community Living	-	60	60	2*	Grade	Grade
Total		**135**	**390**	**525**	**20+2***	**360**	**540**
SEMESTER-2							
266010143022	Retrieval-Augmented Generation (RAG)	15	0	15	1	40	60
266010243023	AI Agents & Workflow Automation	30	0	30	2	40	60
266010143024	AgentOps: AI Agent Deployment and Monitoring	15	0	15	1	40	60
266010243025	Case Study (AI Ethics, Safety, Governance & Responsible AI)	0	60	60	2	40	60
266010843026	Industries Project	0	240	240	8	40	60
266010243027	Lab Based on Retrieval-Augmented Generation (RAG)	0	60	60	2	40	60
266010243028	Lab Based on AI Agents & Workflow Automation	0	60	60	2	40	60
266010243029	Lab Based on AgentOps: AI Agent Deployment and Monitoring	0	60	60	2	40	60
	MOOC (Proposed)-Elective	0	0			40	60
-	Community Living	*	60	60	2*	Grade	Grade
Total		**60**	**540**	**600**	**20+2***	**320**	**480**
GRAND TOTAL		**195**	**930**	**1125**	**44**	**680**	**1020**

***CCE- Continuous Comprehensive Evaluation; **TEE- Term End Evaluation**

Programme Contents	Credits
Core Courses	**30**
Internship	**10**
Total Credits of the Programme	**40**

Programme Outcomes (POs)

After successful completion of the PGDCA program, students will be able to:

PO1	Disciplinary Knowledge	Demonstrate foundational and advanced knowledge in Artificial Intelligence, Generative AI, Prompt Engineering, Cloud Computing, and AI-driven applications.
PO2	Problem Analysis	Identify, analyse, and interpret real-world problems using AI methodologies, computational thinking, and data-driven approaches.
PO3	Design & Development Skills	Design and develop AI-enabled solutions, workflows, and intelligent applications using modern programming and cloud technologies.
PO4	Modern Tool Usage	Apply contemporary AI tools, APIs, Python ecosystems, automation platforms, and cloud services for practical applications.
PO5	Research & Innovation	Demonstrate research aptitude, innovation skills, and experimental approaches in emerging AI technologies.
PO6	Critical Thinking	Critically evaluate AI-generated outputs and make informed decisions through analytical reasoning.
PO7	Communication Skills	Communicate technical concepts, AI solutions, and project findings effectively through written, oral, and digital modes.
PO8	Teamwork & Collaboration	Work collaboratively in multidisciplinary teams for AI project development and deployment.
PO9	Ethics & Responsible AI	Apply ethical principles, governance frameworks, fairness, privacy, and accountability in AI applications.
PO10	Environment & Society	Assess the societal, cultural, economic, and environmental impact of AI technologies responsibly.
PO11	Lifelong Learning	Engage in continuous learning and adapt to rapidly evolving AI technologies and professional practices.
PO12	Employability & Entrepreneurship	Develop employability skills, entrepreneurial abilities, and industry readiness in AI and digital innovation domains.

Programme Specific Outcomes (PSOs)

After successful completion of the PGDCA program with a specialization in Computer Application, students will be able to:

PSO1	Generative AI Application Development	Develop and implement Generative AI applications using prompt engineering, LLMs, APIs, and Python-based AI ecosystems.
PSO2	Intelligent Retrieval & AI Automation	Design Retrieval-Augmented Generation (RAG) systems, AI agents, and workflow automation solutions for real-world applications.
PSO3	Cloud-Based AI Deployment	Deploy, monitor, and manage AI applications and intelligent agents using cloud computing and AgentOps methodologies.
PSO4	Responsible & Industry-Oriented AI Solutions	Create ethical, secure, and industry-oriented AI solutions through case studies, governance frameworks, and project-based learning.

CO Attainment Levels (OBE & NEP 2020 Aligned)						
COs Attainment Levels	**Level**	**Description**	**Attainment Criteria**			
	Level 3	High	≥ 80% of students score above a set performance benchmark			
	Level 2	Moderate	60%–79% of students meet the performance benchmark			
	Level 1	Low	40%–59% of students meet the performance benchmark			
	Level 0	Not Attained	< 40% of students achieve the desired learning outcome			
Target Attainment (Benchmark)	**Cos**		**CO-1**	**CO-2**	**CO-3**	**CO-4**
	Target Level (%)		60	60	60	60

Program - PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243013	Name of Course Python Ecosystem for AI Applications-Lab Based	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO1 Understand the Python ecosystem, essential libraries, and data handling techniques required for developing AI-based applications and workflows.

CO2 Apply REST API concepts, JSON processing, and secure AI API integration techniques for consuming and managing AI services in Python applications.

CO3 Develop AI-powered Python applications for text processing, automation scripting, and command-line based intelligent workflows using structured AI outputs.

CO4 Design and implement basic AI systems with secure environment configurations, deployment concepts, and lightweight application integration using modern development practices.

Detailed Syllabus

Unit-1. Python Ecosystem for AI Applications

1.1 **Python Environment for AI Development:** Virtual environments (venv, conda – conceptual), Package management using pip, Project structuring for AI applications

1.2 **Essential Python Libraries for AI Apps:** requests (API communication), json module, os & dotenv (environment handling), logging for AI applications

1.3 **Data Handling for AI Applications:** Working with CSV and JSON datasets, Using pandas for preprocessing, Handling structured vs unstructured text data

Unit-2. API Integration & AI Service Consumption

2.1. **Understanding REST APIs:** REST architecture, HTTP methods (GET, POST), Status codes & error handling

2.2. **Working with JSON:** JSON structure & schema understanding, Parsing nested JSON, Serializing & deserializing data

2.3. **Integrating AI APIs in Python:** Sending prompts via API, Managing API keys securely, Handling token limits & response structures, Rate limiting & exception handling

Unit-3. Building AI-Powered Python Applications

3.1. **Text Processing & AI Workflows:** Prompt construction within Python, Automating summarisation pipelines, Generating structured outputs (JSON-based AI responses)

3.2. **Automation Scripting:** File-based automation, Email automation, Batch processing using Python scripts

3.3. **Building CLI-Based AI Tools:** Creating command-line tools, Input-output pipelines, Logging & debugging AI scripts

Unit-4. AI Application Design & Deployment Basics

4.1. **Environment Variables & Security:** Using environment variables for API keys, .env file configuration, Secure credential handling

4.2. **Building Mini AI Systems:** AI content generator script, AI report automation system, AI-based FAQ assistant

4.3. **Deployment Concepts (Introductory):** Running scripts on cloud VM (conceptual), Streamlit-based lightweight app (conceptual introduction), Version control with Git (basic integration)

Mapping Matrix of POs, PSOs, and COs

Cos	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	3	1	2	1	–	1	–	2	1	1.50	3	1	1	1	1.50
CO-2	2	3	3	3	2	2	1	1	2	–	2	2	1.92	3	2	2	2	2.25
CO-3	2	2	3	3	2	2	2	1	1	–	2	3	1.92	3	3	2	2	2.50
CO-4	2	2	3	2	2	3	2	1	3	2	2	3	2.25	2	2	3	3	2.50
Avg	2.25	2.25	2.75	2.75	1.75	2.25	1.50	1.00	1.75	2.00	2.00	2.25		2.75	2.00	2	2	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Lecture, Examples, Demonstration, Problem Solving, Assignments

Assessment Method

	COs	Marks	Exam Component			
			Practical Test	Quiz	Seminar + Assignment	Involvement
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	5	5	13	7
	CO-2	10				
	CO-3	10	5	5		
	CO-4	10				
Term-End Evaluation 60 Marks	COs	Marks	Exam Component			
	CO-1	15	Term End Examination			
	CO-2	15				
	CO-3	15				
	CO-4	15				

References

Books:

- Python-Crash-Course by Eric Matthes
- Python for Data Analysis by Wes McKinney
- RESTful-Web-APIs by Leonard Richardson and Mike Amundsen Foreword by Sam Ruby
- Automate the Boring Stuff with Python, 3rd Edition by Al Sweigart

Online Resources & Tools:

- **NumPy & Pandas labs**
  - **NumPy:** https://www.youtube.com/watch?v=x7ULDYs4X84
  - **Pandas:** https://www.youtube.com/watch?v=RhEjmHeDNoA
- **Rest APIs**
  - https://medium.com/@amirarahma.aa/everything-you-need-to-know-about-rest-apis-90d659dc9fc9
  - https://www.youtube.com/watch?v=cJAyEOZQUQY
- **Work With JSON Using Python**
  - https://realpython.com/python-json/

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243014	Name of Course Prompt Engineering - Principles & Patterns	Compulsory
Credit: 02	Teaching Scheme: Theory (30) - Practical (0)	Hours: 30

Course Outcomes (COs)

After completing this course, students will be able to

CO1 Understand the foundational concepts of Generative AI and apply zero-shot, one-shot, and few-shot prompting strategies for effective AI interactions.

CO2 Apply advanced reasoning and acting frameworks such as Chain-of-Thought (CoT), ReAct, Tree-of-Thought (ToT), and self-consistency techniques for solving complex AI tasks.

CO3 Design structured and role-based prompts using system prompts, persona assignment, prompt chaining, and schema-driven output techniques for specialised AI applications.

CO4 Evaluate prompt failure modes, perform prompt testing and refinement, and implement responsible and secure prompting practices for reliable AI outputs.

Detailed Syllabus

Unit-1. Foundations of Prompting Strategies

1.1. **Introduction to Generative AI: LLMs, transformers, and the prompt-response paradigm**
1.2. **Zero-shot prompting: capabilities, limitations, and optimal use cases**
1.3. **One-shot prompting: providing a single demonstration to guide model behaviour**
1.4. **Few-shot prompting: selecting and ordering in-context examples for maximum impact**
1.5. **Comparison of zero/one/few-shot approaches: when to use each strategy**
1.6. **Temperature, top-p, and other decoding parameters that affect output quality**
1.7. **Prompt tokens vs. context window: managing length and relevance**

Tutorial: Prompt writing exercises using zero-shot and few-shot templates

Unit-2. Advanced Reasoning & Acting Frameworks

2.1. **Chain-of-Thought (CoT) prompting: explicit step-by-step reasoning elicitation**
2.2. **Zero-shot CoT: 'Let's think step by step' and its variants**
2.3. **ReAct framework: interleaving reasoning traces with tool-use actions**
2.4. **Tree-of-Thought (ToT): branching exploration of multiple reasoning paths**
2.5. **Self-consistency decoding: sampling multiple paths and majority voting**
2.6. **Comparing CoT, ReAct, ToT, and Self-Consistency: problem-type fit**
2.7. **Structured scratchpads and intermediate representations**

Tutorial: Tracing reasoning steps manually before prompting; error analysis in CoT outputs

Unit-3. Prompt Design Patterns & Structured Output

3.1. **System prompts: anatomy, best practices, and scope of control**
3.2. **Persona assignment: crafting consistent character, voice, and domain-expert identities**
3.3. **Role-playing patterns: scenario-based prompting and interactive simulations**
3.4. **Structured output prompting: generating valid JSON, XML, and Markdown via prompt constraints**
3.5. **Schema-driven prompting: providing output templates and type hints inline**
3.6. **Instruction hierarchy: combining system, user, and assistant turns effectively**
3.7. **Prompt chaining: decomposing complex workflows into sequential prompt pipelines**

Tutorial: Designing system prompts for a customer-service bot, a coding assistant, and a tutor

Unit-4. Failure Modes, Evaluation & Iterative Refinement

4.1. **Taxonomy of prompt failure modes: hallucinations, confabulation, and factual drift**
4.2. **Refusals and over-refusals: safety filters, misclassification, and mitigation strategies**
4.3. **Inconsistency and instability: non-deterministic outputs and reproducibility challenges**
4.4. **Prompt injection and adversarial prompting: threats and defence patterns**
4.5. **Prompt evaluation frameworks: human rubrics, automated metrics (BLEU, ROUGE, G-Eval)**
4.6. **A/B prompt testing: controlled experiments for systematic improvement**
4.7. **Iterative refinement** pipeline: diagnose → hypothesise → revise → test loop

Mapping Matrix of POs, PSOs, and COs

Cos	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	3	1	2	1	–	1	–	2	1	1.50	3	2	1	1	1.75
CO-2	2	3	3	3	2	3	1	1	1	–	2	2	1.92	3	3	2	2	2.50
CO-3	3	2	3	3	2	2	2	1	1	–	2	2	1.92	3	2	2	2	2.25
CO-4	2	3	2	2	2	3	2	1	3	2	2	3	2.25	2	2	2	3	2.25
Avg	2.50	2.50	2.50	2.75	1.75	2.50	1.50	1.00	1.50	2.00	2.00	2.00		2.75	2.25	1.75	2	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3)	• Examples, Questioning, Assignment
CO-4 (Unit: 4)	• Problem Solving, Experimental, Project

Assessment Method

	COs	Marks	Exam Component		
			Class Test	Assignment	Presentation
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	5	7	13
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

References

Books:

- AI Prompt Engineering Absolute Beginner's Guide by Michael Miller
- Prompt Engineering by Lee Boonstra

Online Resources & Tools:

- https://www.promptingguide.ai/
- https://www.mercity.ai/blog-post/advanced-prompt-engineering-techniques/
- https://arxiv.org/html/2401.14423v4#S4
- Prompt Engineering - SWAYAM Plus

Program - PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243015	Name of Course **Large Language Models: Concepts, APIs, and Application Development**	Compulsory
Credit: 02	**Teaching Scheme: Theory (30) - Practical (0)**	**Hours: 30**

Course Outcomes (COs)

After completing this course, students will be able to

CO1 Understand the evolution, architecture, and application domains of Large Language Models (LLMs), including transformer architecture, major LLM ecosystems, and evaluation methodologies.

CO2 Apply advanced LLM API functionalities, parameter optimisation, asynchronous processing, and responsible AI practices for efficient and scalable AI application development.

CO3 Develop AI-powered applications using modern LLM frameworks, vector databases, and no-code/low-code platforms for document retrieval, conversational AI, and intelligent workflows.

CO4 Deploy and evaluate local and cloud-based LLM systems, build multimodal AI applications, and analyse the ethical and societal implications of Large Language Models.

Detailed Syllabus

Unit-1. LLM Foundations: Architecture & Evolution

1.1 AI → ML → DL → LLM: evolution & landscape
1.2 Key Application Domains: NLP, Computer Vision, Speech, Robotics
1.3 Transformer architecture: attention mechanism, encoder-decoder
1.4 Major LLMs: GPT-4, Claude 3, Gemini, Llama 3, Mistral
1.5 Generative vs discriminative models—conceptual overview
1.6 Key milestones: GANs → VAEs → Diffusion Models → LLMs
1.7 Evaluation metrics: BLEU, ROUGE, perplexity, human evaluation

Unit-2. LLM APIs — Advanced Usage & Performance Optimisation

2.1 API keys, authentication & request-response lifecycle
2.2 Parameters: temperature, top-p, stop sequences, max tokens
2.3 System prompts, roles & context window management
2.4 Streaming & asynchronous API calls
2.5 Batch processing, rate limits & cost budgeting
2.6 AI safety & responsible AI — practical perspective

Unit-3. LLM Frameworks for Application Development

3.1 LangChain framework: chains, memory, output parsers
3.2 LlamaIndex: document-based querying
3.3 Use-cases: chatbot, document QA systems
3.4 Vector databases: Chroma, Pinecone, FAISS — concepts
3.5 AI platforms: Hugging Face, Google Colab, Kaggle
3.6 No-code & Low-code AI Tools

Unit-4. Local LLM Deployment, Multimodal AI & End-to-End Project

4.1 Local models: Ollama, LM Studio—concepts & benefits
4.2 Running open-source LLMs locally (Llama 3, Mistral, Phi-3, Gemma)
4.3 Cloud APIs vs local models: trade-offs & selection criteria
4.4 Multimodal AI: vision-language models (GPT-4o, Gemini Vision)
4.5 Ecosystem players: OpenAI, Anthropic, Google, Meta AI, Mistral
4.6 Ethical considerations & societal impact of LLMs

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	3	2	2	1	–	1	–	2	1	1.58	3	2	1	1	1.75
CO-2	2	3	3	3	2	3	1	1	2	–	2	2	2.00	3	2	2	2	2.25
CO-3	2	3	3	3	2	2	2	1	1	–	2	3	2.00	3	3	2	2	2.50
CO-4	2	2	3	2	2	3	2	1	3	2	2	3	2.25	2	2	3	3	2.50
Avg	2.25	2.50	2.75	2.75	2	2.50	1.50	1.00	1.75	2.00	2.00	2.25	2	2.75	2.25	2	2	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Laboratory Teaching, Assignment, Practical, Seminar, Case Study

Assessment Method

			Exam Component		
	COs	Marks	Class Test	Assignment	Participation/ Performance
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	5	13	7
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

References

Books:

- Mastering Ollama: Run, Optimize, and Deploy AI Models Locally by Ted Winston
- Ollama Fast Track: A Hands-On Guide to Building Local LLM-Powered Applications by Eric Chandler Jr (Author)
- Generative AI with LangChain - Second Edition: Build production-ready LLM applications and advanced agents using Python, LangChain, and LangGraph Paperback – 23 May 2025 by Ben Auffarth (Author), Leonid Kuligin (Author)

Online Resources & Tools:

- https://www.youtube.com/watch?v=8fX3rOjTloc (Youtube - Free -CampusX)
- System Prompts
  https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/
- Streaming & asynchronous API calls
  - https://docs.python.org/3/library/asyncio.html
  - https://gautam75.medium.com/streaming-llm-responses-importance-and-implementation-911b135ef541
- Rate Limits
  - https://developers.openai.com/cookbook/examples/how_to_handle_rate_limits
- Cost Budgeting
  - https://python.plainenglish.io/how-to-reduce-chatgpt-api-costs-in-python-projects-02b7ebdce6f6

- https://learnwith.campusx.in/courses/Generative-AI-Projects-using-Llamaindex-660dad017a92fb75afc0fe04 (llamaindex - Free - CampusX)
- https://learnwith.campusx.in/courses/Gen-AI-Projects-using-Langchain-660a9a1d7908621df055074f (LangChain - Free - CampusX)
- https://www.youtube.com/watch?v=YcAYmIFtA0o (Ollama - Youtube - Free -CampusX)
- https://www.youtube.com/watch?v=nAmC7SoVLd8&pp=ygUSbGFuZ2NoYWluIHR1dG9yaWFs
- https://www.youtube.com/watch?v=pSVk-5WemQ0&list=PLKnIA16_RmvaTbihpo4MtzVm4XOQa0ER0
- https://rdi.berkeley.edu/responsible-genai/assets/CS294-Lecture-3_1.pdf
- https://github.com/rasbt/LLMs-from-scratch
- https://github.com/pathwaycom/llm-app

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243016	Name of Course Cloud Computing with AI Application	Compulsory
Credit: 02	Teaching Scheme: Theory (30) - Practical (0)	Hours: 30

Course Outcomes (COs)

After completing this course, students will be able to

CO1 Understand the fundamental concepts, service models, deployment models, and major platforms of cloud computing for modern digital and AI applications.

CO2 Explain cloud infrastructure technologies including virtualization, containerization, cloud storage, networking, and cost management mechanisms.

CO3 Apply cloud-based AI services and pre-trained APIs from major cloud providers to develop intelligent and scalable AI-enabled solutions.

CO4 Analyse cloud-based data services, collaborative AI tools, and real-world case studies to design practical cloud-supported AI applications and workflows.

Detailed Syllabus

Unit-1. Fundamentals of Cloud Computing

1.1. Introduction to Cloud Computing: definition, characteristics, evolution
1.2. Cloud Service Models: IaaS, PaaS, SaaS — concepts and examples
1.3. Cloud Deployment Models: Public, Private, Hybrid, Multi-Cloud
1.4. Major Cloud Providers: AWS, Google Cloud Platform, Microsoft Azure — overview

Unit-2. Cloud Infrastructure & Core Technologies

2.1. Virtualization: Virtual Machines (VMs), Hypervisors
2.2. Docker basic architecture: images, containers, volumes, networks
2.3. Cloud Storage: Object, Block, File storage
2.4. Cloud Networking: VPC, Load Balancers, CDN, DNS basics
2.5. Pricing models and cost management

Unit-3. Cloud AI Services & Platforms

3.1. AI-as-a-Service (AIaaS): concept and benefits
3.2. AWS AI/ML services: Rekognition, Comprehend, Translate, Polly, AWS Bedrock, Lex
3.3. Google Cloud AI services: GCP Vertex, Vision AI, Natural Language, Speech-to-Text, AutoML
3.4. Azure Cognitive Services: Face API, Text Analytics, Bot Service, Azure OpenAI
3.5. Pre-trained models & APIs usage

Unit-4. Cloud Data, Tools & Real-World Applications

4.1. Cloud-based data services: BigQuery, Redshift, Azure Synapse
4.2. Jupyter Notebooks & Google Colab for AI experiments
4.3. Case studies: real-world AI solutions built on cloud platforms

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	3	1	2	1	–	1	1	2	1	1.58	2	1	3	1	1.75
CO-2	2	3	3	3	2	2	1	1	2	1	2	2	2.00	2	2	3	2	2.25
CO-3	2	3	3	3	2	2	2	1	2	1	2	3	2.17	3	2	3	2	2.50
CO-4	2	3	3	2	2	3	2	1	3	2	2	3	2.33	2	3	3	3	2.75
Avg	2.25	2.75	2.75	2.75	1.75	2.25	1.50	1.00	2.00	1.25	2.00	2.25		2.25	2.00	3	2	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1)	• Examples, Questioning, Assignment
CO-2 (Unit: 2)	
CO-3 (Unit: 3)	
CO-4 (Unit: 4)	• Problem Solving, Experiments, Project

Assessment Method

Continuous Comprehensive Evaluation 40 Marks	**COs**	**Marks**	**Exam Component**		
			Class Test	**Assignment**	**Presentation**
	CO-1	10	5	7	13
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	**COs**	**Marks**	**Exam Component**		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

References

Books:

- Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig
- Cloud Computing Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej Goscinski
- Cloud Computing: A Practical Approach by Anthony T. Velte, Toby J. Velte and Robert Elsenpeter

Online Resources & Tools:

- https://www.skills.google/paths/36 (By Google- Free)

Program - PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010343017	Name of Course Case Studies in Generative AI — Real-World Applications	Compulsory
Credit: 03	Teaching Scheme: Theory (0) - Practical (90)	Lab Hours: 90

Course Outcomes (COs)

After completing this course, students will be able to

CO1 Understand the real-world applications of Generative AI across customer support, healthcare, legal systems, education, media, retail, and the startup ecosystem.

CO2 Analyse the impact of AI technologies on productivity, decision-making, automation, and user experience through industry-oriented case studies.

CO3 Evaluate AI case studies using frameworks based on return on investment (ROI), ethical considerations, risks, governance, and responsible AI practices.

CO4 Develop professional skills in industry case analysis, report writing, research presentation, and recommendation formulation for AI-driven business solutions.

Detailed Syllabus

Case Study 1: ChatGPT in customer support — Swiggy, Zomato, and HDFC Bank deployments
Case Study 2: GitHub Copilot — productivity impact, code quality, and adoption challenges
Case Study 3: AI in healthcare — Google Med-PaLM 2 and clinical decision support systems
Case Study 4: Legal AI — Harvey.ai in contract review and due diligence workflows
Case Study 5: EdTech — Khanmigo AI tutor and personalised adaptive learning at scale
Case Study 6: Generative AI in media — Reuters, NDTV, and AI-assisted journalism
Case Study 7: Retail & e-commerce — Amazon AI-generated product descriptions at scale
Case Study 8: Failures and lessons — Air Canada chatbot lawsuit, Samsung data leak
Case Study 9: Indian startup ecosystem — Sarvam AI, Krutrim, and vernacular LLMs
Framework for evaluating AI case studies: ROI, risk assessment, ethical dimensions
Group presentations: students research and present an original industry case analysis
Writing a case study report: structure, methodology, findings, and recommendations

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	2	2	1	1	2	2	2	1	1.75	2	1	1	2	1.50
CO-2	2	3	2	2	2	3	2	1	2	2	2	2	2.08	2	2	1	3	2.00
CO-3	2	3	2	2	3	3	2	1	3	2	2	2	2.25	2	2	1	3	2.00
CO-4	2	2	2	2	2	2	3	2	2	1	2	3	2.08	2	1	1	3	1.75
Avg	2.25	2.5	1.75	2	2.25	2.50	2.00	1.25	2.25	1.75	2	2		2	1.50	1	2.75	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental, Group Discussion, Presentation, Case Study, Seminar

Assessment Method					
Continuous Comprehensive Evaluation 40 Marks	**COs**	**Marks**	**Exam Component**		
			Class Test	**Assignment**	**Participation/ Performance**
	CO-1	10	5	13	7
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	**COs**	**Marks**	**Exam Component**		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243018	Name of Course Lab based on Prompt Engineering - Principles & Patterns	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Apply fundamental prompting techniques, including zero-shot, one-shot, and few-shot prompting, to generate effective responses from Large Language Models (LLMs).

CO-2: Design and implement advanced reasoning prompts using Chain-of-Thought (CoT), ReAct, Tree-of-Thought (ToT), and self-consistency frameworks for solving complex problems.

CO-3: Develop structured and role-based prompt workflows by employing system prompts, persona design, prompt chaining, and schema-driven output generation techniques.

CO-4: Evaluate, test, and refine prompts by identifying failure modes, mitigating prompt injection risks, and applying systematic prompt evaluation and iterative improvement methodologies.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	3	1	2	1	–	1	–	2	2	1.5	2	2	1	1	1.5
CO-2	3	3	3	3	2	3	1	1	1	–	2	2	2	3	2	1	2	2
CO-3	3	2	3	3	2	2	2	1	1	–	2	3	2	3	3	1	2	2.25
CO-4	2	3	2	2	3	3	2	1	3	2	2	2	2.25	3	2	3	3	2.75
Avg	2.75	2.5	2.25	2.75	2	2.5	1.5	0.75	1.5	0.5	2	2.25		2.75	2.25	1.5	2	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental Learning, Demonstration and Guided Practice • Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Practical Test	Journal	Viva
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	10	13	7
	CO-2	10			
	CO-3	10	10		
	CO-4	10			
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243019	Name of Course Lab based on Large Language Models: Concepts, APIs, and Application Development	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Demonstrate the fundamental concepts of Large Language Models (LLMs), including transformer architecture, major LLM ecosystems, generative AI paradigms, and evaluation metrics through hands-on experimentation.

CO-2: Apply advanced LLM API techniques by configuring model parameters, managing context and prompts, and implementing streaming, asynchronous, and cost-optimized AI applications.

CO-3: Develop AI-powered applications using modern LLM frameworks, vector databases, and AI platforms to build chatbots, document question-answering systems, and intelligent workflows.

CO-4: Design and evaluate end-to-end AI solutions by deploying local and cloud-based LLMs, experimenting with multimodal AI systems, and assessing their ethical, societal, and practical implications.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	2	2	1	–	1	3	2	1	2	2	1	1	2	1.5
CO-2	3	2	3	3	2	2	1	1	2	3	2	3	3	3	2	2	2	2.25
CO-3	3	3	3	3	2	2	2	1	1	3	3	3	3	3	3	2	2	2.5
CO-4	3	3	3	3	3	3	2	1	3	3	3	3	3	3	2	3	3	2.75
Avg	3	2.5	2.5	2.75	2.25	2.25	1.5	0.75	1.75	3	2.5	2.5		2.75	2	2	2.25	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental Learning, Demonstration and Guided Practice • Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Practical Test	Journal	Viva
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	10	13	7
	CO-2	10			
	CO-3	10	10		
	CO-4	10			
Term-End Evaluation 60 Marks	**COs**	**Marks**	**Exam Component**		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 1

Course Code 266010243020	Name of Course Lab based on Cloud Computing with AI Application	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Demonstrate the fundamental concepts of cloud computing, including service models, deployment models, and major cloud platforms through hands-on experimentation.

CO-2: Apply cloud infrastructure technologies such as virtualization, containerization, cloud storage, networking, and cost management techniques for deploying and managing cloud resources.

CO-3: Develop AI-enabled applications by utilizing cloud-based AI services, pre-trained models, and APIs offered by AWS, Google Cloud Platform, and Microsoft Azure.

CO-4: Design and implement cloud-based data analytics and AI solutions using cloud data services, Jupyter Notebooks, Google Colab, and real-world cloud application case studies.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	1	1	1	–	1	1	2	2	1.42	1	1	2	1	1.25
CO-2	3	2	3	3	2	2	1	1	1	–	2	3	1.92	2	2	3	2	2.25
CO-3	3	3	3	3	2	2	1	1	2	1	2	3	2.17	3	2	3	2	2.5
CO-4	3	3	3	3	3	2	2	1	2	2	2	3	2.42	2	2	3	3	2.5
Avg	3	2.5	2.5	2.75	2	1.75	1.25	0.75	1.5	1	2	2.75		2	1.75	2.75	2	

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Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental Learning, Demonstration and Guided Practice • Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Practical Test	Journal	Viva
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	10	13	7
	CO-2	10			
	CO-3	10	10		
	CO-4	10			
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Appendix-A

Program – PGDCA (Faculty of Information, Communication and Technology)		
Semester- 1		
Course Code **266020343021**	**Name of Course** **MOOC-Programming with Generative AI**	**MOOC**
Credit: 03 **NCrF level: 4.5 – 8.0**	**Teaching Scheme: Theory (Online)**	**Teaching Hours:** **8 Weeks**

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Use Generative AI tools and techniques for assisting software development, enabling them to understand data representation, programming fundamentals, and AI-assisted code generation.

CO-2: Analyze and decompose complex computational problems into manageable tasks and utilize Generative AI effectively for designing, implementing, and debugging program solutions.

CO-3: Skills in writing structured, modular, and efficient programs through the use of functions, recursion, testing methodologies, and AI-supported code evaluation practices.

CO-4: Learn and adapt to new programming languages and technologies with the support of Generative AI, while understanding performance optimization, memory management, and best programming practices.

Detailed Syllabus

Week 1: Introduction: What is programming and how effective are modern GenAI tools at programming? Optional: Installing GenAI tools on your computer.

Week 2: Representing and manipulating data: Fundamental data types (and potential mismatches with a problem's needs), objects, expressions, assignments, and error handling in Python.

Week 3: Decomposing complex problems: Using functions to represent and solve sub-problems, principles of good function design. Introduction to conditionals and recursion in Python.

Week 4: Critiquing code: Comprehending and testing code (including AI-generated code) to identify potential errors. Introduction to lists and iteration in Python.

Week 5: Debugging problem statements and code: Asking clarifying questions, manual and AI-assisted debugging. Introduction to dictionaries in Python.

Week 6: Learning a new programming language (C): C vs Python: key differences. Introduction to arrays and structures in C.

Week 7: Introduction to memory management in C: A deeper understanding of Python lists by developing a simplified implementation of Python lists in C.

Week 8: Fast implementations: Identifying "hot" Python code and translating into C, a peek ahead into Data Structures and Algorithm.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Avg**	**1**	**2**	**3**	**4**	**Avg**
CO-1	3	2	1	3	1	2	1	-	1	-	2	1	**2**	3	2	1	1	**2**
CO-2	2	3	3	3	2	3	1	1	1	-	2	2	**2**	3	3	1	2	**2**
CO-3	2	3	3	2	2	3	1	1	1	-	2	2	**2**	3	2	1	2	**2**
CO-4	2	2	2	3	2	2	1	1	1	1	3	2	**2**	2	2	2	2	**2**
Avg	**2**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

<table>
<tr><th colspan="4">Teaching Pedagogy</th></tr>
<tr><td>CO-1 (Unit: 1)
CO-2 (Unit: 2)
CO-3 (Unit: 3)
CO-4 (Unit: 4)</td><td colspan="3">• As per MOOC Instructor</td></tr>
<tr><th colspan="4">Assessment Method</th></tr>
<tr><td colspan="2" rowspan="2">Continuous Comprehensive Evaluation
40 Marks</td><td colspan="2">Exam Component</td></tr>
<tr><td colspan="2">AS per MOOC Guidelines</td></tr>
<tr><td rowspan="2">Term-End Evaluation
60 Marks</td><td>Case Study</td><td>Theory</td><td>Exam Component</td></tr>
<tr><td>20</td><td>40</td><td>Term End Examination</td></tr>
<tr><th colspan="4">References</th></tr>
<tr><td colspan="4">Books:
• Python 3 documentation (https://docs.python.org/3/)
• The GNU C Reference Manual (https://www.gnu.org/ software/gnu-c-manual/gnu-c-manual.html)
• Learn AI-Assisted Python Programming (Leo Porter and Daniel Zingaro, Manning Sept 2023, ISBN 9781633437784)
Online Resources & Tools:
• UGC Swayam Portal(Swayam Central)</td></tr>
<tr><td colspan="4">Course Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs188
Course Instructor: Prof. Viraj Kumar, IISC Bangalore</td></tr>
</table>

Program - PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code 266010143022	Name of Course Retrieval-Augmented Generation (RAG)	Compulsory
Credit: 01	Teaching Scheme: Theory (15) - Practical (0)	Hours: 15

Course Outcomes (COs)

After completing this course, students will be able to

CO1 Explain the limitations of Large Language Models (LLMs) and apply embeddings, tokenization, semantic search, and Retrieval-Augmented Generation (RAG) concepts to enhance the accuracy and relevance of AI-generated responses.

CO2 Design and implement vector database solutions by creating, storing, indexing, retrieving, and managing embeddings using modern vector databases and embedding models.

CO3 Develop document retrieval pipelines using document ingestion, chunking strategies, semantic search, hybrid retrieval methods, re-ranking, and contextual compression techniques for efficient information retrieval.

CO4 Build and evaluate end-to-end Retrieval-Augmented Generation (RAG) applications by integrating LLMs, vector databases, and retrieval systems to create domain-specific question-answering systems and intelligent chatbots.

Detailed Syllabus

Unit-1. Enhancing LLMs with RAG and Semantic Search

1.1. Limitations of LLMs (hallucination, outdated knowledge, context limits)
1.2. Need for external knowledge integration
1.3. Introduction to Retrieval-Augmented Generation (RAG)
1.4. Basics of embeddings, Tokenisation & semantic understanding

Unit-2. Vector Databases & Embedding Systems

2.1. Vector databases: concepts & architecture
2.2. Overview: Pinecone, Weaviate, Chroma, pgvector, Qdrant
2.3. Indexing, storage & retrieval mechanisms
2.4. Embedding models: OpenAI ada-002, sentence-transformers

Unit-3. Document Processing & Retrieval Techniques

3.1. Document ingestion pipeline
3.2. Chunking strategies & overlapping windws
3.3. Semantic search vs keyword search
3.4. Hybrid retrieval approaches
3.5. Re-ranking & contextual compression

Unit-4. RAG Systems & Application Development

4.1. Architecture of domain-specific Q&A systems
4.2. RAG pipeline design (retrieval + generation)
4.3. Evaluation of QA systems

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	1	3	1	–	1	–	2	1	1.7	2	3	1	2	2
CO-2	3	2	3	3	2	2	1	1	–	–	2	2	2.1	2	3	2	2	2.25
CO-3	2	3	3	3	2	3	1	1	–	–	2	2	2.2	2	3	2	2	2.25
CO-4	3	3	3	3	3	2	2	2	2	1	2	3	2.41	3	3	2	3	2.75
Avg	2.75	2.5	2.5	2.75	2	2.5	1.25	1.33	1.5	1	2	2		2.25	3	1.75	2.25	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy	
CO-1 (Unit: 1) **CO-2 (Unit: 2)** **CO-3 (Unit: 3)** **CO-4 (Unit: 4)**	• Experiential Learning, Demonstration and Guided Practice, Project-Based Learning, Reflective Practice

Assessment Method

Continuous Comprehensive Evaluation 40 Marks	**COs**	**Marks**	**Exam Component**		
			Class Test	**Assignment**	**Participation/ Performance**
	CO-1	10	5	13	7
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	**COs**	**Marks**	**Exam Component**		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

References

Books:

- A Simple Guide to Retrieval Augmented Generation by Abhinav Kimothi

Online Resources & Tools:

- https://www.youtube.com/watch?v=o126p1QN_RI&pp=ygUHcmFnIGFwcA%3D%3D
- https://www.trychroma.com/
- https://qdrant.tech/
- https://pypi.org/project/sentence-transformers/
- https://learn.deeplearning.ai/courses/embedding-models-from-architecture-to-implementation (Deeplearning.ai)
- https://learn.deeplearning.ai/courses/advanced-retrieval-for-ai (Deeplearning.ai)
- https://www.coursera.org/learn/retrieval-augmented-generation-rag (Coursera - Deeplearning.ai)
- https://aws.amazon.com/what-is/retrieval-augmented-generation/
- https://blogs.nvidia.com/blog/what-is-retrieval-augmented-generation/

Program - PGDCA (Faculty of Information, Communication and Technology) Semester- 2		
Course Code **266010243023**	**Name of Course** **AI Agents & Workflow Automation**	**Compulsory**
Credit: 02	**Teaching Scheme: Theory (30) - Practical (0)**	**Hours: 30**

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Explain the architecture, components, and operational principles of AI agents, including perception, reasoning, action loops, tool usage, function calling, and React-based agent workflows.

CO-2: Design and implement AI agent applications using modern agentic frameworks such as LangChain, LangGraph, OpenAI Assistants API, and CrewAI, selecting appropriate frameworks for different problem domains.

CO-3: Develop intelligent agent systems incorporating memory, planning strategies, multi-agent collaboration, and workflow tracing to solve complex tasks efficiently and reliably.

CO-4: Build enterprise-grade AI agent solutions with automation capabilities, human-in-the-loop mechanisms, safety guardrails, and responsible deployment practices for real-world applications.

Detailed Syllabus

Unit-1. Introduction to AI Agents

1.1. What is an AI agent? – Perception, reasoning, action loop
1.2. Agent components: LLM brain, tools, memory, planning
1.3. ReAct (Reason + Act) pattern – worked examples
1.4. Tool use and function calling in OpenAI and Anthropic APIs
1.5. Simple agent from scratch: web search + calculator + LLM orchestration

Unit-2. Agentic Frameworks

2.1. LangChain Agents: AgentExecutor, Tool, Toolkit
2.2. LangGraph: stateful graph-based agent workflows
2.3. OpenAI Assistants API: threads, runs, and built-in tools
2.4. CrewAI: role-based agent teams with defined goals
2.5. Choosing the right framework for a given use case

Unit-3. Memory, Planning & Multi-Agent Systems

3.1. Agent memory types: in-context, summary, external (vector store)
3.2. Planning strategies: ReWOO, LLM-Compiler, Plan-and-Execute
3.3. Multi-agent coordination: orchestrator-worker pattern
3.4. Inter-agent communication and handoffs
3.5. Debugging agentic workflows: tracing with LangSmith

Unit-4. Enterprise Automation & Safety

4.1. Automating email, calendar, and document workflows with AI agents
4.2. Text-to-SQL agents for database querying
4.3. Human-in-the-loop: approval steps and interruption patterns
4.4. Agent safety: guardrails, sandboxing, and cost controls
4.5. Case studies: AI agents in customer support, code review, research

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	1	2	1	–	1	–	2	1	1.6	2	3	1	2	2
CO-2	3	2	3	3	2	2	1	1	1	–	2	2	2	3	3	2	2	2.5
CO-3	3	3	3	3	3	3	1	2	1	–	2	2	2.36	3	3	2	2	2.5
CO-4	3	3	3	3	2	2	2	2	3	2	2	3	2.5	3	3	2	3	2.75
Avg	3	2.5	2.5	2.75	2	2.25	1.25	1.25	1.5	0.5	2	2		2.75	3	1.75	2.25	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experiential Learning, Demonstration and Guided Practice, Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Class Test	Assignment	Participation/ Performance
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	5	13	7
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

References

Books:

- Building Agentic AI Systems: Create intelligent, autonomous AI agents that can reason, plan, and adapt by Anjanava Biswas and Wrick Talukdar

Online Resources & Tools:

- LangGraph Documentation (langchain-ai.github.io/langgraph)
- Agent Development Kit By Google (https://adk.dev/)
- CrewAI Documentation (docs.crewai.com)
- OpenAI Assistants API Documentation
- Yao et al. – ReAct: Synergizing Reasoning and Acting in LLMs (arXiv 2022)

Program - PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code 266010143024	Name of Course **AgentOps:** **AI Agent Deployment and Monitoring**	
Credit: 01	**Teaching Scheme: Theory (15) - Practical (0)**	**Hours: 15**

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Explain the concepts, lifecycle, architecture, observability mechanisms, and responsible AI practices involved in AgentOps for developing, monitoring, and managing AI agents.

CO-2: Apply experiment tracking, session management, prompt versioning, event logging, and A/B testing techniques to evaluate and optimize AI agents using AgentOps and related MLOps tools.

CO-3: Design and deploy containerized AI agent applications using Docker, Docker Compose, and Kubernetes while managing dependencies, scalability, security, and computing resources.

CO-4: Develop, deploy, monitor, and optimize cloud-native and serverless AI agent solutions using modern cloud platforms, CI/CD pipelines, observability tools, and cost-efficient deployment strategies.

Detailed Syllabus

Unit-1. Introduction to AgentOps & its lifecycle

1.1 What is AgentOps? — overview, scope & industry relevance
1.2 AI agent lifecycle: build → test → deploy → monitor → retire
1.3 MLOps vs AgentOps vs DevOps — key differences
1.4 Agent types: task agents, RAG agents, tool-use agents
1.5 Observability fundamentals: logs, traces, metrics
1.6 AgentOps SDK architecture & core concepts
1.7 Responsible AI in agent pipelines — safety & guardrails

Unit-2. Experiment Tracking & Model Management

2.1 Why experiment tracking matters in AI development
2.2 AgentOps session management & event recording
2.3 Prompt versioning & template management
2.4 A/B testing AI agents — strategy & metrics
2.5 Comparing MLflow vs Weights & Biases vs AgentOps

Unit-3. Containerization for AI Applications

3.1 Containerizing LLM/Agent applications using Docker
3.2 Writing Dockerfile for RAG / agent-based apps
3.3 Managing dependencies (OpenAI, vector DBs, LangChain agents)
3.4 Multi-stage builds for optimized AI containers
3.5 Docker Compose for agent + database + API setup
3.6 Intro to Kubernetes for scaling AI agents (pods, deployments)
3.7 Handling GPU / CPU workloads for AI containers
3.8 Container security for LLM APIs & secrets (API key**s)**

Unit-4. Cloud & Serverless AI Deployment

4.1 Deployment architectures for AI agents (API-based, async agents)
4.2 Serverless AI agents using: AWS Lambda, Google Cloud Run, Azure Functions
4.3 Hosting LLM-powered APIs (FastAPI + agent backend)
4.4 API Gateway + serverless for agent endpoints
4.5 Secrets management (API keys, vector DB credentials)
4.6 Cost optimization for LLM apps (tokens, latency, scaling)
4.7 CI/CD for AI agents using GitHub Actions
4.8 Monitoring & observability: Amazon CloudWatch, Google Cloud Monitoring, AgentOps integration
4.9 Configuration & environment management for agents

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	1	2	1	–	3	2	2	1	1.8	2	2	2	3	2.25
CO-2	2	3	2	3	3	3	1	1	1	–	2	2	2.09	2	3	2	2	2.25
CO-3	2	2	3	3	2	2	1	2	1	–	2	3	2.09	2	2	3	2	2.25
CO-4	3	3	3	3	2	2	2	2	2	1	2	3	2.33	2	2	3	3	2.5
Avg	2.5	2.5	2.25	2.75	2	2.25	1.25	1.7	1.75	1.5	2	2.25		2	2.25	2.5	2.5	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Lecture, Seminar, Examples, Problem Solving, Experiments

Assessment Method

	COs	Marks	Exam Component			
			Class Test	Assignment	Presentation	Involvement
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	5	7	7	6
	CO-2	10	5			
	CO-3	10	5			
	CO-4	10	5			
Term-End Evaluation 60 Marks	COs	Marks	Exam Component			
	CO-1	15	Term End Examination			
	CO-2	15				
	CO-3	15				
	CO-4	15				

References

Books:

- AI Engineering, Author: Chip Huyen, Publisher: O'Reilly Media, First publication date: December 2024

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code	Name of Course	Compulsory
266010243025	Case Study (AI Ethics, Safety, Governance & Responsible AI)	
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Understand the real-world applications of Generative AI across customer support, healthcare, legal systems, education, media, retail, and the startup ecosystem.

CO-2: Analyse the impact of AI technologies on productivity, decision-making, automation, and user experience through industry-oriented case studies.

CO-3: Evaluate AI case studies using frameworks based on return on investment (ROI), ethical considerations, risks, governance, and responsible AI practices.

CO-4: Develop professional skills in industry case analysis, report writing, research presentation, and recommendation formulation for AI-driven business solutions.

Detailed Syllabus

Case Study 1: ChatGPT in customer support — Swiggy, Zomato, and HDFC Bank deployments
Case Study 2: GitHub Copilot — productivity impact, code quality, and adoption challenges
Case Study 3: AI in healthcare — Google Med-PaLM 2 and clinical decision support systems
Case Study 4: Legal AI — Harvey.ai in contract review and due diligence workflows
Case Study 5: EdTech — Khanmigo AI tutor and personalised adaptive learning at scale
Case Study 6: Generative AI in media — Reuters, NDTV, and AI-assisted journalism
Case Study 7: Retail & e-commerce — Amazon AI-generated product descriptions at scale
Case Study 8: Failures and lessons — Air Canada chatbot lawsuit, Samsung data leak
Case Study 9: Indian startup ecosystem — Sarvam AI, Krutrim, and vernacular LLMs
Framework for evaluating AI case studies: ROI, risk assessment, ethical dimensions
Group presentations: students research and present an original industry case analysis
Writing a case study report: structure, methodology, findings, and recommendations

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	1	2	2	2	1	1	2	2	2	1	1.75	2	1	1	2	1.50
CO-2	2	3	2	2	2	3	2	1	2	2	2	2	2.08	2	2	1	3	2.00
CO-3	2	3	2	2	3	3	2	1	3	2	2	2	2.25	2	2	1	3	2.00
CO-4	2	2	2	2	2	2	3	2	2	1	2	3	2.08	2	1	1	3	1.75
Avg	2.25	2.50	1.75	2	2.25	2.50	2	1.25	2.25	1.75	2	2	2.04	2	1.50	1	2.75	1.81

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Assessment Method

	COs	Marks	Exam Component		
			Class Test	Assignment	Participation/ Performance
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	5	13	7
	CO-2	10	5		
	CO-3	10	5		
	CO-4	10	5		
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Program - PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code 266010843026	Name of Course Industries Project	Compulsory
Credit: 08	Teaching Scheme: Theory (0) - Practical (240)	Hours: 240

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Analyze industrial problems and design AI-based solutions using Generative AI, Large Language Models (LLMs), Retrieval-Augmented Generation (RAG), and AI Agent technologies.

CO-2: Develop and deploy scalable AI applications using Prompt Engineering, Cloud Computing platforms, and Workflow Automation tools.

CO-3: Apply AgentOps techniques for monitoring, evaluation, optimization, and maintenance of AI agents in real-world industrial environments.

CO-4: Demonstrate ethical, safe, and responsible AI practices through proper governance, documentation, presentation, and performance evaluation of industry-oriented AI projects.

Mapping Matrix of POs, PSOs, and COs

Cos	Pos													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	3	3	2	2	2	1	1	1	1	1	2	1.83	3	3	2	2	2.5
CO-2	3	2	3	3	2	1	1	2	1	1	2	3	2	3	2	3	1	2.25
CO-3	2	2	2	3	2	3	1	2	2	1	2	3	2.08	2	3	3	2	2.5
CO-4	2	1	1	1	2	2	3	2	3	3	2	2	2	1	1	2	3	1.75
Avg	2.5	2	2.25	2.25	2	2	1.5	1.75	1.75	1.5	1.75	2.5	1.97	2.25	2.25	2.5	2	2.25

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Assessment Method (As per the PGDCA Internship guideline)

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code 266010243027	Name of Course Lab based on Retrieval-Augmented Generation (RAG)	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Demonstrate the concepts of embeddings, tokenization, semantic search, and Retrieval-Augmented Generation (RAG) to improve the accuracy and contextual relevance of Large Language Model (LLM)-based applications.

CO-2: Design and implement vector database solutions by creating, storing, indexing, and retrieving embeddings using modern embedding models and vector database technologies.

CO-3: Develop efficient document retrieval pipelines by applying document ingestion, chunking strategies, semantic search, hybrid retrieval methods, re-ranking, and contextual compression techniques.

CO-4: Build and evaluate end-to-end Retrieval-Augmented Generation (RAG) applications by integrating LLMs, vector databases, and retrieval systems to develop domain-specific question-answering systems and intelligent chatbots.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	3	1	2	1	–	1	–	2	2	1.58	2	3	1	2	2
CO-2	3	3	3	3	2	2	1	1	1	–	2	2	1.92	2	3	2	2	2.25
CO-3	3	3	3	3	2	3	1	1	1	–	2	3	2.0	2	3	2	2	2.25
CO-4	3	3	3	3	3	3	2	1	2	1	2	3	2.42	3	3	2	3	2.75
Avg	3	2.75	2.75	3	2	2.5	1.25	0.75	1.25	0.25	2	2.5		2.25	3	1.75	2.25	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental Learning, Demonstration and Guided Practice • Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Practical Test	Journal	Viva
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	10	13	7
	CO-2	10			
	CO-3	10	10		
	CO-4	10			
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code 266010243028	Name of Course Lab based on AI Agents & Workflow Automation	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Apply the fundamental concepts of AI agents, including perception, reasoning, action loops, tool usage, function calling, and ReAct patterns, to develop simple agent-based applications.

CO-2: Design and implement intelligent agent applications using modern agentic frameworks such as LangChain, LangGraph, OpenAI Assistants API, and CrewAI for solving domain-specific problems.

CO-3: Develop multi-agent systems by incorporating memory mechanisms, planning strategies, inter-agent communication, and workflow tracing techniques to execute complex tasks effectively.

CO-4: Build enterprise-grade AI agent solutions by integrating automation workflows, Text-to-SQL capabilities**:** human-in-the-loop mechanisms, safety guardrails, and responsible deployment practices.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	3	1	2	1	–	1	–	2	2	1.58	2	3	1	2	2
CO-2	3	3	3	3	2	2	1	1	1	–	2	3	2	3	3	2	2	2.5
CO-3	3	3	3	3	2	3	1	2	1	–	2	3	2.17	3	3	2	2	2.5
CO-4	3	3	3	3	2	3	2	2	3	1	2	3	2.5	3	3	2	3	2.75
Avg	3	2.75	2.75	3	1.75	2.5	1.25	1.25	1.5	0.25	2	2.75		2.75	3	1.75	2.25	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental Learning, Demonstration and Guided Practice • Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Practical Test	Journal	Viva
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	10	13	7
	CO-2	10			
	CO-3	10	10		
	CO-4	10			
Term-End Evaluation 60 Marks	COs	Marks	Exam Component		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			

Program – PGDCA (Faculty of Information, Communication and Technology)

Semester- 2

Course Code 266010243029	Name of Course Lab based on AgentOps: AI Agent Deployment and Monitoring	Compulsory
Credit: 02	Teaching Scheme: Theory (0) - Practical (60)	Lab Hours: 60

Course Outcomes (COs)

After completing this course, students will be able to

CO-1: Demonstrate the concepts, lifecycle, architecture, observability mechanisms, and responsible AI practices involved in AgentOps for developing, monitoring, and managing AI agents.

CO-2: Apply experiment tracking, session management, prompt versioning, event logging, and A/B testing techniques to evaluate and optimize AI agents using AgentOps and related MLOps tools.

CO-3: Design and deploy containerized AI agent applications using Docker, Docker Compose, and Kubernetes while managing dependencies, scalability, security, and computing resources.

CO-4: Develop, deploy, monitor, and optimize cloud-native and serverless AI agent solutions using modern cloud platforms, CI/CD pipelines, observability tools, and cost-efficient deployment strategies.

Mapping Matrix of POs, PSOs, and COs

COs	POs													PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	Avg	1	2	3	4	Avg
CO-1	3	2	2	2	2	2	1	1	3	2	2	2	2	2	2	2	3	2.25
CO-2	2	3	2	3	3	3	1	1	2	–	2	2	2	2	3	2	2	2.25
CO-3	2	2	3	3	2	2	1	1	2	1	2	3	2	2	2	3	2	2.25
CO-4	2	3	3	3	2	2	2	1	2	1	2	3	2.17	2	2	3	3	2.5
Avg	2.25	2.5	2.5	2.75	2.25	2.25	1.25	1	2.25	1	2	2.5		2	2.25	2.5	2.5	

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, --- = No Significant Contribution

Teaching Pedagogy

CO-1 (Unit: 1) CO-2 (Unit: 2) CO-3 (Unit: 3) CO-4 (Unit: 4)	• Experimental Learning, Demonstration and Guided Practice • Project-Based Learning, Reflective Practice

Assessment Method

	COs	Marks	Exam Component		
			Practical Test	Journal	Viva
Continuous Comprehensive Evaluation 40 Marks	CO-1	10	10	13	7
	CO-2	10			
	CO-3	10	10		
	CO-4	10			
Term-End Evaluation 60 Marks	**COs**	**Marks**	**Exam Component**		
	CO-1	15	Term End Examination		
	CO-2	15			
	CO-3	15			
	CO-4	15			