

JADAVPUR UNIVERSITY
COMPUTER AIDED DESIGN CENTRE
Kolkata - 700 032

Certificate Course on
Data Analytics, ML and GenAI

Analyze | Visualize | Predict | Build with AI

Background

Data now drives decisions in nearly every field, from engineering and manufacturing to business, healthcare and public administration. Organizations increasingly expect professionals to collect and clean data, analyze it, present it visually, and use machine learning to draw insights from it. Generative AI (Artificial Intelligence) and Large Language Models (LLMs) have added a new layer to this workflow, changing how analysis is done and how intelligent applications are built.

Most learners meet these skills as separate topics: programming in one place, business intelligence tools in another, and AI somewhere else. This course, offered by the Computer Aided Design Centre, Jadavpur University, brings them together in one structured program. It covers Python-based data analysis, visualization, machine learning, computer vision, business intelligence, and generative AI.

The purpose of this course is to give learners a practical, end-to-end foundation in modern data analytics and applied AI. It follows the path of a real project, from raw data to insight to an intelligent application. The teaching alternates theory sessions with hands-on lab sessions, so every concept is applied immediately. The course aims to make participants confident with the tools used in industry, and ready to continue into more specialized study or to apply these skills in their workplace.

Objectives

By the end of the course, participants will be able to:

1. Write Python programs for data-oriented tasks, and use NumPy and Pandas to clean, transform and analyze datasets.
2. Create clear, effective visualizations with Matplotlib and Seaborn, and carry out exploratory data analysis.
3. Process and analyze images using OpenCV.
4. Understand the machine learning workflow, and build and evaluate regression, classification and clustering models using Scikit-learn.
5. Analyze business data with Excel, and design interactive dashboards and KPI reports in Power BI and Tableau.
6. Build visual data-analytics workflows using KNIME.
7. Work with large language models through the OpenAI and Google Gemini APIs and Hugging Face models, apply prompt engineering, and build simple LLM-based and retrieval-augmented (RAG) applications using LangChain.
8. Combine these skills in a capstone project that solves a realistic data problem.

Eligibility

Applicants in any of the following categories are eligible to apply:

- Students currently pursuing, or graduates who have completed, a bachelor's degree (B.E./B.Tech., B.Sc., B.Com., BBA, BCA or equivalent) in any discipline
- Students currently pursuing, or graduates who have completed, a master's degree in any discipline
- Working professionals, faculty members, researchers and research scholars holding a bachelor's degree or equivalent qualification
- Diploma holders in engineering or allied disciplines

Prerequisites

No prior programming experience is required, as the course begins with Python fundamentals. Basic computer literacy and comfort with elementary mathematics are recommended.

Course at a Glance

- **Course Duration:** 4 months (48 classes) (3 days/week) [* Due to Govt. holidays, the course may take more than four months to complete.]
- **Course fees:** Rs. 16,000/- + Rs. 2,880/-(18% GST) = **Rs. 18,880/-**
- **Class Duration:** Theory and Lab both 2 hrs./ Class
- **Total contact hours:** 96 (48 classes × 2 hrs)

Month 1: Python, Data Analytics and Visualization Foundation

Duration: 12 Classes

Class	Type	Topic
1	Theory	Introduction to Data Analytics, Data Science, AI & Python
2	Lab	Python Setup, Syntax, Variables, Data Types & Operators
3	Theory	Control Flow: Conditions, Loops & Problem-Solving
4	Lab	Python Control Flow & Programming Practice
5	Theory	Functions, Data Structures, Modules & File Handling
6	Lab	Functions, Lists, Dictionaries & File Handling Practical
7	Theory	NumPy Fundamentals: Arrays, Indexing & Mathematical Operations
8	Lab	NumPy Data Analysis Practical
9	Theory	Pandas Fundamentals: Series, DataFrames, Cleaning & Manipulation
10	Lab	Data Cleaning & Manipulation using Pandas

11	Theory	Exploratory Data Analysis, Matplotlib & Seaborn Fundamentals
12	Lab	EDA & Data Visualization Mini Project

Month 1 Outcomes

Students will be able to use Python for data-oriented programming, manipulate numerical data with NumPy, clean and analyze datasets with Pandas, and create basic visualizations using Matplotlib and Seaborn.

Month 2: Advanced Data Visualization, OpenCV and Machine Learning

Duration: 12 Classes

Class	Type	Topic
13	Theory	Advanced Pandas: Grouping, Aggregation, Merge, Join & Transformation
14	Lab	Advanced Data Analysis using Pandas
15	Theory	Advanced Matplotlib & Seaborn: Statistical Visualization & Customization
16	Lab	Advanced Data Visualization Practical
17	Theory	Introduction to Computer Vision & OpenCV Fundamentals
18	Lab	OpenCV: Reading, Resizing, Cropping, Drawing & Image Manipulation
19	Theory	Image Processing: Color Spaces, Thresholding, Blurring, Edges & Contours
20	Lab	OpenCV Image Processing & Basic Object/Shape Detection
21	Theory	Machine Learning Fundamentals & Regression: Linear, Multiple & Polynomial
22	Lab	Regression Implementation & Prediction Case Study
23	Theory	Classification, Logistic Regression, Clustering & Model Evaluation
24	Lab	Classification & Clustering Practical with Model Evaluation

Month 2 Outcomes

Students will be able to perform advanced data analysis and visualization, process images using OpenCV, understand the Machine Learning workflow, and implement regression, classification, and clustering models.

Month 3: Business Intelligence and Analytics

Duration: 12 Classes

Class	Type	Topic
25	Theory	Introduction to Business Intelligence, Excel Analytics & BI Workflow
26	Lab	Excel Data Analysis, Pivot Tables, Charts & Dashboard Practice
27	Theory	Power BI Interface, Data Import, Power Query & Data Connections
28	Lab	Data Cleaning & Transformation using Power BI
29	Theory	Power BI Data Modeling, Relationships & Star Schema
30	Lab	Building Data Models & Relationships in Power BI
31	Theory	DAX Fundamentals: Measures, Calculated Columns & KPIs
32	Lab	Interactive Power BI Dashboard & KPI Report Development
33	Theory	Tableau Fundamentals, Visualization & Data Storytelling
34	Lab	Building Interactive Tableau Dashboards
35	Theory	KNIME Fundamentals, Nodes, Workflows & Data Integration
36	Lab	Data Cleaning, Transformation & Analytics Workflow using KNIME

Month 3 Outcomes

Students will be able to analyze business data with Excel, build professional dashboards in Power BI and Tableau, create DAX measures and KPIs, and develop visual data workflows using KNIME.

Month 4: Generative AI, LLM Applications and RAG for Data Analytics

Duration: 12 Classes

Class	Type	Topic
37	Theory	Introduction to Generative AI, LLMs & Prompt Engineering
38	Lab	Prompt Engineering with LLMs
39	Theory	OpenAI & Google Gemini APIs with Python
40	Lab	Building Python Applications using OpenAI & Gemini APIs
41	Theory	Hugging Face Models & Transformer Fundamentals

42	Lab	Working with Pre-trained Hugging Face Transformer Models
43	Theory	LangChain, AI Agents & RAG
44	Lab	Building a Simple AI Data Analyst
45	Lab	Capstone Project Work & Doubt Discussion
46	Lab	Capstone Project Work & Doubt Discussion
47	Lab	Capstone Project Work & Doubt Discussion
48	Lab	Capstone Project Work & Doubt Discussion

Month 4 Outcomes

Students will understand modern Generative AI systems, work with commercial and open-source LLMs, and build simple LLM-based and retrieval-augmented (RAG) applications using LangChain.

Final Course Structure

Module	Duration	Classes
Python, Data Analytics and Visualization Foundation	1 Month	12
Advanced Visualization, OpenCV and Machine Learning	1 Month	12
Business Intelligence and Analytics	1 Month	12
Generative AI, LLM Applications and RAG	1 Month	12
Total	4 Months	48 Classes

Assessment Scheme

Component	Marks
Theory Exam	50
Lab Exam	50
Project Report Submission and Viva	100
Total	200

Certification: A certificate will be awarded to participants who secure a minimum of 40% marks in each of the three components: Theory Exam (20 out of 50), Lab Exam (20 out of 50), and Project Report Submission & Viva (40 out of 100).

Software & Technologies

- Programming & Development: Python, Jupyter Notebook, VS Code, Google Colab
- Data Analysis: NumPy, Pandas, Microsoft Excel
- Data Visualization: Matplotlib, Seaborn
- Computer Vision: OpenCV
- Machine Learning: Scikit-learn
- Business Intelligence: Microsoft Power BI, Tableau, KNIME
- Generative & Agentic AI: OpenAI API, Google Gemini API, Hugging Face Transformers, LangChain, Prompt Engineering, AI Agents, RAG