MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Bishop kurialacherry College for Women, Amalagiri					
Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Dr. Nisha Mathew					
Contributors	Dr. Jinitha Varughese, Dr. Nisha Mathew, Sr. Beena Joseph					
Course Name	Introduction to Programming with Python					
Type of Course	DSE					
Specialization title	Data Science with Artificial Intelligence					
Course Code	MG3DSEMATA10					
Course Level	200					
Course Summary	This course introduces students to the fundamentals of programming using Python. It covers basic concepts such as variables, data types, operators, input/output, and control structures. Students learn to work with essential data structures like lists, tuples, dictionaries, and sets, along with functions for modular programming. The course also provides an overview of Python libraries and their applications in data handling, visualization, and machine learning. Emphasis is placed on developing problem-solving skills and writing efficient programs, enabling students to apply Python in real-world computational and analytical tasks.					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic mathematical knowledge (logic and reasoning)					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand fundamental concepts of programming and basic Python constructs	U	PO1, PO2, PO3, PO4, PO10
2	Apply data types, input/output operations, and control structures in Python	A	PO1, PO2, PO3, PO4, PO5, PO10
3	Apply Python data structures and functions for basic operations and program development	A	PO1, PO2, PO3, PO4, PO5, PO9, PO10
4	Analyze Python libraries and their applications in data analysis and visualization	An	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	1	1	-	-	-	-	-	2
CO 2	3	3	2	2	1	-	-	-	-	2
CO 3	3	3	2	2	2	-	-	-	1	2
CO 4	3	3	3	2	2	1	1	1	2	3

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Fundamentals of Programming and Python Basics			
	1.1	Introduction to Programming	6	["1"]
	1.2	Introduction to Python Programming: Features and IDE	3	["1"]
	1.3	Parts of the Python Programming Language: Identifiers, Keywords, Variables, Expressions, Statements and Operators.	6	["1"]
2	Data Handling and Control Structures			
	2.1	Data Types : Numbers, Boolean, Strings, None; Type Conversion	3	["2"]
	2.2	Input and Output, Indentation, Comments	2	["2"]
	2.3	Control Structures : Control Flow Statements, Decision Making, Loops	10	["2"]
3	Data Structures and Functions			
	3.1	Data Structures: List, Tuples, Dictionaries, Sets: Creation, Basic Operations, Built-in-Functions And Methods	12	["3"]
	3.2	Functions: Built-in-Functions and User Defined Functions	3	["3"]
4	Python Libraries and Applications			
	4.1	Introduction to Python Libraries: Definition, Difference Between Library, Module and Package	5	["4"]
	4.2	Overview of Libraries : Python for Data Handling & Analysis, Data Visualization, Machine Learning and Web Development	10	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course follows a student-centered and practice-oriented approach to develop programming skills in Python. Fundamental concepts are introduced through interactive lectures, supported by live coding demonstrations to illustrate practical implementation. Emphasis is placed on hands-on laboratory sessions, where students practice coding and problem-solving exercises of increasing complexity. Collaborative learning through group activities encourages peer interaction and teamwork. Digital resources and coding platforms are integrated to promote self-paced learning. Continuous assessment through mini projects, quizzes, assignments and coding tests provides regular feedback. This approach ensures the development of logical thinking, problem-solving ability, and a strong foundation for advanced computing.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Mini project- 20, Test - 10 **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Examinations Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (7 out of 10) – 7 × 2 = 14 ◦ PART - B ◦ Short answer - (6 out of 9) – 6 × 6 = 36 ◦ PART - C ◦ Short Essays - (2 out of 4) – 2 × 10 = 20

References

- Gowrishankar, S., & Veena, A. (2019). Introduction to Python programming. CRC Press.
- Downey, A. B. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.

Suggested Readings

- McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
- VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. O'Reilly Media.
- Matthes, E. (2019). Python crash course: A hands-on, project-based introduction to programming (2nd ed.). No Starch Press.
- Deitel, P., & Deitel, H. (2020). Intro to Python for computer science and data science: Learning to program with AI, big data, and the cloud. Pearson.

Affidavit

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SIGNATURE COURSE						
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Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Dr. Nisha Mathew					
Contributors	Dr. Jinitha Varughese, Dr. Nisha Mathew, Sr. Beena Joseph					
Course Name	Mathematical Computing and Foundations of Artificial Intelligence					
Type of Course	DSE					
Specialization title	Data Science with Artificial Intelligence					
Course Code	MG4DSEMATA10					
Course Level	200					
Course Summary	This course introduces the foundational concepts of mathematical computing and artificial intelligence with a strong emphasis on hands-on training and practical programming skills. It covers object-oriented programming principles such as encapsulation, inheritance, polymorphism, and abstraction for effective software design. The course focuses on data handling and numerical computation using NumPy through practical exercises involving array creation, indexing, slicing, and mathematical operations. It further develops data manipulation skills using Pandas, with hands-on work on Series and DataFrame structures. Additionally, it provides an overview of big data concepts and the fundamentals of artificial intelligence, including its types, hierarchy, and applications. Learners gain practical experience in data analysis and a conceptual understanding of AI systems and intelligent agents.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of mathematics and familiarity with fundamental computer operations are preferred.					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Apply OOP principles in program design	A	PO1, PO2, PO3, PO4, PO5, PO10
2	Analyze NumPy arrays using indexing, slicing, and operations	An	PO1, PO2, PO3, PO10
3	Apply Pandas for data manipulation using Series and DataFrames	A	PO1, PO2, PO3, PO4, PO10
4	Understand fundamentals of AI	U	PO1, PO2, PO3, PO4, PO6, PO7, PO8, PO9, PO10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	3	2	1	1	-	-	-	-	2
CO 2	3	3	1	-	-	-	-	-	-	2
CO 3	3	3	2	1	-	-	-	-	-	2
CO 4	2	2	3	1	-	1	1	1	1	3

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Object Oriented Programming			
	1.1	OOP-Core Concepts and Features	4	["1"]
	1.2	Four Principles of OOP: Encapsulation, Inheritance, Polymorphism, Abstraction	6	["1"]
2	Working with NumPy			
	2.1	NumPy: Creating Arrays, Array Attributes, Indexing and Slicing	7	["2"]
	2.2	Basic Arithmetic Operations on NumPy Arrays	7	["2"]
	2.3	Mathematical Functions in NumPy	3	["2"]
3	Pandas Data Structures and Operations			
	3.1	Pandas Series: Creating Series from Dictionaries and Scalar Data, Indexing and Slicing	6	["3"]
	3.2	Pandas DataFrame: Creating DataFrame from Dictionaries and Lists, Column Operations, Displaying Data	12	["3"]
4	Big Data and AI Fundamentals			
	4.1	Big Data: Definition, Characteristics, Types, Sources	3	["4"]
	4.2	Foundations of AI: Definition, History, Applications	3	["4"]
	4.3	Types of AI : Narrow AI, General AI, Super-intelligent AI	3	["4"]
	4.4	AI Hierarchy: AI, Machine Learning and Deep Learning	3	["4"]
	4.5	Intelligent Agents: Definition, Components and Types	3	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course will be delivered through a blend of interactive lectures and hands-on lab sessions. Concepts will be introduced through demonstrations, supported by practical exercises in Python, NumPy, and Pandas. Assignments, mini-project, and discussions will reinforce learning and ensure continuous assessment.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Mini Project – 20 marks, Test -10 marks **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (7 out of 10) – 7 × 2 = 14 ◦ PART - B ◦ Short answer - (6 out of 9) – 6 × 6 = 36 ◦ PART - C ◦ Short Essays - (2 out of 4) – 2 × 10 = 20

References

- Gowrishankar, S., & Veena, A. (2018). Introduction to Python programming. CRC Press.
- Xiao, P. (2022). Artificial intelligence programming with Python. John Wiley & Sons.

Suggested Readings

- Grus, J. (2015). Data science from scratch: First principles with Python. O'Reilly Media.
- VanderPlas, J. (2023). Python data science handbook: Essential tools for working with data (2nd ed.). O'Reilly Media.

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SIGNATURE COURSE						
Name of the College	Bishop kurialacherry College for Women, Amalagiri					
Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Dr. Nisha Mathew					
Contributors	Dr. Jinitha Varughese, Dr. Nisha Mathew, Sr. Beena Joseph					
Course Name	Data Science Techniques for Artificial Intelligence					
Type of Course	DSE					
Specialization title	Data Science with Artificial Intelligence					
Course Code	MG5DSEMATA10					
Course Level	300					
Course Summary	This course introduces students to essential data science techniques used in artificial intelligence. It covers the data science workflow, including data cleaning, preprocessing, and handling real-world data issues. Students learn to visualize data effectively using Matplotlib through various plots and customization techniques. The course also focuses on descriptive statistics such as measures of central tendency, dispersion, skewness, and kurtosis for data analysis. Additionally, it introduces SciPy and its role in scientific computing, along with hypothesis testing methods like t-tests and chi-square tests. By the end of the course, students will be able to analyze, interpret, and visualize data, forming a strong foundation for advanced studies in data science and AI applications.						
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of Python programming and understanding of fundamental mathematics					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand data science concepts, workflow, and preprocessing techniques.	U	PO1, PO2, PO3, PO4, PO10
2	Apply data visualization techniques using Matplotlib.	A	PO1, PO2, PO3, PO4, PO5, PO10
3	Analyze datasets using descriptive statistics.	An	PO1, PO2, PO3, PO4, PO10
4	Apply SciPy tools and hypothesis testing for data analysis.	A	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	2	1	-	-	-	-	-	2
CO 2	2	3	2	2	1	-	-	-	-	2
CO 3	3	3	2	1	-	-	-	-	-	2
CO 4	3	3	2	2	1	1	-	-	1	3

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Data Science			
	1.1	What is Data Science?, Data Science Workflow, Data Science Tools, Applications of Data Science in Real Life	3	["1"]
	1.2	Data Cleaning and Preprocessing: Role in Data Science Workflow, Data Quality Issues, Data Handling Techniques, Data Splitting	12	["1"]
2	Matplotlib for Data Visualization and Customization			
	2.1	Data Visualisation using Matplotlib: Bar charts, Line Charts, Scatter plots	10	["2"]
	2.2	Customising Matplotlib: Title, Labels, Legend	5	["2"]
3	Descriptive Statistics Using Python			
	3.1	Describing a Single Set of Data	3	["3"]
	3.2	Central Tendencies: Mean, Median, Mode; Dispersion, Skewness and Kurtosis	12	["3"]
4	SciPy for Data Analysis			
	4.1	SciPy: Definition, Relationship with NumPy, Features, Modules	8	["4"]
	4.2	Testing of Hypothesis: t-test, chi-square test	7	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course adopts a student-centered and application-oriented approach to develop data analysis and visualization skills. Concepts are introduced through interactive lectures supported by real-world examples from data science applications. Demonstrations using Python libraries such as Matplotlib and SciPy help students understand practical implementation, where students perform data cleaning, visualization, and statistical analysis. Problem-solving exercises are used to enhance analytical thinking; Mini projects and case studies encourage application of concepts to real-life scenarios. Collaborative activities promote peer learning and communication skills. Digital resources and coding platforms support self-paced learning. Continuous assessment through assignments, quizzes, and practical tasks ensures regular feedback and skill development.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Mini Project – 20 marks, Test -10 marks **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (7 out of 10) – 7 × 2 = 14 ◦ PART - B ◦ Short answer - (6 out of 9) – 6 × 6 = 36 ◦ PART - C ◦ Short Essays - (2 out of 4) – 2 × 10 = 20

References

- Grus, J. (2019). Data science from scratch: First principles with Python (2nd ed.). O'Reilly Media.
- Rogel-Salazar, J. (2017). Data science and analytics with Python. CRC Press.
- McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
- Bressert, E. (2012). SciPy and NumPy: An overview for developers. O'Reilly Media.

Suggested Readings

- Motwani, B. (2021). Data analytics using Python. Wiley India.
- Downey, A. B. (2014). Think stats: Exploratory data analysis in Python (2nd ed.). O'Reilly Media.

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Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Dr. Nisha Mathew					
Contributors	Dr. Jinitha Varughese, Dr. Nisha Mathew, Sr. Beena Joseph					
Course Name	Machine Learning for Data Science					
Type of Course	DSE					
Specialization title	Data Science with Artificial Intelligence					
Course Code	MG6DSEMATA10					
Course Level	300					
Course Summary	This course introduces the fundamental concepts and techniques of Machine Learning for data science applications. It covers the complete workflow, including data preprocessing, feature engineering, model building, and evaluation. Students will explore supervised and unsupervised learning methods such as classification, regression, clustering, and dimensionality reduction. Advanced topics including ensemble techniques and emerging trends like generative AI and responsible AI are also discussed. Emphasis is given to practical understanding through Python-based tools for data analysis. The course enables learners to develop analytical skills and apply machine learning techniques to solve real-world problems effectively and ethically.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of statistics & linear algebra and familiarity with fundamental programming concepts					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand fundamental concepts of machine learning and feature engineering techniques.	U	PO1, PO2, PO3, PO4, PO5
2	Apply supervised learning algorithms for classification and regression problems and evaluate model performance.	A	PO1, PO2, PO3, PO4, PO5, PO9
3	Analyze unsupervised learning methods such as clustering and dimensionality reduction for data interpretation.	An	PO1, PO2, PO3, PO4, PO5
4	Evaluate ensemble methods and emerging AI concepts including generative and responsible AI practices.	E	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

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CO 2	3	3	2	2	3	-	-	-	1	-
CO 3	3	3	2	3	2	-	-	-	-	-
CO 4	3	2	2	3	2	2	2	3	1	2

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Machine Learning			
	1.1	Machine Learning: Definition and Concepts, Traditional Programming vs. ML, Applications Across Domains	5	["1"]
	1.2	Types of ML, Workflow, Tools & Environment, Model Evaluation	5	["1"]
	1.3	Feature Engineering – Key Methods and Tools	5	["1"]
2	Supervised Learning			
	2.1	Introduction to Supervised Learning: Types and Key Concepts; Generalization, Overfitting and Underfitting	5	["2"]
	2.2	Classification: Naïve Bayes, k-Nearest Neighbours	5	["2"]
	2.3	Regression: Simple Linear Regression, Multiple Linear Regression, Model Assessment	5	["2"]
3	Unsupervised Learning			
	3.1	Introduction to Unsupervised Learning: Types and Key Concepts	3	["3"]
	3.2	Clustering Techniques, k-Means Clustering	6	["3"]
	3.3	Dimensionality Reduction, Feature Extraction, Principal Component Analysis	6	["3"]
4	Ensemble Techniques & Generative AI			
	4.1	Ensemble Techniques: Bagging, Boosting, Random Forest	5	["4"]
	4.2	Generative AI : Generative vs Predictive models, Applications, Large Language Models, Prompt Engineering	5	["4"]
	4.3	Responsible AI : Key Principles, Issues, Bias & Fairness in AI, Transparency, Explainability & Privacy	5	["3"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course will be delivered through a combination of lectures, interactive discussions, and hands-on Python-based practical sessions, enabling students to apply machine learning concepts to real-world datasets

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Mini Project – 20 marks, Test -10 marks **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (7 out of 10) – 7 × 2 = 14 ◦ PART - B ◦ Short answer - (6 out of 9) – 6 × 6 = 36 ◦ PART - C ◦ Short Essays - (2 out of 4) – 2 × 10 = 20

References

- Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python. O'Reilly Media.
- VanderPlas, J. (2023). Python data science handbook: Essential tools for working with data (2nd ed.). O'Reilly Media.
- Okadome, T. (2025). Essentials of generative AI. Springer Nature Singapore.

Suggested Readings

- Xiao, P. (2022). Artificial intelligence programming with Python. John Wiley & Sons.
- George, N. (2021). Practical data science with Python. Packt Publishing.

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