MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College for Women, Perumbavoor					
Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Jismy Varghese					
Contributors	Jismy Varghese, Gopikrishna S Nair, Seira Susan Prasad, Manju Varghese					
Course Name	Python Programming					
Type of Course	DSE					
Specialization title	Artificial Intelligence with Python					
Course Code	MG3DSEMATA09					
Course Level	200					
Course Summary	This course introduces basic knowledge of python programming which becomes a base for artificial intelligence and machine learning					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic programming knowledge					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the basics of writing Python code	U	PO1, PO2, PO3
2	Implement programs using lists, tuples and dictionaries	A	PO1, PO2, PO3
3	Understand the use of control structures	U	PO1, PO2, PO3, PO4
4	Implement programs using packages	A	PO1, PO2, PO3

**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	3	-	-	-	-	-	-	-
CO 2	1	3	3	-	-	-	-	-	-	-

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 3	1	3	3	2	-	-	-	-	-	-
CO 4	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	Introduction to Python			
	1.1	Introduction to Python	2	["1"]
	1.2	Advantages of using Python	2	["1"]
	1.3	Executing Python Programs	3	["1"]
	1.4	Python's Core data types	3	["1"]
	1.5	Numeric Types	3	["1"]
	1.6	String Fundamentals	3	["1"]
2	Operations in Python			
	2.1	Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters	3	["2"]
	2.2	Tuples: tuple assignment, tuple as return value	3	["2"]
	2.3	Dictionaries: operations and methods	3	["2"]
	2.4	Advanced list processing – list comprehension	3	["2"]
3	Statements, Functions, Class and Modules			
	3.1	Python Statements: Assignments – Expressions – If condition – While and for loops.	3	["3"]
	3.2	Functions: Definition, Calls – Scopes – Arguments – Recursive Functions	3	["3"]
	3.3	Functional Programming tools	3	["3"]
	3.4	Classes and Object Oriented programming with Python	3	["3"]
	3.5	Modules and Packages: Purpose, using packages	3	["3"]
	3.6	Exception Handling with Python	3	["3"]
4	Packages in Python			
	4.1	Packages: NumPy, Pandas, Scikit learn - Machine learning with Python	5	["4"]
	4.2	Cleaning up, Wrangling, Analysis, Visualization	5	["4"]
	4.3	Matplotlib package – Plotting Graphs	4	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures Tutorials Interactive Sessions Blended Learning Hands on Training

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** • Assignments • Seminars • MCQ • Open Book Exam • Class Tests **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written 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 ◦ Short answer - (8 out of 10) – 8 × 2 = 16 ◦ PART - B ◦ Short Essays/Problems - (4 out of 6) – 4 × 6 = 24 ◦ PART - C ◦ Essays - (2 out of 4) – 2 × 15 = 30

References

- 1. Mark Lutz, “Learning Python”, Fifth Edition, O’Reilly, 2013. 2. Daniel Liang, “Introduction to programming using Python”, Pearson, First edition, 2021. 3. Wes Mc Kinney, “Python for Data Analysis”, O’Reilly Media, 2012.

Suggested Readings

- 1. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, First Edition, 2009. 2. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, Apress, Second Edition, 2005.

Affidavit

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Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Jismy Varghese					
Contributors	Jismy Varghese, Gopikrishna S Nair, Seira Susan Prasad, Manju Varghese					
Course Name	Fundamentals of Artificial Intelligence					
Type of Course	DSE					
Specialization title	Artificial Intelligence with Python					
Course Code	MG4DSEMATA09					
Course Level	200					
Course Summary	This course provides an in-depth understanding of the core principles, techniques, and applications in the field of Artificial Intelligence (AI). This course helps to have a solid understanding of the fundamental concepts of AI, including problem-solving, search strategies, knowledge representation, reasoning, and planning. They'll be equipped to apply AI techniques to various domains, from games and puzzles to complex real-world applications involving uncertainty, time, and resources.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	A basic understanding of algorithmic thinking, including data structures like lists, arrays, stacks, queues, trees and graphs. Concepts such as logic, set theory and combinatorics					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Explain how intelligent agents can solve problems	U	PO1, PO2, PO3
2	Use the different types of search methods to solve various problems	U	PO1, PO2, PO3
3	Apply knowledge representation and examine resolution in propositional logic and first order logic	A	PO1, PO2, PO3
4	Choose a sequence of actions for intelligent agents to accomplish a task by applying appropriate planning strategies	An	PO1, PO2, PO3, PO4

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

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to AI			
	1.1	Introduction, Foundation and history of AI Agents and Environments	2	["1"]
	1.2	The concept of rationality	2	["1"]
	1.3	The nature of environments	2	["1"]
	1.4	Structure of agents, Problem solving Agents Well-defined problems and solutions	2	["1"]
	1.5	Formulating problems, Example problems- vacuum world, 8-puzzle, 8-queens	2	["1"]
2	Search and Algorithms			
	2.1	Depth First Search, Breadth First Search, Iterative Deepening Search	2	["2"]
	2.2	Heuristic Search strategies - Heuristic functions	2	["2"]
	2.3	The effect of heuristic accuracy on performance	2	["2"]
	2.4	Generate and test search	2	["2"]
	2.5	Greedy best first search, A* algorithm	2	["2"]
	2.6	Constraint satisfaction problems, Crypt arithmetic problems	2	["2"]
	2.7	Means-end analysis	2	["2"]
	2.8	Local search strategies - Simple Hill Climbing, Simulated Annealing	2	["2"]
	2.9	Adversarial search - Games, Optimal Decision in games	2	["2"]
	2.10	The minimax algorithm, Alpha–beta pruning	2	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Logic in AI			
	3.1	The Wumpus World	2	["3"]
	3.2	Logic, Propositional Logic	2	["3"]
	3.3	Reasoning Patterns in Propositional Logic	2	["3"]
	3.4	First order logic	2	["3"]
	3.5	Inference in first order logic	2	["3"]
	3.6	Propositional vs. first order inference	2	["3"]
	3.7	Unification & lifts forward chaining Backward chaining	2	["3"]
4	Planning and High level Actions			
	4.1	Classical planning - Algorithms for Classical Planning, Forward state-space search for planning	3	["4"]
	4.2	Backward search for planning, Planning as Boolean satisfiability	3	["4"]
	4.3	Heuristics for Planning, Domain-independent pruning, State abstraction in planning, Hierarchical Planning	2	["4"]
	4.4	High-level actions	2	["4"]
	4.5	Searching for primitive solutions, Searching for abstract solutions	2	["4"]
	4.6	Planning and Acting in Nondeterministic Domains	2	["4"]
	4.7	Time, Schedules, and Resources	2	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) • Lectures • Tutorials • Interactive Sessions • Blended Learning

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** • Assignments • Seminars • MCQ • Class Tests **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written 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 ◦ Short answer - (5 out of 8) – 5 × 2 = 10 ◦ PART - B ◦ Short Essays/Problems - (5 out of 8) – 5 × 6 = 30 ◦ PART - C ◦ Essays - (2 out of 6) – 2 × 15 = 30

References

- 1. Al – A Modern Approach, Stuart Russel, Peter Norvig, Pearson Education, 4/e, 2021 2. Artificial Intelligence, Kevin Knight, Elaine Rich, Shivashankar B. Nair, Tata McGraw-Hill, 2/e, 2009

Suggested Readings

- Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, Pearson Education, 1/e, 2015 2. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, George F. Luger, 6/e, 2009 3. Artificial Intelligence: Making a System Intelligent, Nilakshi Jain, Wiley, 1/e, 2019

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SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College for Women, Perumbavoor					
Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Jismy Varghese					
Contributors	Jismy Varghese, Gopikrishna S Nair, Seira Susan Prasad, Manju Varghese					
Course Name	Machine Learning					
Type of Course	DSE					
Specialization title	Artificial Intelligence with Python					
Course Code	MG5DSEMATA09					
Course Level	300					
Course Summary	Machine Learning (ML) is one of the most in-demand and rapidly evolving fields in Computer Science, with applications spanning a wide range of industries such as Banking, Insurance, Travel & Tourism, Medicine, Education, Logistics & Supply Chain, E-commerce, and Computer Games, among others. This course provides a comprehensive introduction to the core concepts of Machine Learning. The course is designed for individuals who are new to the field of ML but have a basic understanding of programming and problem-solving techniques.					
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic Programming and Statistics					

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Explain different machine learning paradigms and parameter estimation methods	U	PO1, PO2, PO3
2	Demonstrate the various algorithms of supervised learning	U	PO1, PO2, PO4
3	Illustrate the notions of bias, variance and analyse the overfitting and underfitting issues in machine learning models.	A	PO1, PO2, PO3
4	Evaluate the different performance measures for analysing the performance of different classification models	An	PO1, PO2, PO3, PO4
5	Make use of different ensembling techniques to form better machine learning models than conventional ones.	U	PO1, PO2, PO9

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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	1	2	3	-	-	-	-	-	-	-
CO 2	2	2	-	2	-	-	-	-	-	-
CO 3	2	3	2	-	-	-	-	-	-	-
CO 4	2	3	3	1	-	-	-	-	-	-
CO 5	2	3	-	-	-	-	-	-	2	-

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Estimation			
	1.1	Supervised Learning, Unsupervised Learning, Reinforcement Learning, Semi Supervised Learning	3	["1"]
	1.2	Parameter Estimation Methods:- Maximum Likelihood Estimation (MLE)	2	["1"]
	1.3	Maximum Aposteriori Estimation (MAP)	2	["1"]
	1.4	Bayes Estimation, Least Square Estimation (LS), Minimum Mean Square Estimation (MMSE)	3	["1"]
	1.5	The Gradient Descent Method and its variants (Simple Gradient Descent Method, Stochastic Gradient Method, Batch Gradient Method)	2	["1"]
	1.6	Illustrative examples of parameter estimation using different methods	2	["1"]
2	Regression Models and Decision Trees			
	2.1	Supervised Learning Models:- Regression - Regression Models (Simple Regression, Multivariable linear regression, Polynomial Regression, Logistic Regression)	3	["2"]
	2.2	Illustrative examples of designing regression models	3	["2"]
	2.3	Decision Trees - Working Principle , Decision Tree formation using ID3 Algorithm, The Classification and Regression Trees Algorithm (CART), Illustrative examples on designing decision trees	3	["2"]
	2.4	Overfitting and Underfitting :- Bias and Variance, Bias-Variance Trade-off,	3	["3"]
	2.5	Regularization (Ridge, Lasso and Elastic Net Regularization techniques)	4	["3"]

Module	Units	Course Description	Hrs	CO No.
3	Different Types of Classification			
	3.1	More Supervised Learning Methods:- Support Vector machines (SVM) - Maximum Margin Classification	2	["2"]
	3.2	Mathematics behind Maximum Margin Classification	2	["2"]
	3.3	Hard Margin SVM, Soft Margin SVM, Non-Linear SVM The Kernel Trick	3	["2"]
	3.4	Different Kernel Functions (Linear Kernel, Polynomial Kernel, RBF Kernel, Sigmoid Kernel)	3	["2"]
	3.5	K-Nearest Neighbour Classifier (KNN):- Working Principle, Illustrative examples on designing KNN Classifiers	3	["2"]
	3.6	Naive Bayes Classifier - Working Principle , Types of Naive Bayes Classifiers, Illustrative examples	3	["2"]
4	Ensemble Learning and Classification model assessment			
	4.1	Ensemble Learning:- Basic Techniques (Voting, Simple and Weighted Averaging Techniques)	2	["5"]
	4.2	Advanced Techniques (Bagging, Boosting, Stacking) - The Random Forest Classifier	2	["5"]
	4.3	Assessment of Classification Models:- Performance measures- Confusion Matrix, Accuracy, Precision, Recall, F1- Score	3	["4"]
	4.4	Receiver Operating Characteristics Curve (ROC)	3	["4"]
	4.5	Area Under the Curve (AUC)	2	["4"]
	4.6	Illustrative examples on Classification model assessment	2	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures Tutorials Interactive Sessions Blended Learning

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Assignments Seminars Class Tests **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written 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 ◦ Short answer - (5 out of 8) – 5 × 2 = 10 ◦ PART - B ◦ Short Essays/Problems - (5 out of 8) – 5 × 6 = 30 ◦ PART - C ◦ Essays - (3 out of 6) – 3 × 10 = 30

References

- 1. Machine Learning, Tom M. Mitchell, Tata McGraw Hill, 1/e, 2017 2. The Elements of Statistical Learning Data Mining,Inference, and Prediction, Trevor Hastie Robert Tibshirani Jerome Friedman, Springer Publishers, 2/e, 2017 3. Understanding MachineLearning: From Theory to Algorithms, Shai Shalev-Shwartz,Shai Ben-David, Cambridge University Press, 1/e,2014

Suggested Readings

- Introduction to Machine Learning, Ethem Alpaydin, MIT Press, 3/e, 2015

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Faculty/ Discipline	Mathematics					
Programme	BSc (Hons) Mathematics					
Course Coordinator	Jismy Varghese					
Contributors	Jismy Varghese, Gopikrishna S Nair, Seira Susan Prasad, Manju Varghese					
Course Name	Deep Learning and Image Analytics					
Type of Course	DSE					
Specialization title	Artificial Intelligence with Python					
Course Code	MG6DSEMATA09					
Course Level	300					
Course Summary	This course provides an outline of the working of neural networks and the architecture and applications of image analytics.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the basic architecture and workings of neural networks	U	PO1, PO2, PO3
2	Understand the fundamentals of deep neural networks	U	PO1, PO2, PO3
3	Build the CNN model for image analytics	A	PO1, PO2, PO3, PO4
4	Use deep networks for data prediction and analysis	A	PO1, PO2, PO3

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CO 2	2	3	3	-	-	-	-	-	-	-

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

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Neural Networks			
	1.1	Foundations of Neural Networks	3	["1"]
	1.2	Training Neural Networks	3	["1"]
	1.3	Activation Functions & Loss Functions	4	["1"]
	1.4	Hyper-parameters	4	["1"]
2	Foundation of Deep Learning			
	2.1	Understanding Deep Learning	2	["2"]
	2.2	Common Architectural Principles of Deep Networks	2	["2"]
	2.3	Parameters & Layers	2	["2"]
	2.4	Activation Functions & Loss Functions	2	["2"]
	2.5	Optimization Algorithms	2	["2"]
	2.6	Hyper parameters	3	["2"]
	2.7	Building Blocks of Deep Networks	3	["2"]
3	Applications in Neural Networks			
	3.1	Convolutional Neural Networks	3	["3"]
	3.2	Architecture	3	["3"]
	3.3	Input, Convolutional, Pooling, fully connected Layers	3	["3"]
	3.4	Applications	3	["3"]
	3.5	CNN Variants - Resnet	4	["3"]
4	Deep Learning with some problems			
	4.1	Matching Deep Networks to the Right Problem	5	["4"]
	4.2	Modeling CSV Data with Multilayer Perceptron Networks	5	["4"]
	4.3	Predicting Handwritten Images Using CNNs	4	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures Tutorials Interactive Sessions Blended Learning Hands on Training

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References

- 1. Josh Patterson and Adam Gibson, “Deep Learning- a practitioner’s approach”, 1st Edition, O’Reilly Media, 2017. 2. Nikhil Buduma and Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms”, 1st Edition, O’Reilly Media, 2017

Suggested Readings

- 1. Ian Goodfellow, Yoshua Bengio. Aaron Courville "Deep Learning" 2015 2.Charu C Agarwal, " Neural Networks and Deep Learning" Springer 2018

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