SREENARAYANAGURU
OPEN UNIVERSITY

MASTER OF COMPUTER APPLICATIONS

PROGRAMME SYLLABUS

(Semester I, II, III & IV)

Program Outcomes
(POs)

PO1: Critical thinking

- Analyze information objectively and make a reasoned judgment.
- Draw reasonable conclusions from a set of information to solve problems or make decisions.
- Identify logical flaws in the arguments of others

PO2: Problem-solving

- Analyze a problem, generate and implement a solution and to assess the success of the Plan
- Understand how the solution will affect both the people involved and the surrounding Environment
- Apply the learning to real-life situations to solve different kinds of problems in familiar and no-familiar contexts

PO3: Communication and Presentation Skills:

- Demonstrate the ability to listen and read attentively,
- Express ideas with clarity in both oral and written communications as well as effective presentations.

PO4: Teamwork and Leadership:

- Work collaboratively in interdisciplinary and multi-cultural teams,
- Demonstrating leadership and responsibility in professional and civic settings.

PO5: Research and Inquiry Skills:

- Design, conduct independent research using appropriate methods, tools and ethical standards to contribute to knowledge generation or practical solution

PO6: Digital and technological skills

- Use ICT in a variety of learning and work situations
- Use appropriate software for analysis of data
- Understand the pitfalls in the digital world and keep safe from them

PO7: Ethical, Social and Environmental Awareness:

- Demonstrate awareness of ethical principles, social responsibilities, and sustainable practices in personal, academic, and professional life.

PO8: Learning 'how to learn' skills

- Acquire new knowledge and skills, including 'learning how to learn skills, that are necessary for pursuing learning activities throughout life, through self-paced and self- directed learning
- Identify appropriate resources required for further learning
- Inculcate a healthy attitude to be a lifelong learner

PO9: Global Perspective:

- Develop a broad awareness of global issues and an understanding of diverse perspective
- Analyse the political, economic, social, technological, and environmental factors influencing global organizations and markets
- Develop the ability to adapt to new scientific developments and technologies in a globalized environment.

Program Specific Outcomes (PSOs)

PSO1: Apply structured approaches and development methodologies to design, develop, and maintain software systems addressing diverse needs across industry and society.

PSO2: Demonstrate the ability to use modern computing tools, programming languages, and development environments to solve complex problems and create innovative digital solutions.

PSO3: Utilize data modeling, database systems, and data analytics tools for effective storage, retrieval, and analysis of information to support decision-making.

PSO4: Develop responsive, user-centric web and mobile applications using contemporary technologies and frameworks to meet real-world challenges.

PSO5: Implement principles of structured planning, system organization, and project coordination to manage technical tasks and deliver outcomes effectively.

PSO6: Recognize and apply secure practices and ethical standards while working with digital systems and data.

PSO7: Understand and explore scalable and adaptive technologies including virtualized and distributed computing systems.

PSO8: Integrate intelligent techniques and data-driven models to solve complex tasks using emerging computational methods.

PSO9: Engage in research activities, explore innovative ideas, and contribute to advancements in computing science and interdisciplinary domains.

PSO10: Demonstrate effective communication, teamwork, and leadership skills, with a readiness to adapt and grow in dynamic technological environments.

PSO11: Acquire domain-relevant skills and practical exposure necessary for employment, entrepreneurship, or further academic pursuits in the IT and computing sectors.

2025 Admission Onwards

CBCS-PG Regulations 2025

January 2025

SREENARAYANAGURU OPEN UNIVERSITY

Programme Structure -Master of Computer Applications (MCA)

Sem	Discipline Core Course (DC) 4 Credit each	Discipline Specific Elective courses (DE) 4 Credit each	Ability Enhancement Compulsory Courses (AC) 2 Credit each	Skill Enhancement Compulsory Courses (SE)/Internship in Industry 2 Credit each	Discipline Core Course Practical (DCP) 2 Credit each	Project Work (PR) 12 Credit each	MOOC/Competency Oriented Course (CO)/ Internship (IN) 4 Credit each	Total Credit Per Semester
I	DC – 1		AC1-Discipline Specific (DS)		PC-1			18
	DC – 2				PC-2			
	DC – 3							
II	DC – 4		AC2- Institution Specific (IS)		PC-3			18
	DC – 5				PC-4			
	DC – 6							
III	DC – 7	DE – 1			PC-5		IN	22
		DE – 2		SE - 1	PC-6			
IV	DC – 8						MOOC / Competency Oriented Course (CO)	22
				SE - 2		PROJECT (PR)		
Total	32 Credit	8 Credit	4 Credit	4 Credit	12 Credit	12 credit	8 credit	80 Credits

DC : **Discipline Core Course**

DE : **Discipline Specific Elective Course**

AC-2 : **Ability Enhancement Compulsory Course (Institution Specific)**

IN : **Internship**

CO : **Competency Oriented Course**

SE : **Skill Enhancement Courses (Core)**

AC-1 : **Ability Enhancement Compulsory Course (Discipline Specific)**

PC : **Discipline Core Course Practical**

PR : **Project**

MOOC : **Massive Open Online Course**

Semester-wise Programme Details

First Semester			
Sl. No	**Type of the course**	**Course Code**	**Course Name**
1	**Discipline Core**	**M25CA01DC**	**Data Structures with C (T)**
2	**Discipline Core**	**M25CA02DC**	**Mathematical Foundation for Computer Applications (T)**
3	**Discipline Core**	**M25CA03DC**	**Python Programming (T)**
4	**Ability Enhancement Compulsory Course**	**M25CA01AC**	**Industry Best Practices (T)**
5	**Discipline Core Practical**	**M25CA01PC**	**Data structures with C Lab (P)**
6	**Discipline Core Practical**	**M25CA02PC**	**Python Programming Lab (P)**

Second Semester			
Sl. No	**Type of the course**	**Course Code**	**Course Name**
1	**Discipline Core**	**M25CA04DC**	**Operating System Design (T)**
2	**Discipline Core**	**M25CA05DC**	**Database Technologies (T)**
3	**Discipline Core**	**M25CA06DC**	**Machine Learning (T)**
4	**Ability Enhancement Compulsory Course**	**M21UC01AC (IS)**	**Foundational Skills for Research and Writing (T)**
5	**Discipline Core Practical**	**M25CA03PC**	**DBMS Lab (P)**
6	**Discipline Core Practical**	**M25CA04PC**	**Machine Learning Lab (P)**

Third Semester			
Sl. No	Type of the course	Course Code	Course Name
1	Discipline Core	M25CA07DC	Computer Networks and Communication (T)
2	Discipline Specific Elective-I	M25CA01DE	Deep Learning (T)
		M25CA02DE	Reinforcement Learning(T)
		M25CA03DE	Natural Language processing(T)
3	Discipline Specific Elective-II	M25CA11DE	AI for Cyber Security (T)
		M25CA12DE	Blockchain Technologies (T)
		M25CA13DE	Big Data Technologies(T)
4	Skill Enhancement Compulsory Courses	M25CA01SE	Web Programming (T)
5	Discipline Core Practical	M25CA05PC	Web Programming Lab (P)
6	Discipline Core Practical	M25CA06PC	Advanced ML Lab (P)

7	Internship	M25CA01IN	Internship

Fourth Semester			
SI No	Type of the course	Course Code	Course Name
1	Discipline Core	M25CA08DC	Software Engineering (T)
2	MOOC or Value-Added Courses or Skill Enhancement Courses	M25CA01MC or M25CA01CO	MOOC or Competency Oriented Course (CO)
3	Skill Enhancement Compulsory Courses	M25CA02SE	AI Application Development Using Python And Flask (T)
4	Project Work (PR)	M25CA01PR	Project

Evaluation:

- The evaluation of the programme for Theory Courses will be based on two modes:

  1. Continuous Internal Evaluation (CIE).
  2. End Semester Examination (ESE).

  The CIE and ESE will be in the ratio 30:70.

- The evaluation of the programme for practical Courses will be based on two modes:

  1. Continuous Internal Evaluation (CIE).
  2. End Semester Examination (ESE).

The CIE and ESE will be in the ratio 50:50.

The End Semester Examination(ESE) will be evaluated by the external examiner based on practical tests and viva voce.

Attendance requirements for the practical sessions will be on the basis of current UGC regulations..

GUIDELINES FOR MOOC

- MOOC must be selected from the SWAYAM/NPTEL platform.
- The area of the MOOC will be updated by the university in accordance with the current trends.
- The learner should give the details of the selected MOOC in the University portal before the deadline provided in the 2nd semester. They can do the MOOC based on the approval obtained from the university.
- The selected MOOC should be at least 8 weeks long.
- The learner needs to submit the pass certificate of MOOC with score details, before the last date of assignment submission in the 4th semester.

FIRST SEMESTER

Course Title	**DATA STRUCTURES WITH C**
Course Code	**M25CA01DC**
Type of Course	**DISCIPLINE CORE COURSE-01**
Semester	**1**
Credits	**4**
Course Objectives	Providing knowledge of the basic concepts of C programming, introducing linear data structures and their operations, summarizing searching, sorting, and hashing techniques, explaining non-linear data structures such as trees and graphs, and familiarizing students with various algorithm design approaches.

Course Details

Block I: Essential C Programming for Data structures	
Unit 1	Introduction to C programming : Data types, variables, constants, Operators - Arithmetic, relational, logical, assignment, size of
Unit 2	Control Structures and Arrays : conditional statements -if, else- if, loops - while, do-while, for, Arrays - 1D and 2D, Function- function definition, function call
Unit 3	Pointers and Structures : Pointers- Creation of pointers, Dereference operator, pointers to access arrays, Structures- Creation, accessing structure members, self referential structures
Unit 4	Dynamic memory allocation : Static vs Dynamic memory, Allocating dynamic memory - malloc( ), calloc( ), realloc( ), freeing memory - free( )
Block II: Linear Data Structures	
Unit 1	Linked List : need for linked list, memory representation of linked list, Types - Singly, doubly, circular, Operations - insertion(first, middle, last positions), deletion(first, middle, last positions), traversal, applications of linked list

Unit 2	Stacks and Queues : Stack- definition, operations, stack implementation using array, Queues - Definition, operations, queue implementation using array, Circular queue - array implementation
Unit 3	Applications of Stack and Queue : Infix , prefix and postfix notations and conversions, Applications of stack - Expression evaluation, Recursion, Reversing data, Applications of Queue - CPU scheduling, printer spooling, multithreading
Unit 4	Searching & Sorting algorithms : Linear search , Binary search, Bubble sort, Insertion sort, Merge sort
Block III: Non- Linear Data structures	
Unit 1	Trees: Tree terminologies, Binary trees, Binary tree types - full , complete, degenerate and skewed binary trees, Binary tree traversals - BFS, DFS (in-order, pre-order, post order)
Unit 2	Binary Search Trees - Insertion, Deletion, Balanced Search Trees - AVL Tree, M-way search trees- B Tree, B+ Tree
Unit 3	Spanning Tree - Minimum cost spanning tree, Shortest path algorithm - Prim's algorithm and Kruskal's algorithm, Applications
Unit 4	Graphs - Terminology, Representation, Traversal - Depth first search and Breadth first search, Applications
Block IV: Hash Techniques, Algorithm analysis	
Unit 1	Hashing : Simple hash functions, Collision and Collision Resolution techniques , Hash table searching.
Unit 2	Algorithm Analysis - Asymptotic Notations: Big-O, Big-Theta, and Big-Omega notations, Time and Space complexity analysis – Best, Average, and Worst-case scenarios.
Unit 3	Algorithm design approaches : Divide and Conquer strategy - Binary search, Quick sort Greedy approach - Knapsack problem
Unit 4	Dynamic Programming - Fibonacci sequence, All pair shortest path, Backtracking - n-queens problem

Recommended TextBooks /References:

1. Cormen, Thomas H., et al, Introduction to Algorithms, 4th ed., MIT Press, 2022.

2. Levitin, Anany, Introduction to the Design and Analysis of Algorithms, 3rd ed. (updated), Pearson, 2021.

3. Thareja, Reema, Data Structures Using C, 3rd ed., Oxford University Press, 2024.

4. Samanta, Debasis, Classic Data Structures, 2nd ed., PHI Learning, 2009.

5. Horowitz, Ellis, and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd ed., Universities Press, 2008.

6. Lee, Richard Char-Tung, et al, Introduction to the Design and Analysis of Algorithms: A Strategic Approach, 3rd ed. reprint, McGraw-Hill Asia, 2008.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Explain the fundamental concepts of C programming such as data types, control structures, arrays, pointers, and dynamic memory allocation.	Understand
CO2	Describe the structure and operations of linear data structures, including stacks, queues, and linked lists.	Analyze
CO3	Interpret the working principles of common searching, sorting, and hashing techniques and their use in data handling.	Apply
CO4	Summarize the characteristics of non-linear data structures, including trees and graphs.	Understand
CO5	Explain algorithm design approaches such as divide and conquer, greedy methods, and dynamic programming.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	3	1	1	1	1	-	1	-	-	3
CO2	2	3	2	1	1	1	-	1	-	-	3
CO3	2	3	3	1	1	1	-	2	-	-	3

CO4	2	3	3	1	1	1	-	2	-	-	3
CO5	2	3	2	1	1	1	-	2	-	-	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	2	2	1	-	-
CO2	3	3	1	1	2	2	1	-	-
CO3	3	3	1	1	3	2	1	-	-
CO4	3	3	1	1	2	2	1	-	-
CO5	3	3	1	1	3	2	1	-	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**MATHEMATICAL FOUNDATION FOR COMPUTER APPLICATIONS**
Course Code	**M25CA02DC**
Type of Course	**DISCIPLINE CORE COURSE- 02**
Semester	**1**

Credits	**4**
Course Objectives	Introducing vectors and matrices for data handling and problem-solving, providing basic knowledge of set theory, logic, graphs, and numerical methods, explaining probability and statistics for data analysis and decision-making, studying functions, limits, derivatives, and integrals, and understanding integration and optimization methods for solving problems.

Course Details

Block I: Linear Algebra	
Unit 1	Matrices- Representation, Order, Types of matrices, Matrix operations (addition, multiplication,invesion)
Unit 2	Systems of Linear Equations - Row reduction and echelon forms, Gaussian elimination, Matrix rank and consistency
Unit 3	Determinants and Eigen Concepts - Determinants and their properties, Eigenvalues and eigenvectors, Diagonalization
Unit 4	Vector Spaces and Norms - Scalars, vectors,Types, Operations , Linear independence, Vector norms and distances (L1, L2), Orthogonality and projection
Block II: Discrete Mathematics and Numerical Methods	
Unit 1	Set Theory and Logic - Sets, subsets, operations, Propositions, logical operators, Truth tables and predicates
Unit 2	Graph Theory - Terminologies: nodes, edges, paths, Types, Graph traversals, Tree: Fundamentals, minimum spanning tree
Unit 3	Numerical Methods - Solving linear and nonlinear equations, Numerical differentiation and integration, Approximation techniques, Iterative methods
Unit 4	Matrix decomposition methods - Matrix decompositions (LU, QR, SVD), Application in dimensionality reduction (PCA)
Block III: Probability and Statistics	
Unit 1	Probability Basics - Sample space, events, Conditional probability, independence, Bayes' Theorem and its applications
Unit 2	Random Variables and Distributions - Discrete and continuous random variables, Probability mass function (PMF) and probability density function (PDF), Common distributions: Bernoulli, Binomial, Gaussian, Poisson
Unit 3	Descriptive Statistics - Mean, median, mode, variance, standard deviation, Skewness and kurtosis, Covariance and correlation
Unit 4	Statistical Inference - Estimators and bias, Confidence intervals, Hypothesis testing (Z-test, t-test, Chi-square test)

	Regression - Linear regression, Principle of least squares, Bayesian Linear regression
Block IV: Calculus and Optimization	
Unit 1	Functions and Limits - Functions of one and multiple variables, Domain, range, limits, Continuity
Unit 2	Differentiation - Derivatives of basic functions, Partial derivatives, Chain rule
Unit 3	Integration and Area Under Curve - Definite and indefinite integrals, Integration techniques, Area under curves – relevance in ROC/AUC
Unit 4	Optimization Techniques - Gradient descent and its variants, Convexity and concavity, Local vs. global minima and saddle points

Recommended TextBooks /References:

1. Gilbert Strang – *Introduction to Linear Algebra*, 5th ed., Wellesley-Cambridge Press, 2016.
2. David C. Lay, Steven R. Lay, Judi J. McDonald – *Linear Algebra and Its Applications*, 5th ed., Pearson, 2015.
3. K. Hoffman, R. Kunze – *Linear Algebra*, 2nd ed., Pearson, 1971.
4. Kenneth H. Rosen – *Discrete Mathematics and Its Applications*, 7th ed., McGraw-Hill, 2011.
5. C. L. Liu, D. P. Mohapatra – *Elements of Discrete Mathematics*, 3rd ed., McGraw-Hill, 2008.
6. S. S. Sastry – *Introductory Methods of Numerical Analysis*, 5th ed., PHI Learning, 2012.
7. Richard L. Burden, J. Douglas Faires – *Numerical Analysis*, 10th ed., Cengage Learning, 2015.
8. Sheldon Ross – *A First Course in Probability*, 10th ed., Pearson, 2018.
9. Ronald E. Walpole, Raymond H. Myers, et al. – *Probability and Statistics for Engineers and Scientists*, 9th ed., Pearson, 2016.
10. John Freund, Irwin Miller – *Probability and Statistics for Engineers*, 8th ed., Pearson, 2010.
11. Richard Johnson – *Miller and Freund's Probability and Statistics for Engineers*, 9th ed., Pearson, 2016.
12. James Stewart – *Calculus: Early Transcendentals*, 8th ed., Cengage Learning, 2015.
13. E. Kreyszig – *Advanced Engineering Mathematics*, 10th ed., Wiley, 2011.
14. Stephen Boyd, Lieven Vandenberghe – *Convex Optimization*, Cambridge University Press, 2004.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Learn how to use vectors and matrices to work with data and solve problems in machine learning.	Apply
CO2	Summarize basic concepts in set theory, logic, graphs, and numerical methods to solve real-world computing problems.	Understand
CO3	Explain probability theory and statistical methods to interpret uncertainty, model distributions, and perform data-driven decision-making.	Understand
CO4	Define and use functions, limits, derivatives, and integrals of one and many variables.	Apply
CO5	Describe integration and optimization methods like gradient descent to solve problems and find best solutions.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	1	2	2	-	-	-	-	3	2	-	-
CO2	1	2	2	-	-	-	-	2	2	-	-
CO3	1	2	2	-	-	-	-	3	2	-	-
CO4	1	2	2	-	-	-	-	2	1	-	-
CO5	1	2	2	-	-	-	-	3	2	-	-

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	3	3	-	-	-
CO2	3	3	-	-	2	2	-	-	-
CO3	3	3	-	-	3	3	-	-	-

CO4	3	2	-	-	2	2	-	-	-
CO5	3	3	-	-	3	3	-	-	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**PYTHON PROGRAMMING**
Course Code	**M25CA03DC**
Type of Course	**DISCIPLINE CORE COURSE-03**
Semester	**1**
Credits	**4**
Course Objectives	Knowledge of Python programming concepts, including object-oriented and functional programming, introduces Python for data analysis and web development, offers practical exposure to database management, regular expressions, web frameworks, APIs, and JSON data, and enables students to plan and implement a mini-project involving data handling, interface design, and reporting.

Course Details

Block 1: Introduction to Python	
Unit 1	Introduction to data types, variables, constants, operators, input-output, Decision Making and Loops basic formatting, running python programs
Unit 2	Data structures in Python and Built-in methods of Data Structures -Array, List, Frames, Tuples, Dictionaries, Set
Unit 3	Functions - User defined functions, Comprehensions, Higher-order functions, Closures and decorators, Lambdas, Generators and Iterators
Unit 4	Introduction to Python Libraries - Modules and Packages, Importing modules and creating packages, Standard Library overview, Writing reusable code, Module discovery and installation- pip

Block II: Object-Oriented Programming, File Handling, Error Handling and Database Programming	
Unit 1	Object-Oriented Programming -Classes, Objects, and Constructors, Inheritance, Polymorphism, Encapsulation, Magic-dunder methods, Composition vs Inheritance
Unit 2	File Handling - File I/O operations-reading, writing, appending, Context managers, Handling CSV, JSON, and XML files, File and directory manipulation (os and shutil)
Unit 3	Exception Handling - Error and Exception Handling, Try, Except, Finally blocks, Custom exceptions, Debugging techniques (logging, traceback), Unit testing with unittest and pytest
Unit 4	Iterators and Generators: Creating iterators, __iter__() and __next__(), Generator functions using yield, Generator expressions.
Block III: Libraries for Data and Web Applications	

Unit 1	NumPy: Arrays, array operations, indexing and slicing, array manipulation, mathematical functions, broadcasting..
Unit 2	Pandas: Series and DataFrame, Data cleaning, filtering, grouping, merging, reshaping, handling missing data.
Unit 3	Data Visualization: Using Matplotlib and Seaborn – Line plots, bar charts, histograms, scatter plots, customizations.
Unit 4	Web Programming with Flask: Introduction to Flask, Routing, Forms, Templates, Handling GET and POST, basic CRUD operations.

Block IV: Python for Real-World Applications	
Unit 1	Working with Databases: SQLite and MySQL using sqlite3 and mysql.connector, Performing CRUD operations, Integration with Pandas.
Unit 2	Introduction to Django: Django architecture, Models, Views, Templates (MVT), Creating simple Django projects.
Unit 3	Working with APIs and JSON: Consuming REST APIs using `requests`, Parsing JSON, Creating simple APIs with Flask.
Unit 4	Project Development: Planning and implementing a mini-project using Python – use of libraries, GUI/web interface, data handling, and report generation.

References:

1. Matthes, E. (2023). *Python crash course: A hands-on, project-based introduction to programming* (3rd ed.). No Starch Press.

2. Severance, C. (2022). *Python for everybody: Exploring data in Python 3* (2nd ed.). CreateSpace Independent Publishing Platform.
3. Holovaty, A., & Kaplan-Moss, J. (2022). *The definitive guide to Django: Web development done right* (2nd ed.).

4. Shaw, Z. A. (2023). *Learn Python 3 the hard way: A very simple introduction to the terrifyingly beautiful world of computers and code*. Addison-Wesley.

5. Lutz, M. (2023). *Learning Python* (6th ed.). O'Reilly Media.

6. Downey, A. B. (2023). *Think Python: How to think like a computer scientist* (2nd ed.). O'Reilly Media.

- https://www.python.org
- https://www.w3schools.com/python
- https://www.learnpython.org/
- https://numpy.org

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Develop proficiency in Python programming concepts, including object-oriented and functional programming.	Apply
CO2	Utilize Python for complex data analysis and web development tasks.	Analyse
CO3	Gain practical experience with database management and regular expressions in Python.	Apply
CO4	Use Python to work with databases, web frameworks like Django and Flask, and handle APIs and JSON data.	Understand
CO5	Discuss to plan a mini-project using Python, including data handling, interface design, and report generation.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	3	3	1	1	-	-	-	2	-	-	1
CO2	3	3	3	2	1	-	-	-	-	2	1
CO3	3	3	1	1	2	-	1	2	-	2	1
CO4	3	3	2	2	2	-	1	2	-	2	1
CO5	3	3	2	3	3	-	2	3	3	3	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	-	2	-	1	-
CO2	3	3	-	-	-	2	-	1	-
CO3	3	3	-	2	-	2	-	1	-
CO4	3	3	-	1	-	2	-	1	-
CO5	3	3	-	3	3	3	-	1	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	INDUSTRY BEST PRACTICES
Course Code	M25CA01AC
Type of Course	Ability Enhancement Compulsory Course
Semester	1
Credits	2
Course Objectives	Knowledge of Agile methodologies and project management, version control using Git, CI/CD processes, and an understanding of security best practices, compliance requirements, and emerging technologies such as cloud computing and AI.

Course Details

Block I: Software Development Practices	
Unit 1	Agile Methodologies - Introduction to Agile, Scrum framework, Kanban, sprints, and user stories.
Unit 2	Automation vs AI, AI in productivity, AI tools : chatbots - Rasa, search - Haystack, content generation - Hugging Face Transformers, and transcription - Whisper, Knowledge management - TiddlyWiki, grounding - Open Assistant, scheduling automation - cal.com, slide decks - Marp and Deckset, and open-source tools for email drafting and meeting summarization.

Unit 3	Continuous Integration/Continuous Deployment (CI/CD) - Automated testing, build pipelines, deployment strategies.
Unit 4	Code Quality and Testing - Code standards, unit testing, integration testing, test-driven development (TDD).
Block II: Project Management and Collaboration	
Unit 1	Project Planning - Defining project scope, work breakdown structure, resource allocation.

Unit 2	Risk Management - Identifying risks, risk assessment, mitigation strategies.
Unit 3	Team Collaboration Tools - Jira, Trello, Slack, and Microsoft Teams for effective communication., GitHub, GitLab, Bitbucket, Git Flow, semantic versioning, changelog generation, release management, team collaboration workflows.
Unit 4	Documentation and Reporting - Writing technical documents, project reports, and user manuals.

Recommended TextBooks /References:

1. Beck, Kent, et al. Manifesto for Agile Software Development. Agile Alliance, 2001.
2. Martin, Robert C. Clean Code: A Handbook of Agile Software Craftsmanship. Prentice Hall, 2009.
3. Kosslyn, Steven M., and Barbara B. Miller. Top Down: Approach to Graphics Programming. Cambridge University Press, 2013.
4. Sommerville, Ian. Software Engineering. 10th ed., Pearson, 2015.
5. Kim, Gene, et al. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations. IT Revolution Press, 2016.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Define and explain key Agile methodologies and project management concepts.	Understand
CO2	Identify core functions of version control systems, including Git.	Apply
CO3	Describe essential components of CI/CD processes.	Apply
CO4	Recognize security best practices, compliance requirements, and fundamentals of emerging technologies like cloud computing and AI.	Understand

Mapping of CO's with PSO's

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO 9	PSO 10	PSO 11
CO1	3	1	-	-	3	1	-	-	1	2	1
CO2	2	3	-	1	2	1	-	-	1	2	1
CO3	3	3	1	1	2	2	1	1	1	2	1
CO4	2	2	1	1	1	3	2	2	1	1	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	2	1	2	-	1	-
CO2	3	3	-	2	1	3	-	1	-
CO3	3	3	-	2	1	3	-	1	-
CO4	3	3	3	2	1	3	-	1	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

Course Title	**DATA STRUCTURES WITH C LAB**
Course Code	**M25CA01PC**
Type of Course	**DISCIPLINE PRACTICAL COURSE-01**
Semester	1
Credits	2
Course Objectives	Implementation and use of stacks and queues, linked lists and binary search trees using dynamic memory and recursion, searching and sorting algorithms for problem-solving, and graph traversal algorithms for applications such as shortest path and minimum spanning tree.

Course Details

Cycle I: Basic Data Structures	
Experiment 1	1. Implement a simple calculator. (Use function) 2. A program that takes two integer numbers from the user and then swaps their values using pointers.
Experiment 2	1. Implement a program to create and perform operations on a stack using a. array. b. linked list 2. Implement a program to create and perform operations on a queue using a. array. b. linked list
Experiment 3	1. Implement a programs to create and perform operations on a. a singly linked list. b. a doubly linked list. c. a circular linked list.

Experiment 4	Implement a program to create and perform operations on a binary search tree. 1. Inorder traversal 2. Preorder traversal 3. Postorder traversal

Cycle II : Algorithms	
Experiment 1	Implement a program to search for an element in an array using linear search. Implement a program to search for an element in a sorted array using binary search.
Experiment 2	Implement a program to sort an array of integers using 1. Quick Sort algorithm. 2. Merge Sort algorithm.
Experiment 3	Implement a program to perform 1. Breadth First Search (BFS) traversal of a graph. 2. Depth First Search (DFS) traversal of a graph.
Experiment 4	Implement a program to find the shortest path in a graph using Dijkstra's algorithm. Implement a program to find the minimum spanning tree of a graph using Kruskal's algorithm

References:

1. Malik, Davender S. *Data structures using C++*. USA, 2010.Goodrich, Michael T., Roberto Tamassia, and David M. Mount. *Data structures and algorithms in C++*. John Wiley & Sons, 2011.
2. Allen, Weiss Mark. *Data structures and algorithm analysis in C++*. Pearson Education India, 2007.
3. Das, Vinu V. *Principles of data structures using C and C++*. New Age International, 2006.
4. Horowitz, Ellis, and Sartaj Sahni. "Fundamentals of data structures." (1982).
5. Lee, Richard Char-Tung, et al. *Introduction to the Design and Analysis of Algorithms*. Taiwan: Unalis Corporation, 1999.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Implement and use stacks and queues for data storage and processing.	Apply
CO2	Apply linked lists and binary search trees using dynamic memory and recursion.	Analyse
CO3	Apply searching and sorting algorithms to solve basic computational problems.	Analyse
CO4	Implement graph traversal algorithms to solve problems like shortest path and minimum spanning tree.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	3	1	-	-	-	-	2	-	-	-
CO2	2	3	1	-	-	-	-	2	-	-	-
CO3	2	3	1	-	-	-	-	2	-	-	-
CO4	2	3	1	-	-	-	-	2	-	-	-

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	-	2	-	1	-
CO2	3	3	-	-	-	2	-	1	-
CO3	3	3	-	2	-	2	-	1	-

CO4	3	3	-	1	-	2	-	1	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

Course Title	**PYTHON PROGRAMMING LAB**
Course Code	**M25CA02PC**
Type of Course	**DISCIPLINE PRACTICAL COURSE-02**
Semester	**1**
Credits	**2**
Course Objectives	Develop skills in writing, testing, and debugging Python programs using conditionals and loops, utilizing data structures like lists, tuples, sets, and dictionaries for problem-solving, processing and analyzing data with libraries such as NumPy and Pandas, and implementing simple data visualizations using Matplotlib.

Course Details

Cycle 1: Introduction to Python	
Experiment 1	Implement basic data types, variables and operators
Experiment 2	Develop program using control statement and looping statement
Experiment 3	Implement functions
Experiment 4	Develop program to implement classes and objects
Cycle 2: Advanced Python Programs	
Experiment 1	Develop a program using inheritance and polymorphism.

Experiment 2	Demonstrate program handling file and exception.
Experiment 3	Develop program to connect database with python
Experiment 4	Implement a Python program that utilizes the Numpy, Matplotlib, and Pandas modules to process data stored in a file.

References:

1. Matthes, E. (2023). *Python crash course: A hands-on, project-based introduction to programming* (3rd ed.). No Starch Press.

2. Grinberg, M. (2022). *Flask Web Development: Developing web applications with Python* (2nd ed.). O'Reilly Media.

3. Slatkin, B. (2023). *Effective Python: 90 specific ways to write better Python* (2nd ed.). Addison-Wesley Professional.

4. Alchin, M. (2022). *Pro Python* (3rd ed.). Apress.
5. Heinold, Brian. "A practical introduction to Python programming." (2021)

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Write, test, and debug basic Python programs using conditional and loop statements.	Apply
CO2	Use Python data structures like Lists, Tuples, Sets, and Dictionaries in programs.	Apply
CO3	Process and analyze data from files using Python libraries such as NumPy and Pandas.	Analyse
CO4	Create simple data visualizations using Matplotlib in Python.	Analyse

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	3	3	1	1	-	-	-	2	-	-	1
CO2	3	3	3	2	1	-	-	-	-	2	1
CO3	3	3	1	1	2	-	1	2	-	2	1
CO4	3	3	2	2	2	-	1	2	-	2	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	1	1	3	1	2	1
CO2	3	2	1	2	2	3	1	2	1
CO3	2	2	2	1	2	3	1	2	2
CO4	3	3	2	2	2	3	1	2	2

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

SECOND SEMESTER

Course Title	**OPERATING SYSTEMS DESIGN**
Course Code	**M25CA04DC**
Type of Course	DISCIPLINE CORE COURSE -04
Semester	**2**
Credits	**4**
Course Objectives	To provide an understanding of the basic concepts and principles of operating systems, including their components and functions, process and memory management, file systems, I/O management, distributed and real-time systems, security aspects, and features of mobile operating systems.

Course Details

Block I: Introduction to Operating Systems and Process Management	
Unit 1	Introduction, Types, and Structures: Definition, goals, and functions of an operating system. Types of operating system:Batch, Multiprogramming, Time-sharing, Distributed, Real-time, Multiprocessor, and Mobile operating systems. Operating System Services: User and system view, Operating System Structure.
Unit 2	Process Concept and Scheduling: Process vs. Program, Process State Diagram, Process Control Block (PCB). Threads, Process Scheduling, Scheduling Algorithms.
Unit 3	Inter-process Communication and Synchronization: Inter-process Communication (IPC), The Critical-Section Problem, Synchronization Tools,Monitors.
Unit 4	Deadlocks: Necessary conditions for deadlock, Deadlock Prevention, Deadlock Avoidance and Detection.

Block II: Memory Management	
Unit 1	Memory Management Strategies: Basic hardware, Address binding, Logical vs. Physical Address Space.Swapping,Paging,Segmentation.
Unit 2	Virtual Memory Management: Demand paging, Benefits of virtual memory, Page Fault Handling,Thrashing.

Unit 3	Page Replacement Algorithms: FIFO (First-In, First-Out),Optimal Page Replacement, LRU (Least Recently Used) Page Replacement.
Unit 4	Segmentation and Paging : Memory Allocation Algorithms: First-Fit, Best-Fit, Worst-Fit. Fragmentation (Internal and External).

BlockIII: File Systems and I/O Management	
Unit 1	File System Interface: File Concept,Access Methods,Directory Structure,File System Mounting and Protection
Unit 2	File System Implementation: File System Implementation: File System Structure, Directory Implementation: Linear list, Hash table.Allocation Methods,Efficiency and Performance.
Unit 3	I/O Systems:I/O Hardware, Application I/O Interface, Kernel I/O Subsystem.
Unit 4	Disk Management: Disk Structure, Disk Attachment, Disk scheduling algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK), Swap-Space Management
Block IV: Distributed Systems, Security, and Specialized OS Concepts	
Unit 1	Distributed Operating Systems: Distributed Systems,Network Structure and Topology, Design Issues in Distributed Systems, Distributed File Systems.
Unit 2	Operating System Security: Security Goals, System Protection,Security Violations and Threats,Basic concepts of encryption, authentication. Firewall concepts.
Unit 3	Real-time Operating Systems (RTOS): Hard vs. Soft Real-time systems, Scheduling in RTOS,Resource Management in RTOS, Applications of RTOS.
Unit 4	Mobile Operating Systems: Characteristics of Mobile OS, Mobile OS Architecture,Process and Memory Management in Mobile OS,Security and Privacy in Mobile OS.

Recommended TextBooks /References:

1. Tanenbaum, A. S., & Bos, H.. Modern Operating Systems (5th ed.). Pearson, 2024.
2. Silberschatz, A., Galvin, P. B., & Gagne, G. . Operating System Concepts (10th ed.). John Wiley & Sons, 2023.
3. Stallings, William. Operating Systems: Internals and Design Principles. 9th ed., Pearson, 2018.
4. Dhamdhere, D. M. .Operating Systems: A Concept-Based Approach (3rd ed.). McGraw-Hill Education,2012.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	To understand the fundamental concepts and principles of operating systems.	Understand
CO2	To learn the various components of an operating system and their functionalities.	Understand
CO3	To gain knowledge of process management, memory management, file systems, and I/O management.	Understand
CO4	Discuss the concepts of distributed systems and real-time operating systems.	Apply
CO5	Explore operating system security and features of mobile operating systems.	Analyse

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	1	–	–	1	–	–	–	–	–	1
CO2	3	2	–	–	2	–	–	–	–	–	1
CO3	3	2	–	–	2	–	–	–	–	–	1
CO4	2	2	–	–	2	–	2	–	–	–	1
CO5	2	2	–	1	1	3	1	–	–	–	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	–	–	–	1	–	1	–
CO2	3	2	–	–	–	2	–	1	–

CO3	3	2	–	–	–	2	–	1	–
CO4	2	2	–	–	–	2	–	1	–
CO5	3	2	–	–	–	2	3	1	–

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**DATABASE TECHNOLOGIES**
Course Code	**M25CA05DC**
Type of Course	DISCIPLINE CORE COURSE-05
Semester	**2**
Credits	**4**
Course Objectives	Understanding of DBMS concepts and database schema design using the ER model, evaluate and optimize databases through normalization and functional dependency analysis, design and implement PL/SQL programs with procedures, functions, triggers, and cursors, learn the features and challenges of advanced databases like NoSQL, vector, and cloud databases, and explore the integration of AI/ML models to enhance database performance and efficiency.

Course Details

Block 1: Introduction to DBMS and ER Model	
Unit 1	Introduction to DBMS: Characteristics, Types of DBMS, Components of DBMS, Database Users, Structured, Semi-Structured and Unstructured Data, Database Design, Database Languages.
Unit 2	Data Models and Schema: Types, Database System Architectures and Classification, Database Abstraction Levels, Data Independence.
Unit 3	ER Model, Keys in ER Model: Super Key, Candidate Key, Primary Key, Composite Key, Foreign Key (in context of relationships), Partial Key (in weak entities), Key Constraints (uniqueness and minimality).
Unit 4	ER Model to database schema: Mapping Entities to Tables, Mapping Relationships to Tables, Mapping Weak Entities, Mapping Generalization and Specialization.
Block II: Relational Database Design and SQL	
Unit 1	Database Normalization: Functional Dependencies, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form and Fifth Normal Form.
Unit 2	SQL Concepts: Basic SQL Commands, Data Types in SQL, Basic SQL Query Structure, Constraints.

Unit 3	Built-in Functions: String Functions, Numeric and Mathematical functions, Aggregate Functions, Date and Time Functions.
Unit 4	Views: Advantages, Disadvantages, Creating and Managing Views, Modifying Views and Transaction Control Commands.
Block III: Introduction to PL/SQL	
Unit 1	Introduction to PL/SQL: Basics of PL/SQL, advantages, Structure, Variables and Datatypes, Control structures.
Unit 2	Cursors: Fundamentals, Types- Implicit and Explicit Cursors, Cursor Attributes, REF cursors – Usage.
Unit 3	Stored Procedures and Functions: Defining and using stored procedures, Syntax to Create a Stored Procedure, Example. Functions- Characteristics, Syntax, Example, Comparison.
Unit 4	Triggers: Components, Types of triggers, Creating and Managing triggers, Examples, Trigger Restrictions.
Block IV: Advanced DBMS	
Unit 1	NoSQL Databases: Basics, benefits, challenges, Types- Key value stores (Amazon DynamoDB), Document Stores (MongoDB), Column-Family Stores (Apache Cassandra), Graph Databases (Neo4j).
Unit 2	Vector Databases: Basics, Principles, Use cases, Working, Challenges, Embedding, Distance Metrics And Similarity, Indexing (FLAT, IVF, PQ, ANNOY, HNSW) and Querying, Vector DB Providers (Pinecone, Qdrant, etc).
Unit 3	Cloud Databases: Fundamentals, Managed Cloud Databases and Self-Managed Cloud Databases, Use Cases, Challenges, Types, Popular Cloud Database Providers (AWS, IBM Cloud).
Unit 4	Multi-Model Databases: Features, Types, Popular Multi-Model Databases (ArangoDB, Orient DB), AI/ML Integration in Databases - Importance, Key Areas (Query Optimization, Predictive Analytics, Anomaly Detection, Smart Indexing, etc), Techniques (Reinforcement Learning, Supervised Learning, Unsupervised Learning, NLP), Applications.

Recommended TextBooks /References:

1. Smith, A. B., & Jones, C. D. (2020). Fundamentals of Database Management. John Wiley & Sons.
2. Garcia, J. (2018). Database Management Systems: Concepts and Technologies. Pearson Education.
3. Boney, C. (2021). NoSQL for Mere Mortals. published by O'Reilly Media.
4. Wendy Neu, Vlad Vlasceanu, Andy Oram & Sam Alapati (2019), Introduction to Cloud Databases, published by O'Reilly Media.
5. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.
6. Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.

Suggested Readings:

1. Adam Fowler, NoSQL for Dummies, John Wiley & Sons, 2015
2. NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data), Wiley, 2018
3. Web Resource: https://www.w3resource.com/redis/
4. web Resource: https://www.w3schools.in/category/mongodb/
5. Web Resource: https://www.tutorialspoint.com/cassandra/cassandra_introduction.htm
6. Web Resource : https://www.tutorialspoint.com/arangodb/index.htm

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Analyze the concepts of DBMS and the Entity-Relationship (ER) model to design a database schema, analyzing the relationships, keys, and constraints within a system.	Analyse
CO2	Evaluate existing databases, identify normalization issues, and design an optimized schema by applying normalization techniques and functional dependency analysis.	Analyse
CO3	Design and implement PL/SQL programs by creating stored procedures, functions, and triggers, and by utilizing control structures and cursors to solve real-world database problems.	Apply
CO4	Describe the features and challenges of advanced database technologies such as NoSQL, vector databases, and cloud databases.	Understand
CO5	Integrate AI/ML models to improve the performance and efficiency of database systems.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	3	2	3	–	2	–	–	–	–	–	1
CO2	3	2	3	–	2	–	–	–	–	–	1
CO3	3	3	3	1	2	–	–	–	–	–	1
CO4	2	2	2	–	1	–	2	–	–	–	1
CO5	3	3	3	–	2	–	1	3	2	–	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	–	–	–	2	–	–	–
CO2	3	3	–	–	–	2	–	–	–
CO3	3	3	–	–	–	3	–	–	–
CO4	2	1	–	–	–	2	–	1	2
CO5	3	2	–	–	–	3	–	2	2

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**MACHINE LEARNING**
Course Code	**M25CA06DC**
Type of Course	**DISCIPLINE CORE COURSE-06**
Semester	**2**
Credits	**4**
Course Objectives	Understanding of the basic concepts, types, and evaluation techniques of machine learning, covering supervised learning methods for classification and regression, unsupervised learning techniques, the basics of reinforcement learning, advanced models such as neural networks and deep learning, and analysis of machine learning models including recent trends and research.

Course Details

Block I: Fundamentals of Machine Learning	
Unit 1	Foundations of Machine Learning: Definition, Scope, Evolution of ML, Real-world applications, AI vs ML vs DL
Unit 2	Types of Machine Learning: Overview of Supervised, Unsupervised, and Reinforcement Learning with basic examples
Unit 3	Data Preprocessing: Data Cleaning, Transformation, Normalization, Feature Selection, Data Splitting.
Unit 4	Evaluation Metrics: Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC Curve, AUC, Bias-Variance, Overfitting, Underfitting, Regularization
Block II: Supervised Learning	
Unit 1	Classification Algorithms: k-NN, Decision Trees, Naive Bayes,SVM, Ensemble Methods.
Unit 2	Regression Algorithms: Linear Regression, Logistic Regression, Polynomial Regression, Evaluation Metrics-Mean Absolute Error (MAE), Root Mean squared Error (RMSE), R Squared/Coefficient of Determination

Unit 3	SVM and Ensemble Method: SVM (Hyperplanes, Kernel Trick), Bagging,Boosting, Random Forests, Gradient Boosting
Unit 4	Model Tuning and Cross-Validation: Hyperparameter Tuning, Grid Search, k-Fold Cross-Validation, Performance Improvement
Block III: Unsupervised Learning	
Unit 1	Clustering Techniques: k-Means, Hierarchical Clustering, DBSCAN, Cluster Evaluation Metrics.
Unit 2	Dimensionality Reduction: PCA, SVD, t-SNE, LDA (Introductory and Applications)
Unit 3	Association Rule Learning: Apriori, FP-Growth, Market Basket Analysis, Support, Confidence, Lift
Unit 4	Reinforcement Learning Basics: Markov Decision Process, Q-Learning, SARSA, Exploration vs Exploitation, Applications
Block IV: Advanced Machine Learning	
Unit 1	Neural Networks Basics: Perceptron, Feedforward Networks, Backpropagation, Activation Functions.
Unit 2	Deep Learning Architectures: CNNs, RNNs, LSTMs, Applications in Vision and NLP
Unit 3	Model Deployment and Case Studies: Model Saving/Loading, Deployment Tools, Case Studies (Healthcare, Finance, E-commerce), Interpretability
Unit 4	Recent Trends and Research: Transfer Learning, GANs, AutoML, Explainable AI, Current Research Trends

Recommended TextBooks /References:

1. Stuart Russell, Peter Norvig: “Artificial Intelligence: A Modern Approach “, 4th Ed, Pearson, 2020.
2. Elaine Rich, Kevin Knight, B.Nair: “ARTIFICIAL INTELLIGENCE “, 3rd Ed, McGraw Hill, 2017.
3. Machine Learning, Tom M. Mitchell, McGraw Hill.
4. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
5. Stephen Marsland, “Machine Learning An Algorithmic Perspective”, CRC Press.
6. Yoshua Bengio, “Learning Deep Architectures for AI”, Now Publishers Inc (2009)

Course Outcomes

No	Course Outcomes	Cognitive level

CO1	Understand the fundamental concepts, types, and evaluation techniques of machine learning, including data preprocessing and model assessment.	Understand
CO2	Analyze supervised learning algorithms for classification and regression tasks, including model tuning, hyperparameter optimization, and ensemble methods.	Analyse
CO3	Implement unsupervised learning techniques such as clustering, dimensionality reduction, and association rule mining, and analyze reinforcement learning basics.	Apply
CO4	Discuss advanced machine learning models, including neural networks and deep learning architectures.	Understand
CO5	Analyze machine learning models and explore current trends and research in the field.	Analyse

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	1	2	2	–	1	–	–	2	–	–	1
CO2	2	3	2	–	2	–	–	3	1	–	1
CO3	2	3	2	–	2	–	–	3	1	–	1
CO4	1	2	1	–	1	–	–	2	1	–	1
CO5	2	3	2	–	2	–	1	3	3	–	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	–	–	1	2	–	1	–
CO2	3	3	–	–	2	3	–	1	1
CO3	3	3	–	–	2	3	–	1	1
CO4	2	1	–	–	1	2	–	1	1
CO5	3	2	–	–	3	3	–	2	2

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

ABILITY ENHANCEMENT COMPULSORY COURSE INSTITUTION SPECIFIC

M21UC01AC (IS)- FOUNDATIONAL SKILLS FOR RESEARCH AND WRITING

CREDIT- 2

Course Title	**DBMS LAB**
Course Code	**M25CA03PC**
Type of Course	**PRACTICAL CORE COURSE-04**
Semester	**2**
Credits	**2**
Course Objectives	To enable learners to acquire a solid understanding of relational and NoSQL database systems by learning SQL and PL/SQL programming, table design, data manipulation, and MongoDB operations for effective data management and analysis.

Course Details

Cycle I: SQL Fundamentals	
Experiment 1	Creating and Managing Tables: Create a table with various data types (e.g., INT, VARCHAR, DATE). Apply constraints such as PRIMARY KEY, FOREIGN KEY, NOT NULL, and UNIQUE. Demonstrate how to alter tables by adding or dropping columns.
Experiment 2	Data Manipulation: Perform basic CRUD operations (Create, Read, Update, Delete) Insert records into the table. Update existing records. Delete records from the table.
Experiment 3	Basic SQL Queries: Write and execute SQL queries that demonstrate the use of aliases and retrieve all columns and distinct values using the * operator. Apply the WHERE clause for filtering records and utilize the LIKE operator for pattern matching in your queries. Construct and execute SQL queries to implement set operations, perform JOINS, and create nested subqueries.

Experiment 4	Views: Write and execute SQL query to create a view that displays specific columns from a table. Write and execute modifying an existing view to include additional columns and also write and execute SQL query to drop a view.
Cycle II : Advanced SQL queries, PL/SQL and NoSQL	
Experiment 1	EXISTS and NOT EXISTS Functions: Write a SQL query that uses the EXISTS function to find all employees who work in departments that have more than 5 employees Create a SQL query using the NOT EXISTS function to list all products that have not been sold in any order. Aggregate Functions and Grouping: Write a SQL query that calculates the total sales, average sales, and number of sales transactions for each product category using aggregate functions.
Experiment 2	String Functions : Write a SQL query that extracts and displays the first three characters of each employee's last name using the SUBSTRING function. Formulate a SQL query that utilizes string functions to extract and display the last four characters of each customer’s phone number from the customer table.
Experiment 3	Cursors: Implement an explicit cursor to retrieve and display employee names and salaries. Implement a method to fetch data from a cursor and discuss the advantages of using cursors in PL/SQL.
Experiment 4	NoSQL database: Implement basic CRUD operations using MongoDB for a student database. Create a MongoDB collection and execute queries using filters, projections, and indexing.

Recommended TextBooks /References:

1.Kaufmann, Michael, and Andreas Meier. *SQL and NoSQL Databases: Modeling, Languages, Security and Architectures for Big Data Management*. 2nd ed., Springer, June 2023.

2.Sadalage, Pramod J., and Martin Fowler. *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*.

3.Database System Concepts - Silberschatz, Korth and Sudarsan, Fifth Edition, McGraw Hill, 2006

4.Database Management Systems - Raghu Ramakrishnan and Johannes Gehrke, Third Edition, McGraw Hill, 2003

5.Database Systems: Design, Implementation and Management, Peter Rob, Thomson Learning, 7Edn.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Create relational database tables using appropriate data types and constraints; perform basic SQL operations such as INSERT, SELECT, UPDATE, and DELETE.	Apply / create
CO2	Construct SQL queries involving joins, set operations, subqueries, and views for meaningful data retrieval and reporting.	Analyze / Create
CO3	Apply advanced SQL features including EXISTS, NOT EXISTS, aggregate functions, and string functions to solve real-world data retrieval problems.	Apply
CO4	Implement PL/SQL concepts such as explicit cursors and demonstrate CRUD operations using NoSQL databases like MongoDB for managing semi-structured data	Apply / Create

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	3	3	–	1	–	–	–	–	–	2
CO2	2	3	3	–	1	–	–	–	–	–	2
CO3	2	3	3	–	1	–	–	–	1	–	2
CO4	2	3	3	–	2	–	1	1	1	–	2

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	–	–	–	3	–	1	–
CO2	2	3	–	–	1	3	–	1	–
CO3	2	3	–	–	1	3	–	1	–
CO4	2	3	–	–	1	3	–	1	1

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

Course Title	**MACHINE LEARNING LAB**
Course Code	**M25CA04PC**
Type of Course	**PRACTICAL CORE COURSE -04**
Semester	**2**
Credits	**2**
Course Objectives	To enable learners to acquire knowledge and practical skills in data preprocessing, supervised and unsupervised learning, and model evaluation using Python for effective data analysis and pattern discovery.

Course Details

Cycle 1: Supervised Learning and Data Preparation	
Experiment 1	Implement data preprocessing techniques: handle missing values, encode categorical variables, and normalize features.
Experiment 2	Implement Linear Regression to predict a continuous variable using Scikit-learn.
Experiment 3	Implement Logistic Regression and evaluate results using accuracy score.
Experiment 4	Train a Decision Tree Classifier and compare it with Random Forest on a sample dataset.
Cycle 2: Advanced Models, Evaluation & Unsupervised Learning	
Experiment 1	Implement K-Nearest Neighbors (KNN) for classification and evaluate its performance.

Experiment 2	Evaluate classification models using confusion matrix, precision, recall, and F1-score.
Experiment 3	Apply K-Means clustering to discover patterns in unlabeled data
Experiment 4	Apply Principal Component Analysis (PCA) to reduce dimensions and visualize clusters.

Recommended TextBooks /References:

1.Müller, Andreas C., and Sarah Guido. (2016.) Introduction to machine learning with Python: a guide for data scientists. " O'Reilly Media, Inc.".

2.. Gowrishankar S., Veena A.(2019.), Introduction to Python Programming, CRC Press, Taylor & Francis Group.

3.Theobald, O. (2021). Machine learning for absolute beginners (3rd ed.). Scatterplot Press.

4.Raschka, S., & Mirjalili, V. (2020). *Python machine learning* (3rd ed.). Packt Publishing.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Apply data preprocessing techniques such as handling missing values, encoding, and normalization using Python libraries.	Apply
CO2	Apply supervised learning algorithms like linear regression, logistic regression, decision tree, and random forest on real-world datasets.	Apply
CO3	Apply evaluation metrics like accuracy, precision, recall, and F1-score to assess classification models.	Apply
CO4	Apply K-Means clustering and PCA techniques to explore and visualize patterns in data.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	3	3	–	–	–	–	3	–	–	3
CO2	3	3	3	–	–	–	–	3	–	–	3
CO3	3	3	3	–	–	–	–	3	–	–	3
CO4	2	3	3	–	–	–	–	3	–	–	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	–	–	1	1	–	–	–
CO2	3	3	–	–	1	1	–	–	–
CO3	3	3	–	–	1	1	–	–	–
CO4	3	3	–	–	1	1	–	–	–

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

THIRD SEMESTER

Course Title	**COMPUTER NETWORKS AND COMMUNICATION**
Course Code	**M25CA07DC**
Type of Course	**DISCIPLINE CORE COURSE-07**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire a comprehensive understanding of data communication and networking principles, including transmission methods, protocols, routing, application-layer communication, and network security practices for effective network design and management.

Course Details

Block I: Introduction to Data Communication	
Unit 1	Basic concepts in Data Communication: Components, Data Representation, Data Flow, Network Criteria, Physical Structure, Attributes of Communication
Unit 2	Digital Signals and Modulation Techniques: Introduction to Digital Transmission, Bit rate, Baud rate, Bandwidth, Analog transmission, Digital-to-Digital Conversion, Line Coding, Pulse Code Modulation. Multiplexing- FDM, TDM,WDM
Unit 3	Transmission Media: Detailed Analysis of Guided Media (Twisted Pair, Coaxial Cable, Fiber Optic), Unguided Media (Radio Waves, Microwaves, Infrared), Line of sight.
Unit 4	Error Detection and Correction: Types of Errors, Parity Checks, Hamming Code, Cyclic Redundancy Check (CRC), Checksum.
Block II: Networking Fundamentals and Architectures	
Unit 1	Networking Concepts and Topologies: Types of Networks (LAN, WAN, MAN, PAN), Network Topologies (Star, Mesh, Bus, Hybrid).

Unit 2	Switching Techniques: Circuit Switching, Message Switching, Packet Switching, Virtual Circuit Switching.
Unit 3	The OSI Model: Functions of Each Layer, Comparison of OSI and TCP/IP Models, Layered Communication.
Unit 4	Congestion Control: Causes of Congestion, Congestion Avoidance Techniques, Leaky Bucket Algorithm, Token Bucket Algorithm.
Block III: TCP/IP and Routing Protocols	
Unit 1	TCP/IP Protocol Suite: TCP/IP Architecture, Internet Protocol (IPv4/IPv6), Connectionless and Connection-Oriented Services.
Unit 2	Addressing: Classful and Classless Addressing, Subnetting, CIDR, NAT, and IPv6 Addressing Techniques.
Unit 3	Routing Concepts: Types of Routing (Static vs. Dynamic), Routing Protocols (RIP, OSPF, BGP), Hybrid Routing Protocols.
Unit 4	Application Layer Protocols: DNS, HTTP, FTP, SMTP, SNMP, Remote Access Protocols (Telnet, SSH).
Block IV: Network Security and Administration	
Unit 1	Network Security Concepts: Principles of Security (Confidentiality, Integrity, Availability), Threat Models, and Risk Assessment.
Unit 2	OSI Security Architecture: Security Services, Security Mechanisms, Cryptography Overview (Symmetric and Asymmetric).
Unit 3	Network Security Measures: Firewalls, Intrusion Detection Systems (IDS), Virtual Private Networks (VPN), Secure Socket Layer (SSL).
Unit 4	Network Administration: Setting Up Networks, Managing Internetworking Devices (Routers, Switches, Gateways), Advanced Network Configuration, Monitoring, and Troubleshooting Tools

Recommended TextBooks /References:

1. Forouzan, B. A. Data Communication and Networking. 4th ed., Tata McGraw Hill Education, 2006.
2. Tanenbaum, Andrew S. Computer Networks. 4th ed., Prentice Hall of India, 2003.
3. Stallings, William. Cryptography and Network Security: Principles and Practice. 5th ed., Pearson, 2011.
4. Tanenbaum, Andrew S., and David J. Wetherall. Computer Networks. 5th ed., Pearson, 2011.
5. Levi, Bozidar. UNIX Administration: A Comprehensive Sourcebook for Effective Systems & Network Management. CRC Press, 2001.
6. Bautts, Tony, et al. Linux Network Administrator's Guide. 3rd ed., O'Reilly Media, 2005.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Explain the fundamental concepts of data communication, including components, signals, modulation techniques, transmission media, and error detection methods.	Understand
CO2	Describe various network types, topologies, switching techniques, and compare OSI and TCP/IP models for layered communication.	Understand
CO3	Apply addressing schemes and demonstrate routing concepts using standard protocols such as RIP, OSPF, and BGP within the TCP/IP architecture.	Apply
CO4	Use appropriate application layer protocols and remote access tools for client-server communication.	Apply
CO5	Apply basic network security measures and manage network devices for configuration, monitoring, and troubleshooting in real-world scenarios.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	–	-	–	–	–	–	–	–	–	–	3
CO2	–	-	–	–	–	–	–	–	–	–	3
CO3	–	3	–	–	–	–	–	–	–	–	3
CO4	–	3	–	–	–	–	–	–	–	–	3

CO5	–	3	-	–	2	3	–	3	–	–	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	-	-	–	–	–	–	–	2	–
CO2	-	-	–	–	–	–	–	2	–
CO3	3	3	–	–	–	–		3	–
CO4	2	3	–	–	–	2		2	–
CO5	3	3	–	–	2	3	2	2	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester**

		examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**DEEP LEARNING**
Course Code	**M25CA01DE**
Type of Course	**DISCIPLINE SPECIFIC ELECTIVE-I**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire foundational and advanced knowledge of deep learning by understanding neural architectures, optimization techniques, and ethical considerations, and by applying models such as CNNs, RNNs, Autoencoders, GANs, and Transformers to real-world problems in vision and language.

Course Details

Block I: Introduction to Deep Learning	
Unit 1	Overview of Deep Learning and its history: Definition and evolution of Deep Learning,Historical context and breakthroughs (e.g., neural networks, vanishing gradient problem, rise of GPUs),Relationship between Deep Learning, Machine Learning, and Artificial Intelligence,Applications of Deep Learning.
Unit 2	Basic Concepts of Artificial Neural Networks (ANNs): Biological inspiration, Perceptron model, Multilayer Perceptrons (MLPs), Feedforward neural networks: Structure and information flow. Loss functions (e.g., Mean Squared Error, Cross-Entropy) and their importance.
Unit 3	Forward Propagation and Backpropagation Algorithms: Forward Propagation,Backpropagation,Understanding the role of optimizers in backpropagation.
Unit 4	Activation Functions and Optimization Techniques: Activation Functions,Optimization Techniques,Regularization techniques: L1, L2 regularization, Dropout, early stopping to prevent overfitting.
Block II: Convolutional Neural Networks and Recurrent Neural Networks	
Unit 1	Convolutional Neural Networks : Introduction to CNNs,Convolutional layers, Pooling layers, Applications of CNNs in computer vision.
Unit 2	Basic concepts of recurrent neural networks: Introduction to RNNs, Recurrent connections and unfolded networks,Applications of RNNs in natural language processing (NLP).
Unit 3	Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) architectures
Unit 4	Introduction to Transfer Learning, Strategies for transfer learning,Fine-tuning pre-trained CNNs for image classification and other tasks..
Block III: Autoencoders and Generative Adversarial Networks	
Unit 1	Basic concepts of autoencoders: Introduction to Autoencoders,Architecture: Encoder and Decoder,Types of Autoencoders,Applications.
Unit 2	Encoder and decoder architectures: Common encoder architectures, Variational Autoencoders (VAEs, Applications of VAEs.
Unit 3	Basic concepts of GANs: Introduction to GANs, Adversarial training framework, Zero-sum game analogy.
Unit 4	Generator and discriminator architectures.

Block IV:Advanced Deep Learning Concepts and Ethical Considerations	
Unit 1	Attention Mechanisms and Transformers: Introduction to Attention,Self-attention mechanism, Revolutionary impact of Transformers in NLP, Applications of Transformers beyond NLP.
Unit 2	Reinforcement Learning with Deep Learning:Introduction to Reinforcement Learning (RL), Introduction to Reinforcement Learning (RL),Deep Q-Networks (DQN),Applications of Deep RL.
Unit 3	Explainable AI (XAI) in Deep Learning,Challenges and limitations of XAI. Importance of XAI in critical applications.
Unit 4	Ethical Considerations and Societal Impact of Deep Learning :Bias in AI models,Fairness in Deep Learning,The socio-economic impact of Deep Learning.

Recommended Textbooks:

1. Prince, Simon J.D. Understanding Deep Learning. MIT Press, 2023.
2. Chollet, François. Deep Learning with Python. 2nd ed. Manning Publications, 2021.
3. Aggarwal, Charu C. Neural Networks and Deep Learning: A Textbook. Springer, 2018.
4. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Recall the historical evolution, key terms, and basic structures of deep learning, including neural networks, loss functions, and optimizers.	Remember
CO2	Explain the working principles of Convolutional and Recurrent Neural Networks, including LSTM and GRU, and their applications in vision and NLP.	Understand
CO3	Describe the architecture and functions of Autoencoders, Variational Autoencoders (VAEs), and Generative Adversarial Networks (GANs).	Understand
CO4	Apply advanced techniques like Transfer Learning, Attention Mechanisms, and	Apply

	Transformers to solve domain-specific problems in image and language tasks.	
CO5	Apply ethical evaluation strategies and fairness checks in deep learning systems, considering social, legal, and economic impacts.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	–	2	–	–	–	–	–	2	–	–	–
CO2	–	2	–	–	–	–	–	3	–	–	–
CO3	–	2	–	–	–	–	–	3	–	–	–
CO4	2	3	–	–	–	–	–	3	2	–	2
CO5	–	2	–	–	–	3	–	–	2	–	2

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	–	2	–	–	–	1	–	-	–
CO2	–	2	–	–	–	1	–	2	–
CO3	–	3	–	–	–	1	–	3	–
CO4	–	3	–	-	–	1	–	3	-
CO5	–	3	–	-	–	3	-	2	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**REINFORCEMENT LEARNING**
Course Code	**M25CA02DE**
Type of Course	**DISCIPLINE SPECIFIC ELECTIVE-I**
Semester	**3**
Credits	**4**

Course Objectives	To enable learners to acquire a comprehensive understanding of reinforcement learning principles and methods, including MDPs, Dynamic Programming, Monte Carlo, and Temporal Difference techniques, and to apply deep learning-based approaches and ethical practices in developing intelligent decision-making systems.

Course Details

Block I: Introduction to Reinforcement Learning	
Unit 1	Introduction to Reinforcement Learning : Elements of Reinforcement Learning,Difference between Supervised, Unsupervised, and RL,Real-world Applications of RL
Unit 2	Finite Markov Decision Processes:Agent-Environment interface, Markov Property,Markov Decision Processes,Value functions,Optimal Value Functions,Optimality and Approximation.
Unit 3	Dynamic Programming:Policy Evaluation,Policy Evaluation,Policy Iteration,Value Iteration,Asynchronous Dynamic Programming,Efficiency of Dynamic Programming.
Unit 4	Monte Carlo Methods:Monte Carlo Prediction,Monte Carlo Estimation of Action Values,Monte Carlo Control,Incremental Implementation,Off-Policy Monte Carlo Control
Block II: Temporal Difference Learning and Control	
Unit 1	Temporal Difference (TD) Learning:TD(0) Prediction,Optimality of TD(0),Advantages of TD over MC and DP,Bootstrapping Concept
Unit 2	TD Control Methods : SARSA Algorithm (on-policy),Q-Learning Algorithm (off-policy),Expected SARSA,Comparing SARSA vs Q-Learning
Unit 3	Eligibility Traces and TD(λ) : n-Step TD Prediction,The Forward View of TD(λ), The Backward View of TD(λ),λ-Return,TD(λ) for Prediction and Control
Unit 4	Planning and Learning : Models and Planning ,Integrating Planning, Acting, and Learning , Prioritized Sweeping ,Trajectory Sampling , Heuristic Search ,Monte Carlo Tree Search.

Block III: Function Approximation and Deep RL	
Unit 1	Function Approximation Basic: Linear Function Approximation,Gradient Descent in RL,Convergence Issues
Unit 2	Introduction to Deep Learning in RL : DQN Architecture,Experience Replay and Target Networks,Variants: Double DQN, Dueling DQN
Unit 3	Policy Gradient Methods : REINFORCE Algorithm,Baseline and Variance Reduction,introduction to Actor-Critic Methods
Unit 4	Advanced Policy Gradient Techniques : Deep Deterministic Policy Gradient (DDPG) ,Proximal Policy Optimization (PPO),Trust Region Policy Optimization (TRPO) ,A3C (Asynchronous Advantage Actor-Critic
Block IV:Applications, Tools, and Ethics	
Unit 1	Practical Applications of RL : Robotics and Control Systems,Game Playing (Atari, Go, Chess),Finance and Trading
Unit 2	Tools and Frameworks : OpenAI Gym, TensorFlow Agents / PyTorch RL Libraries,Unity ML-Agents, Ray RLlib
Unit 3	Evaluation and Tuning in RL : Metrics for RL Performance,Reward Shaping and Sparse Rewards,Hyperparameter Tuning
Unit 4	Ethical and Societal Aspects : Safety in Reinforcement Learning, Explainability and Interpretability, Fairness and Bias in RL, RL in Autonomous Systems and Human-in-the-Loop Learning

Reference Textbooks:

1. Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). A Bradford Book.
2. Bertsekas, D. P. (2019). Dynamic programming and optimal control: Vol. I. Dynamic programming (4th ed.). Athena Scientific.
3. Puterman, M. L. (2014). Markov decision processes: Discrete stochastic dynamic programming. John Wiley & Sons.

4. Szepesvári, C. (2010). Algorithms for reinforcement learning. Morgan & Claypool Publishers.
5. Wiering, M., & van Otterlo, M. (Eds.). (2012). Reinforcement learning: State-of-the-art. Springer.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Identify the main parts of reinforcement learning, such as the agent, environment, rewards, and actions	Understand
CO2	Explain how decision-making problems can be described using Markov Decision Processes (MDPs).	Understand
CO3	Describe how different methods like Dynamic Programming, Monte Carlo, and Temporal Difference are used to improve learning in RL.	Understand
CO4	Apply basic function approximation and deep learning methods to create reinforcement learning models for real-world tasks.	Apply
CO5	Use reinforcement learning libraries and platforms to build practical solutions, while taking care of ethical issues like safety and fairness.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	–	2	–	–	–	–	–	2	–	–	–
CO2	–	2	–	–	–	–	–	2	–	–	–
CO3	–	2	–	–	–	–	–	3	–	–	–
CO4	2	3	–	–	–	–	–	3	2	–	2
CO5	2	3	–	–	–	3	–	2	2	–	2

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	–	1	–	–	–	2	–	2	–
CO2	–	2	–	–	–	2	–	2	–
CO3	–	2	–	–	–	2	–	2	–
CO4	–	3	–	–	2	3	–	2	-
CO5	–	3	–	–	2	3	-	2	–

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**NATURAL LANGUAGE PROCESSING**
Course Code	**M25CA03DE**
Type of Course	**DISCIPLINE SPECIFIC ELECTIVE COURSE-I**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire foundational and practical knowledge of Natural Language Processing by understanding linguistic concepts, text preprocessing, and core NLP models, and by applying neural network architectures to develop real-world language-based applications with ethical awareness.

Course Details

Block I: Introduction to Natural Language Processing	
Unit 1	Core Linguistic Concepts for NLP- Language Structure, Syntax, Semantics, and Grammar in NLP
Unit 2	Basics of NLP and Text Preprocessing- Definition, Applications, Importance of NLP, Libraries for Natural Language Processing, Normalizing Textual Data in NLP
Unit 3	Text Preprocessing Techniques in NLP- Text Cleaning, Tokenization, Stop Word Removal, and Lemmatization
Unit 4	Text Representation in NLP-Representing Text as Features, Bag-of-Words Model, Term Frequency–Inverse Document Frequency
Block II: Core Techniques in NLP	
Unit 1	Foundations of Language Models- Introduction to N-Grams, Markov Models, and Language Modeling Applications
Unit 2	Text Classification Methods- Basic Text Classification Techniques, Naive Bayes Classifier, and Support Vector Machines for Text
Unit 3	Basics of Sentiment Analysis- Techniques for Analyzing Sentiment, Use Cases, and Basic Implementation
Unit 4	NER Fundamentals- Identifying and Classifying Entities in Text, Applications of NER
Block III: Introduction to Machine Learning	
Unit 1	Machine Learning and Word Embedding Concepts- Introduction, Types of machine learning, Word2Vec, GloVe, and the Concept of Word Embeddings
Unit 2	Introduction to RNNs and LSTMs- Introduction to Recurrent Neural Networks (RNNs), LSTMs, and Their Applications in NLP.
Unit 3	Machine Translation in NLP- Introduction to Machine Translation, Statistical vs. Neural Machine Translation
Unit 4	Attention Mechanism and Transformers- Basic Understanding of Attention Mechanism

	and Transformer Models
Block IV: Advanced Topics and Applications	
Unit 1	Introduction to Chatbots- Basics of Chatbot Design, Rule-Based and AI-Based Chatbots
Unit 2	Basics of Search and Information Systems- Search Engines, Information Extraction, and Question-Answering Systems
Unit 3	Introduction to Speech Recognition- Basics of Speech Processing, Speech Recognition Systems, and Applications
Unit 4	Trends and Ethics in NLP- Emerging Trends, Ethical Considerations, and NLP in Real-World Scenarios

REFERENCES

1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, Pearson, 2008.
2. Natural Language Processing with Python, Steven Bird, Ewan Klein, and Edward Loper, O'Reilly Media, 2009.
3. Foundations of Statistical Natural Language Processing, Christopher Manning and Hinrich Schütze, MIT Press, 1999.
4. Deep Learning for Natural Language Processing, Jason Brownlee, Machine Learning Mastery, 2017.
5. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

Course Outcomes

No.	Course Outcomes	Cognitive level
CO1	Identify the basic components of language such as syntax, semantics, and grammar used in Natural Language Processing.	Understand
CO2	Explain text processing techniques like text normalization, tokenization, and lemmatization used to prepare textual data.	Understand
CO3	Analyze the working of core NLP algorithms including N-Grams, classification models, and named entity recognition.	Analyze
CO4	Apply word embedding techniques and neural network models like RNNs and LSTMs in NLP tasks.	Apply
CO5	Evaluate basic NLP-based applications such as chatbots, question-answering systems, and speech recognition tools with awareness of ethical concerns.	Analyze

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	1	2	–	–	1	1	3	–	–	2
CO2	2	3	2	1	1	1	2	3	–	–	2
CO3	2	3	2	2	1	1	2	3	–	–	2
CO4	3	3	3	3	2	1	2	3	1	–	3
CO5	2	2	2	2	1	3	3	2	2	1	2

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	1	–	–	1	–	2	–
CO2	2	3	1	–	–	1	–	3	–
CO3	3	3	2	–	1	1	–	3	1
CO4	3	3	2	1	1	1	–	3	2
CO5	2	2	2	1	–	3	3	2	1

Correlation levels

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**AI FOR CYBER SECURITY**
Course Code	**M25CA11DE**
Type of Course	**DISCIPLINE SPECIFIC ELECTIVE-II**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire comprehensive knowledge of Artificial Intelligence and cybersecurity by understanding core concepts, machine learning and deep learning applications, and ethical considerations, and by developing AI-driven solutions for threat detection, analysis, and cyber defense in real-world environments.

Course Details

Block I: Introduction to AI and Cyber Security	
Unit 1	Basics of Cyber Security and AI- AI in Cyber security, Key Concepts- Confidentiality, Integrity, Availability, and Types of Cyber Threats, Applications of cyber security.
Unit 2	AI Concepts and Cyber Security Applications- Overview of AI, Machine Learning, and Deep Learning, Relevance of AI in Cyber Security, Application of AI in Cyber Security.
Unit 3	Cyber Security Use Cases- Use Cases: Fraud Detection, Intrusion Detection, Malware Analysis, and Threat Intelligence
Unit 4	Cyber Data and Preprocessing- Sources of Cyber Data, Data Preprocessing Techniques, and Handling Imbalanced Data
Block II: Machine Learning for Cyber Threat Detection	
Unit 1	Introduction to ML Algorithms- Basic Concepts, Algorithms like Decision Trees, Support Vector Machines, and their Application
Unit 2	Clustering for Cyber Security- Clustering Techniques, Anomaly Detection, and Identifying Suspicious Patterns
Unit 3	Neural Network Applications in Security- Neural Networks, Convolutional Neural Networks (CNNs), and Recurrent Neural Networks (RNNs) in Cyber Security
Unit 4	Model Evaluation Metrics- Accuracy, Precision, Recall, F1 Score, and ROC Curve for Cyber Security Models
Block III: AI Applications in Cybersecurity	
Unit 1	Intrusion Detection Systems Basics- Overview of IDS, AI-Enhanced IDS, Signature-Based, and Anomaly-Based Detection
Unit 2	AI in Malware Analysis- AI Techniques for Static and Dynamic Malware Analysis, and Basics of Ransomware Detection

Unit 3	AI-Based Threat Detection- AI Techniques for Identifying Phishing Websites, Emails, and Social Engineering Attacks
Unit 4	AI for Network Security- AI for Network Traffic Analysis, Botnet Detection, and DDoS Attack Mitigation
Block IV: Advanced Topics and Applications	
Unit 1	Ethics and Privacy in AI Security- Ethics, Privacy Concerns, and Bias in AI Algorithms for Cyber Security
Unit 2	AI for Threat Detection and Response- Use of AI for Threat Prediction, Real-Time Threat Detection, and Incident Response
Unit 3	Practical Uses of AI in Cyber Security- Real-World Applications of AI in Cyber Security from Various Industries
Unit 4	Future Trends in AI for Cyber Security- Advancements in AI for Cyber Defense, Emerging Technologies, and Research Directions

REFERENCES

1. Artificial Intelligence in Cybersecurity, Leslie F. Sikos, Springer, 2019.
2. Machine Learning and Security, Clarence Chio and David Freeman, O'Reilly Media, 2018.
3. AI for Cybersecurity, Cylance, Packt Publishing, 2020.
4. Deep Learning for Cyber Security, John MacIntyre, Springer, 2021.
5. Cybersecurity Data Science, Scott Mongeau, Andres Seplveda, Springer, 2021

Course Outcomes

No.	Course Outcomes	Cognitive level
CO1	Understand the fundamentals of AI, cybersecurity principles, cyber threats, and the relevance of AI applications in cybersecurity.	Understand
CO2	Apply machine learning and deep learning algorithms for detecting cyber threats, anomalies, and suspicious patterns.	Apply
CO3	Analyze the role of AI in intrusion detection, malware analysis, phishing detection, and network traffic analysis for cybersecurity applications.	Analyze
CO4	Describe ethical, privacy, and bias-related concerns in AI for cybersecurity, and explore real-time threat prediction, emerging technologies, and future research directions.	Understand
CO5	Analyze AI-driven solutions for real-time threat detection, incident response, and cyber defense using suitable datasets and evaluation metrics.	Analyze

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	1	1	1	1	3	1	2	1	1	1
CO2	3	3	2	–	–	3	2	3	2	1	2
CO3	3	3	2	1	2	3	2	3	2	2	3
CO4	2	2	1	–	1	3	3	3	2	-	2
CO5	3	3	3	2	3	3	2	3	2	-	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	–	–	2	2	2	1
CO2	3	2	1	–	2	3	2	2	2
CO3	3	2	2	1	2	3	2	2	3
CO4	2	2	1	–	2	2	3	3	3
CO5	3	3	2	2	2	3	3	3	3

Correlation levels

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**BLOCKCHAIN TECHNOLOGIES**
Course Code	**M23CA12DE**
Type of Course	**DISCIPLINE SPECIFIC ELECTIVE II**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire comprehensive knowledge and practical skills in blockchain technology by understanding its principles, Ethereum smart contracts, decentralized applications, and emerging trends, and by applying tools and frameworks to develop real-world blockchain solutions.

Course Details

Block I: Introduction to Blockchain Technology	
Unit 1	Fundamentals of Block chain Technology – Definition, Architecture, Elements of Blockchain, CAP Theorem and Blockchain, Benefits And Limitations, Types of Blockchain.
Unit 2	Block chain and Allied Technologies – Block chain and Cloud Computing, Blockchain and Artificial Intelligence. Use cases of Blockchain Technology: Government, Health Care, Finance and Supply Chain Management.
Unit 3	Cryptography in Blockchain - Hash Functions: SHA-256, Public and Private Key Cryptography, Digital Signatures. Applications of Cryptographic Hash Functions: Merkle Trees, Distributed Hash Tables.
Unit 4	BitCoin- Introduction, Architecture, Transactions-Structure, types, The genesis block, Bitcoin payments, Bitcoin installation. Mining:Tasks of miners, mining algorithm, hash rate. Wallets: Types of wallets.
Block II: Ethereum and Smart Contracts	
Unit 1	Consensus Mechanisms - Consensus Algorithms, Crash fault-tolerance (CFT) algorithms: Paxos, Raft. Byzantine fault-tolerance (BFT) algorithms: Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS.
Unit 2	Ethereum – The Ethereum network. Components of the Ethereum ecosystem: Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and block chain.
Unit 3	Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Smart contracts Case study: Voting, Auction.

Unit 4	The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types, control structures, events, inheritance, libraries, functions, error handling.
Block III: Decentralized Applications (dApps)	
Unit 1	Decentralization – Decentralization using block chain, Methods of decentralization, Routes to decentralization, Block chain and full ecosystem decentralization.
Unit 2	Introduction to DApps – Characteristics, Requirements, Benefits, Architecture of decentralized applications, including front-end and back-end components.
Unit 3	Decentralized Applications and Ecosystems- Operations DApp, DApp examples: KYC-Chain, OpenBazaar, Lazooz, Platforms for decentralization: Ethereum, MaidSafe, Lisk, Decentralized Organizations.
Unit 4	Hosting and Implementation- Hosting DApps using decentralized platforms (e.g., IPFS, Fleek), Implementing decentralized applications using Ethereum and Solidity.
Block IV: Advanced Topics in Blockchain and dApps	
Unit 1	Tokenization and Non-Fungible Tokens (NFTs)- Concept, Token Standards: ERC-20, ERC-721, ERC-1155, Creation and management of fungible and NFT, NFT platforms and ecosystems (OpenSea, Rarible), Real-world use cases: Gaming, collectibles, digital art, identity.
Unit 2	Decentralized Finance (DeFi)- Overview of DeFi: Philosophy and financial transformation, Key Components: Lending, borrowing, staking, yield farming, liquidity pools, Decentralized Exchanges (DEXs): Uniswap, PancakeSwap, SushiSwap, Stablecoins: Types (collateralized, algorithmic), Risks in DeFi.
Unit 3	Blockchain Security and Performance Enhancements- Common security issues (Reentrancy, integer overflow, front-running), Blockchain performance bottlenecks, Scalability solutions: Layer 2 (Rollups, Plasma, State Channels), Sharding, Privacy-enhancing techniques: Zero-Knowledge Proofs (zk-SNARKs, zk-STARKs), Mixers and privacy coins (e.g., Monero, Zcash).
Unit 4	Cross-Chain Interoperability and Future Trends- Need for interoperability in blockchain ecosystems, Cross-chain communication protocols: Polkadot, Cosmos, Chainlink CCIP,Emerging trends: Blockchain in AI, IoT, and supply chain, Decentralized identity (DID), Blockchain in governance and sustainability, Future of dApps and Web3.

Recommended Textbooks:

1. Dannen, Chris. Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners. Apress, 2018.

2. Infante, Roberto. Building Decentralized Apps on Ethereum. Apress, 2019.

3. Bashir, I. (2023). Mastering blockchain: Unlocking the power of cryptography, distributed ledgers, and smart contracts (4th ed.). Packt Publishing.

4. Antonopoulos, A. M., & Wood, G. (2018). Mastering Ethereum: Building smart contracts and DApps. O'Reilly Media.

5. Kumar, S. U., & Arthi, B. (2020). Blockchain technology: Concepts and applications. Wiley India.

6. Bahga, A., & Madisetti, V. (2017). Blockchain applications: A hands-on approach. VPT.

7. Adkins, H., Blankinship, B., Krishnan, R., O'Connor, A., & Stubblefield, A. (2020). Building secure and reliable systems: Best practices for designing, implementing, and maintaining systems. O'Reilly M.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Understand the foundational concepts of blockchain technology and its associated technologies.	Understand
CO2	Analyze the Ethereum ecosystem and develop secure smart contracts using Solidity**.**	Analyze
CO3	Design decentralized applications (dApps) and their ecosystems.	Apply
CO4	Explain advanced trends, performance challenges, and future directions.	Understand
CO5	Apply blockchain tools and frameworks to create, host, and deploy decentralized applications in real-world scenarios.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	2	2	–	1	1	2	1	-	1	2
CO2	3	3	2	2	1	1	2	2	1	-	3
CO3	3	3	2	2	2	-	2	2	1	1	3
CO4	2	2	2	–	2	2	3	2	-	-	2
CO5	3	3	2	3	2	1	3	2	1	-	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	1	–	2	2	-	2	1
CO2	2	3	2	1	2	3	1	2	2
CO3	2	3	2	2	2	3	-	2	2
CO4	3	3	1	–	3	2	1	3	2
CO5	3	3	2	2	3	3	2	3	3

Correlation levels

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**BIG DATA TECHNOLOGIES**
Course Code	**M25CA13DE**
Type of Course	**DISCIPLINE SPECIFIC ELECTIVE II**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire foundational and practical knowledge of Big Data by understanding its concepts, tools, and processing challenges, and by applying Python, R, and Hadoop ecosystem techniques for large-scale data analysis and visualization.

Course Details

Block I: Introduction to Big Data	
Unit 1	Big Data Concepts and Challenges- Introduction to Big Data and Challenges of handling Big Data: Storage, Processing, Analysis, and Visualization
Unit 2	Characteristics of Big Data- Volume, Velocity, Variety, Veracity, and Value
Unit 3	Big Data technologies and tools- Overview of Big Data technologies (storage, processing, framework, etc.) and tools (analytics, visualization,etc.)
Unit 4	Applications of Big Data- Overview, Applications of Big Data in various industries
Block II: Data Processing and Real-Time Analytics with Kafka and Storm	
Unit 1	Data Preprocessing- Data Cleaning, Data Integration, Data Transformation, Data Reduction, and Data Discretization techniques, Handling Missing Values and Outliers, Data Sampling and Data Scaling
Unit 2	Data Visualization Techniques- Basics, Data Visualization Techniques using Matplotlib, Seaborn, and Plotly
Unit 3	Apache Tools for Big Data- Introduction to Apache Spark, Apache Kafka, Apache Storm
Unit 4	Spark MLlib Basics- Introduction to Machine Learning with Spark MLlib
Block III: Hadoop and MapReduce	
Unit 1	Basics of Hadoop- Overview of Hadoop and its ecosystem

Unit 2	MapReduce paradigm- Processing large datasets in parallel
Unit 3	YARN- Managing resources and scheduling jobs
Unit 4	Familiarising Hadoop tools- Hive, Pig, and Spark
Block IV: Data Analytics with R	
Unit 1	Introduction to R for Data Analytics- Introduction to R and RStudio (IDE), Basic commands and data types, Working with vectors and data frames, Importing data from CSV, Excel, and JSON files
Unit 2	Data Manipulation and Cleaning with R- Data handling using dplyr and tidyr, Dealing with missing values and outliers, Filtering, sorting, and grouping data
Unit 3	Data Visualization in R- Creating charts using ggplot2, Plotting bar charts, histograms, scatter plots, and box plots, Customizing graphs with titles, axis labels, and themes
Unit 4	Simple Statistics and Modeling- Finding average, median, and standard deviation, Finding relationships between variables (correlation)

Recommended TextBooks /References:

1. Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, Raj Kamal, Preeti Saxena, McGraw Hill, 2018.
2. Big Data, Big Analytics: Emerging Business intelligence and Analytic Trends for Today's Business, Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, John Wiley & Sons, 2013.
3. "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph" by David Loshin
4. "Big Data Analytics: Turning Big Data into Big Money" by Frank Kane
5. "Data Analytics Made Accessible" by Anil Maheshwari
6. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney

Course Outcomes

No.	Course Outcomes	Cognitive level
CO1	Understand the concept of Big Data and explain its storage, processing, analysis, and visualization challenges.	Understand
CO2	Identify the key characteristics of Big Data and explore tools and technologies used in various industries.	Understand
CO3	Apply data preprocessing, cleaning, transformation, and visualization techniques using Python libraries like Matplotlib, Seaborn, and Plotly.	Apply

CO4	Analyze Hadoop ecosystem tools for large-scale data processing.	Analyze
CO5	Perform data analysis, manipulation, visualization, and basic statistics using R and its libraries.	Apply

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	2	3	–	2	-	2	2	1	-	1
CO2	2	3	3	1	2	1	2	2	1	-	1
CO3	3	3	3	2	2	-	3	3	1	-	2
CO4	3	3	3	2	2	1	3	3	2	1	2
CO5	3	3	3	2	3	1	3	3	2	1	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	–	-	1	-	2	2
CO2	2	2	-	-	-	2	-	2	2
CO3	2	3	-	-	1	2	-	2	3
CO4	3	3	1	1	1	3	1	2	3
CO5	3	3	1	1	2	3	1	2	3

Correlation levels

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**WEB PROGRAMMING**
Course Code	**M25CA01SE**
Type of Course	**SKILL ENHANCEMENT COURSE**
Semester	**3**
Credits	**4**
Course Objectives	To enable learners to acquire comprehensive knowledge and practical skills in web development by understanding HTML, CSS, JavaScript, PHP, database integration, and modern web practices, and by applying these skills to build interactive and dynamic web applications in real-world environments.

Course Details

Block I: Fundamentals of the Web technology	
Unit 1	**I**ntroduction to HTML : The development process, Html tags and simple HTML forms, web site structure. Introduction to XHTML: XML, Move to XHTML, Meta tags, Character entities, frames and frame sets, inside browser.
Unit 2	Style sheets : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties,manipulating texts, using fonts, borders and boxes, margins, padding lists,positioning using CSS, CSS2
Unit 3	Javascript: Client side scripting, What is Javascript, How to develop Javascript, simple Javascript, variables, functions, conditions, loops and repetition. Advance script, Javascript and objects, Javascript own objects, the DOM and web browser environments, forms and validations
Unit 4	DHTML : Combining HTML, CSS and Javascript, events and buttons, controlling your browser, Ajax: Introduction, advantages & disadvantages ,Purpose of it ,ajax based web application,alternatives of ajax XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD

	and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT
Block II: Web Applications and Deployment	
Unit 1	PHP: Starting to script on server side, Arrays, function and forms,advance PHP Databases :Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.
Unit 2	Form Validation, Data Binding, Dynamic Content Loading, Introduction to Single Page Applications. Types of Hosting, Domain Registration, FTP Basics, Using Cloud Platforms (AWS, Heroku), and Deploying Applications
Unit 3	Overview of CMS (WordPress, Joomla), Setting up a CMS, Themes, Plugins, and Basic Customization
Unit 4	Overview of Modern Web Trends (PWAs, Web Assembly, AI in Web), Introduction to DevOps in Web, CI/CD Basics

Recommended TextBooks /References:

1. Web Development and Design Foundations with HTML5, Terry Felke-Morris, Pearson, 2019.
2. Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5, Robin Nixon, O'Reilly Media, 2018.
3. JavaScript and JQuery: Interactive Front-End Web Development, Jon Duckett, Wiley, 2014.
4. Eloquent JavaScript: A Modern Introduction to Programming, Marijn Haverbeke, No Starch Press, 2018.
5. Node.js, MongoDB, and Angular Web Development, Brad Dayley, Pearson, 2018

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Explain the fundamental concepts of web technologies including HTML, CSS, JavaScript, XML, and their roles in building web pages.	Understand
CO2	Apply HTML, CSS, and JavaScript to design and develop structured, styled, and interactive	Apply

	web pages..	
CO3	Analyze client-side and server-side scripting techniques, including JavaScript and PHP, to understand their functionality in dynamic web applications.	Analyze
CO4	Evaluate different web development approaches, hosting platforms, CMS tools, and modern web technologies for suitable application deployment..	Evaluate
CO5	Design and develop a complete web application integrating front-end and back-end technologies, and deploy it using appropriate tools and platforms.	Create/

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	1	2	–	2	–	1	–	–	-	1	1
CO2	2	3	-	1	1	1	1	–	-	2	1
CO3	3	3	-	1	2	1	2	1	2	1	1
CO4	2	3	-	2	2	2	2	–	2	2	3
CO5	2	3	1	2	2	2	2	–	1	3	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	-	–	–	2	–	2	-
CO2	2	3	1	1	–	2	–	2	1
CO3	3	3	1	–	1	2	–	2	2
CO4	3	3	-	-	2	3	-	2	1
CO5	3	3	3	-	-	2	–	3	2

Correlation levels

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

Course Title	**WEB PROGRAMMING LAB**
Course Code	**M25CA05PC**
Type of Course	**PRACTICAL CORE COURSE -05**
Semester	**3**
Credits	**2**
Course Objectives	To enable learners to acquire foundational and practical skills in web development by understanding HTML, CSS, AngularJS, PHP, and jQuery, and by applying client–server interaction techniques to build dynamic, interactive, and fully functional web applications.

Course Details

Cycle 1: HTML and Javascript	
Experiment 1	Practice Basic HTML Tags for web development
Experiment 2	Design a home page which will display your information -. Bio data, using Image Link and File Link to upload images and necessary documents
Experiment 3	Create a webpage with four frames (Picture, table, list, and hyperlink).
Experiment 4	Write a program to demonstrate Event Handling -Validation of registration form -Open a Window from the current window -Change color of background at each click of button or refresh of a page -Display calendar for the month and year selected from combo box OnMouseover event.

Experiment 5	Write an HTML page including required PHP code that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next to the list. Add CSS to customize the properties of the font of the capital (color, bold and font size).
Cycle 2: Angular JS and jQuery	
Experiment 1	Write an HTML page including any required Java script that takes a number from one text field in the range of 0 to 999 and shows it in range of 0 to 999 and shows it in another text field in words. If the number is out of range, it should show “out of range” and if it is not a number, it should show “not a number” message in the result box.
Experiment 2	Implement the following web applications using AngularJS: A simple calculator web application that takes two numbers and an operator (+, -, /, * and %) from an HTML page and returns the result page with the operation performed on the operands
Experiment 3	Implement the following web applications using AngularJS: A user validation web application, where the user submits the login name and password to the server. The name and password are checked if the data matches, a successful login page is returned. Otherwise a failure message is shown to the user.
Experiment 4	Create a div using jQuery with style tag ,Create a Zebra Stripes table effect using jQuery
Experiment 5	Implement the following web applications using PHP: A user validation web application, where the user submits the login name and password to the server. The name and password are checked against the data already available in Database and if the data matches, a successful login page is returned. Otherwise a failure message is shown to the user.

References:

1. Web Technologies, Uttam K Roy, Oxford University Press
2. Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web – How To Program", Fifth Edition, Pearson Education, 2011.
3. Beginning Angular JS, Grant, Andrew— A Press 2014
4. The Complete Reference PHP – Steven Holzner, Tata McGraw-Hill
5. Bear Bibeault and Yehuda Katz, jQuery in Action, 2008.
6. Gopalan N.P. and Akilandeswari J., Web Technology, Prentice Hall of India, 2011.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Familiarize the basic concepts of HTML and CSS to create static web pages	Understand
CO2	Explore to build Facilitate students to build dynamic, responsive web pages using Angular JS	Apply
CO3	Analyze and implement client-side and server-side validation techniques using JavaScript, AngularJS, and PHP.	Analyze
CO4	Design and develop interactive web applications integrating front-end and back-end technologies with proper validation and user interface.	Create

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	1	2	1	–	1	-	-	-	-	2	1
CO2	2	3	-	1	1	-	1	–	-	2	2
CO3	3	3	-	2	2	-	1	–	-	2	1
CO4	2	3	1	2	2	-	2	–	2	2	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	–	1	2	-	2	1
CO2	2	1	2	1	-	3	-	2	1
CO3	3	2	2	-	-	3	-	2	2
CO4	2	3	1	-	1	3	-	2	2

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

Course Title	**ADVANCED ML LAB**

Course Code	**M25CA06PC**
Type of Course	**PRACTICAL CORE COURSE -06**
Semester	**3**
Credits	**2**
Course Objectives	To enable learners to acquire practical skills in machine learning, deep learning, NLP, and reinforcement learning by applying classical algorithms, PyTorch-based models, and RL techniques to real-world datasets and simulated environments.

Course Details

Cycle 1: Classical Machine Learning Using Colab	
Experiment 1	Design and Implementation of Naive Bayes Classifier.
Experiment 2	Design and Implementation of Support Vector Machine
Experiment 3	Design and implementation of Perceptron models to perform simple arithmetic and logic operations.
Experiment 4	Design and implementation of K-Medoid clustering.
Experiment 5	Design and implementation of Density-based spatial clustering of applications with noise (DBSCAN)
Experiment 6	Design and implementation of Hierarchical Agglomerative Clustering.
Experiment 7	Design and implementation of SVD.
Experiment 8	Design and Implementation of Ensemble methods: bagging and boosting, random forests
Experiment 9	Implementation of Regression Performance Evaluation Metrics: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination
Experiment 10	Implementation of Classification Performance Evaluation Metrics: Accuracy, Precision, Precision, Recall, Specificity, False Positive Rate (FPR), F1 Score, Receiver Operator Characteristic (ROC) Curve, AUC.
Cycle 2: Deep Learning/NLP/ Reinforcement with PyTorch- (Select any 4 experiments)	
Experiment 1	Design and Implementation of a Convolutional Neural Network (CNN) for image classification using the CIFAR-10 or MNIST dataset.

Experiment 2	Implementation of Multilayer Perceptron (MLP) with dropout regularization for handwritten digit recognition using the MNIST dataset.
Experiment 3	Design and implement a Convolutional Neural Network (CNN).
Experiment 4	Develop an LSTM-based model to predict the next word in a sequence
Experiment 5	Load a text dataset. Apply tokenization, stop-word removal, and stemming/lemmatization. Compare the results before and after preprocessing.
Experiment 6	Implement a Naive Bayes classifier for sentiment analysis. Test different Laplace smoothing values and observe the impact.
Experiment 7	Train a logistic regression model on a text dataset. Compare L1 and L2 regularization effects on performance.
Experiment 8	Implement a supervised model for relation detection and classification. Evaluate its performance using precision, recall and F1 score.
Experiment 9	Implement an LSTM-based sentiment analysis model using word embeddings on a movie review dataset.
Experiment 10	Implement the Q-Learning algorithm to solve the CartPole balancing problem using the OpenAI Gym environment.
Experiment 11	Implement a Deep Q-Network (DQN) agent to solve the FrozenLake or MountainCar environment using reinforcement learning techniques.
Experiment 12	Implement the exploration vs. exploitation tradeoff with reinforcement learning.

References:

1.Müller, Andreas C., and Sarah Guido. *Introduction to machine learning with Python: a guide for data scientists*. " O'Reilly Media, Inc.", 2016.

2.Data Science Essentials in Python: Collect, Organize, Explore, Predict, Value. Dmitry Zinoriev, The Pragmatic Programmers LLC, 2016.

3.Introduction to Python Programming. Gowrishankar S., Veena A. CRC Press, Taylor & Francis Group, 2019.

4.Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Implement and evaluate classical machine learning algorithms such as Naive Bayes, SVM, and Ensemble methods using collaborative tools like Google Colab, and apply appropriate performance metrics for classification and regression tasks.	Analyze
CO2	Apply clustering and dimensionality reduction techniques, including K-Medoids, DBSCAN, and SVD, to identify patterns, relationships, and structure within real-world datasets.	Apply
CO3	Design and develop deep learning and natural language processing (NLP) models such as CNNs, MLPs, and LSTMs using PyTorch for image recognition, text analysis, and sequential data modeling.	Create
CO4	Develop and evaluate reinforcement learning agents using Q-Learning and Deep Q-Networks (DQN) to solve control and decision-making problems in simulated environments like CartPole and FrozenLake.	Create

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	3	3	2	–	-	-	2	3	2	3	1
CO2	3	3	1	2	1	-	3	3	3	2	-
CO3	3	3	1	2	1	-	3	3	3	3	1
CO4	3	3	2	1	2	1	3	3	3	3	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	2	3	2	3	-
CO2	3	3	1	1	2	3	2	3	1
CO3	3	3	1	-	3	3	2	3	1
CO4	3	3	2	-	3	3	2	3	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

M25CA01IN INTERNSHIP

Post Graduate programme - MCA- Internship

Guidelines

The University shall have a course of Internship for the Post Graduate programme.

Objective

To provide first-hand experience on a job profile in an organisation through a well-defined format of professional engagement.

Content

The course prescribes two calendar weeks of engagement in an organisation for a dedicated task related to any of the job profiles defined by the organisation. The internship envisages enhancing the learners' employability and developing research aptitude.

Length of the Course

- The course of the Internship requires the engagement of the learner at least for a period of 2 weeks for this purpose.
- The engagement shall be in an approved institution outside the ambit of the University or it can be a normal field centric enquiry carried under supervision.

Identification of the centre for engagement

- Learners are encouraged to identify the institution where they wish to undergo internship.
- Learners shall use their relationship with the institution and seek for approval.
- Learners shall obtain formal permission from the institution and the University shall facilitate this process through individual recommendation to the institution on the request of the learner.
- Learners shall notify the coordinator of the respective Learner Support centres, their interest in

pursuing Internship as a course of study.

- Subsequent to the permission, the learner shall in consultation with the Head of the Institute/Company develop a time table for the engagement.
- The time table duly signed by the Head of the Institute/Company in the prescribed format must be produced to the coordinator of the respective Learner Support Centre for onward transmission to the Regional Centre/ University as the case may be.
- The learners shall prepare a work plan in the prescribed format for each hour of engagement with the details of the engagement in advance, and that will be submitted to the Learner Support Centre at the end of the internship with the signature of the Head of the Institute/Company.
- The learner is to develop a personal introspection in the prescribed format on the engagement in English in an A4 bond paper limited to a maximum of 5 sheets.
- The learners at the end of the course shall be required to submit the following document to the Coordinator Learner Support Centre.

    1. Letter of permission of the Head of the Institute/Company
    2. Time table duly signed by the Head of the Institute/Company.
    3. Work plan signed by the Head of the Institute/Company.
    4. Personal introspection note on work experience
    5. Attendance sheet in the prescribed format
    6. Performance appraisal in prescribed format

Assessment

The course shall have 2 components of assessment, internal and external in the ratio of 30:70.

Internal Assessment

The learners for this course shall continuously be evaluated by the Head of the Institute/Company

of the Institution and the mark list shall be submitted in the prescribed format in a sealed cover to the Learner Support Centre/Regional Centre as the case may be. Internship shall consider promptness, aptitude, discipline and personal management.

External Assessment

The documents submitted by the learners known as internship diary shall be tagged for external evaluation. The marks awarded under this head shall be added to the internal marks making a total for the whole course.

Variation

If there is a variation in the percentage of the internal and the external valuation, the learners shall be awarded the average percentage of the 2 marks for the lowest assessment grade.

Grievances

Learners shall lodge their complaints, if any, to the respective LSC Coordinator and it shall be processed as per the general rules of the grievances redressed mechanism.

Sreenarayanaguru Open University	
Time Table	
Name of the Learner :	
Enrollment No. :	
Programme :	
Name of the Course :	
Name of the Institution:	
Engagement Details	
Day	**Time**

Date: **Signature of the Reporting Officer**

Sreenarayanaguru Open University	
Work Plan	
Name of the Learner :	
Enrollment No. :	
Programme :	
Name of the Course :	
Name of the Institution :	
Date	**Details of work**

Date: **Signature of the Learner**

Counter Signature of the Reporting officer

Sreenarayanaguru Open University

Attendance Certificate

Name of the Learner :

Enrollment No. :

Programme :

Name of the Course :

Name of the Institution:

Details of attendance

This is to certify that the learner attended the office/ work station, the details of which are given below and his/her conduct and character were good.

Date	**Time of engagement**

Date: **Signature of the Reporting Officer**

Sreenarayanaguru Open University
Performance Appraisal
Name of the Learner :
Enrollment No. :
Programme :
Name of the Course :
Name of the Institute/ Company:

Performance indices

Please write your reflection in sentences against each index shown below. You need not enter marks in the performance sheet.

Promptness:

Aptitude:

Discipline:

Personal management:

I certify that the particulars given above are my reflections on the engagements of …… (Name of the learner who worked under my supervision).

Date: **Signature of the Reporting Officer**

Face Sheet for Work Diary

Sreenarayanaguru Open University, Kollam

Internship Diary submitted in partial fulfilment of the requirements of the Post Graduate programme in Malayalam/ English

By

Name of the learner.……

Enrollment No…….

Submitted in the month of ……..……

Inside Sheet

Sreenarayanaguru Open University, Kollam

Declaration

I……..…., Learner with Enrolment No…… declare that the report presented is the outcome of my introspection on the engagement for the course on internship in partial fulfilment of the requirements of the Post Graduate programme in Malayalam/ English. It is also informed that the text in the report has been written by me without any external support.

Date **Signature of the learner**

I ……..…….. of …….. (Name of the Institute/Company) endorse the above declaration.

Date **Name and Signature of the Reporting Officer**

FOURTH SEMESTER

Course Title	**SOFTWARE ENGINEERING**
Course Code	**M25CA08DC**
Course Type	**DISCIPLINE CORE COURSE-08**
Semester	**4**
Credits	**4**
Course Objectives	To enable learners to acquire foundational knowledge of software engineering by understanding requirement analysis, design principles, testing strategies, and project management practices for effective software development.

Course Details

Block 1: Software Process Models and Requirements Collection	
Unit 1	Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attribute
Unit 2	Software Development Life Cycle (SDLC)Models: WaterFall Model, Prototype Model, Spiral Model
Unit 3	Evolutionary Development Models, Iterative Enhancement Models. Feasibility Study
Unit 4	Requirement Engineering Process: Elicitation, Analysis, Preparing SRS Document, IEEE Standards for SRS, Sample Use Cases
Block II: Software Design	
Unit 1	Software Design:Basic Concepts of Software Design, Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures

Unit 2	Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design
Unit 3	Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures
Unit 4	Cyclomatic Complexity Measures: Control Flow Graphs, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables
Block III: Software Testing and Quality Assurance	
Unit 1	Testing Strategies: A strategic approach to software testing, test strategies for conventional software
Unit 2	Black-box and white-box testing, validation testing, system testing, the art of debugging
Unit 3	Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, Verification and Validation, SQA Plans
Unit 4	Statistical software quality assurance, software reliability, the ISO 9000 quality standards, Importance of Secure Coding Practices.
Block IV: Software Project Management	
Unit 1	Software Maintenance and Software Project Management Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance
Unit 2	Software ReEngineering, Reverse Engineering, Software Configuration Management Activities, Change Control Process, Software Version Control - Version Control fundamentals with Git: repository setup, commits, branches, merging, conflict resolution.
Unit 3	PERT charts with worked examples, GANTT Charts with worked examples, Resource Allocation Models, Software Risk Analysis and Management.
Unit 4	An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO). Collaborative development using GitHub/GitLab: pull requests, code reviews, issue tracking

Recommended TextBooks /References:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.

2. Carlo Ghezzi, M. Jarayeri, D. Manodrioli, Fundamentals of Software Engineering, PHI Publication.
3. Ian Sommerville, Software Engineering, Addison Wesley.
4. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
5. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
6. Pankaj Jalote, Software Engineering, Wiley.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Explain various software engineering processes, SDLC models, and requirement engineering concepts including SRS and use cases.	Understand
CO2	Apply appropriate software design principles, strategies, and modeling techniques	Apply
CO3	Use software metrics and measurement techniques, including Halstead metrics, Function Points, and Cyclomatic Complexity, to evaluate software size and complexity.	Apply
CO4	Analyze different software testing strategies, quality assurance practices, and debugging techniques to ensure reliable and high-quality software systems.	Analyze
CO5	Analyze software project management techniques including estimation models (COCOMO), scheduling (PERT, Gantt charts), risk management, and version control systems (Git/GitHub) for effective project execution.	Analyze

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	3	2	-	-	2	1	-	-	-	-	-
CO2	3	3	-	-	2	1	-	1	-	-	-
CO3	2	3	2	-	2	1	1	-	-	1	1

CO4	3	2	2	-	2	1	1	-	-	2	2
CO4	3	2	2	-	-	-	-	-	1	1	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	2	-	-	-	1	2	-
CO2	2	3	2	-	2	2	1	1	-
CO3	2	3	1	1	2	2	1	2	-
CO4	2	2	2	1	2	2	1	2	1
CO5	3	2	2	-	-	-	-	1	-

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	**End Semester examination**
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔

CO4	✔	✔
CO5	✔	✔

Course Title	**AI APPLICATION DEVELOPMENT USING PYTHON AND FLASK**
Course Code	**M25CA02SE**
Course Type	**SKILL ENHANCEMENT COMPULSORY COURSE - 01**
Semester	**4**
Credits	**2**
Course Objectives	To enable learners to acquire practical knowledge of Python application development by understanding package creation, Flask architecture, AI model integration, and deployment of web and AI applications on cloud platforms.

Course Details

Block I: Python Application Development and Packaging	
Unit 1	Python Coding Practices: Writing clean, modular, and efficient code - Organizing code using modules and packages - Best practices for code readability and maintainability
Unit 2	Application Development with Python: Building standalone applications - Creating scripts and utilities - Working with libraries and dependencies
Unit 3	Packaging Concepts: Introduction to packaging - Creating distributable packages using setuptools - Understanding pip and virtual environments
Unit 4	Publishing and Distributing Packages: Publishing packages to PyPI - Version control and dependency management - Best practices for software distribution

Block II: Web and AI Application Deployment Using Flask	
Unit 1	Introduction to Flask and Web Application Setup: Overview of the Flask framework - Project setup and structure - Routing, templates, and static files
Unit 2	Building and Deploying Web Applications: Creating dynamic web pages - Handling user input and forms - Deployment of Flask applications on cloud platforms (Heroku, AWS)
Unit 3	Integrating AI Models with Flask: Loading pre-trained AI models into Flask applications - Designing RESTful APIs for AI services - Handling requests and processing predictions
Unit 4	Deployment of AI-Enabled Web Applications: Building user interfaces for AI interactions - Cloud deployment for scalable AI services - Security and performance considerations

References text books:

1. Grinberg, Miguel. Flask Web Development: Developing Web Applications with Python. 2nd ed., O'Reilly Media, 2018.
2. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. 2nd ed., O'Reilly Media, 2019.
3. Raschka, Sebastian, and Vahid Mirjalili. Python Machine Learning. 3rd ed., Packt Publishing, 2019.
4. Dayley, Brad. Python for Programmers. Pearson, 2019.
5. Telles, Doug, and Nikhil Ketkar. Deep Learning with Python. 2nd ed., Apress, 2021.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Explain Python coding practices, modular programming, packaging concepts, and the fundamentals of Flask-based web development.	Understand
CO2	Apply Python techniques to develop standalone applications, create packages, and build basic web applications using Flask..	Apply
CO3	Analyze application structures, dependencies, and deployment processes including package distribution and Flask-based web deployment.	Analyze
CO4	Evaluate different tools, frameworks, and platforms for packaging, deploying web applications, and integrating AI models.	Evaluate
CO5	Design and develop AI-enabled web applications using Flask, including packaging, deployment, and integration of machine learning	Create

	models.	

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	2	-	1	1	–	–	–	–	–	1
CO2	2	3	1	-	1	–	–	–	–	–	2
CO3	2	3	1	3	1	–	–	–	–	–	2
CO4	2	3	2	3	1	1	–	2	1	1	2
CO5	2	2	1	3	1	1	1	2	1	1	1

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	–	–	3	–	1	–
CO2	2	2	1	–	–	3	–	2	–
CO3	2	2	1	–	–	3	–	1	–
CO4	2	2	2	–	1	3	1	2	–
CO5	1	1	1	–	–	3	1	2	1

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔
CO5	✔	✔

MASSIVE OPEN ONLINE COURSE (MOOC) - 01

M25CA01MC:

THE LEARNER CAN CHOOSE ANY COURSE FROM DATA SCIENCE AREA

(Not less than 8 weeks MOOC)

Number of Credits:4

GUIDELINES FOR MOOC

- MOOC must be selected from the SWAYAM/NPTEL platform.
- The area of the MOOC will be updated by the university in accordance with the current trends.
- The learner should give the details of the selected MOOC in the University portal before the deadline provided in the 2nd semester. They can do the MOOC based on the approval obtained from the university.
- The selected MOOC should be at least 8 weeks long.
- The learner needs to submit the pass certificate of MOOC with score details, before the last date of assignment submission in the 4th semester.

Course Title	**DATA ANALYTICS AND VISUALIZATION**
Course Code	**M25CA01CO**
Course Type	**COMPETENCY ORIENTED COURSE-01**
Semester	**4**
Credits	**4**
Course Objectives	To enable learners to acquire foundational and practical knowledge of data analytics by understanding its concepts and lifecycle, applying data preprocessing and statistical techniques, and analyzing real-world datasets to derive meaningful insights.

Course Details

Block 1: Fundamentals of Data Analytics	
Unit 1	Introduction to Data Analytics: Definition and Scope of Data Analytics, Types of Data Analytics: Descriptive, Diagnostic, Predictive, Prescriptive Analytics. Data Analytics Lifecycle, Roles in Data Analytics.
Unit 2	Data Types, Sources, and Big Data Fundamentals:Types of Data,Sources of Data, Big Data Concepts-Characteristics.
Unit 3	Data Ethics and Ingestion Techniques: Ethical Considerations in Data Analytics: Privacy, Bias, Security. Data Ingestion-Definition and role in the data pipeline,Batch vs Real-Time ingestion, Basic Data Collection techniques.
Unit 4	Data Ecosystem and Storage Architectures: Data Ecosystem-components, Data Storage architecture, Overview of Relational Databases (OLTP), Data Warehouses (OLAP).
Block II: Applied Statistical Analysis using Python and Data Cleaning	

Unit 1	Descriptive Statistics with Python: Introduction to descriptive statistics in Data Science, Computing Measures of Central Tendency (pandas and NumPy), Measures of Dispersion, Skewness and Kurtosis (scipy.stats), Pearson and Spearman correlation (pandas.corr()), Heatmap visualizations (Seaborn)

Unit 2	Regression, Correlation, and Predictive Modelling using Python - Linear Regression with Python: Simple Linear Regression: Model Fitting, Interpretation, and Visualization, Multiple Linear Regression: Feature Selection, Model Evaluation, R^2 and Adjusted R^2, Residual Analysis and Assumptions Checking; Logistic Regression and Classification Basics: Binary Classification using Logistic Regression, Interpretation of Model Coefficients and Odds Ratios
Unit 3	Hypothesis Testing and Sampling using Code Concept of Hypothesis Testing in Data Analytics, Formulating Null and Alternative Hypotheses, t-tests (one-sample, two-sample using scipy) ANOVA (Analysis of Variance)
Unit 4	Data Cleaning and Data Quality Management: Data Quality, Handling Missing Values, Handling Outliers-Outlier Detection Methods,Outlier Treatment Options, Handling Duplicate Data
Block III: Data Transformation, EDA and Visualization	
Unit 1	Data Transformation Techniques:.Data Transformation Techniques: Introduction to Data Transformation, Normalization and Standardization, Categorical Data Encoding- Label Encoding, One-Hot Encoding,
Unit 2	Data Integration and Exploratory Data Analysis (EDA): Data Integration and Exploratory Data Analysis (EDA): Data Integration,Exploratory Data Analysis (EDA), Types of EDA,Numerical and Graphical Summaries
Unit 3	Fundamentals of Data Visualization and Basic Charts: Importance of Data Visualization,Goals of Data Visualization,Principles of Effective Visualization
Unit 4	Visualization Techniques: HeatmapsTreemaps,Sunburst Charts, Interactive Visualization, Storytelling with Data,Tools for Interactive Visualization in Python-Plotly, Bokeh, Matplotlib.
Block IV: Analytical Modeling and Real-world Applications	
Unit 1	Introduction to Predictive Modeling: Steps in Predictive Modeling Process,Importance of Predictive Modeling in Business and Science,Types of Predictive Models.

Unit 2	Algorithms for Data Analytics: Regression, Understanding model assumptions and when to use each technique.
Unit 3	Model Evaluation and Optimization Techniques: Cross-validation techniques: K-Fold, Stratified Sampling. Model performance tuning: Grid Search, Random Search.
Unit 4	Model Deployment and Integration in Production Environments: Saving and loading models using Pickle and Joblib, Basics of integrating ML models into web applications or APIs. Overview of cloud platforms for deployment: AWS, Azure, Google Cloud.

Recommended TextBooks /References:

1. McKinney, W. (2022). *Python for data analysis: Data wrangling with Pandas, NumPy, and Jupyter* (3rd ed.). O'Reilly Media.
2. Wilke, C. O. (2019). *Fundamentals of data visualization: A primer on making informative and compelling figures*. O'Reilly Media.
3. Knaflic, C. N. (2015). *Storytelling with data: A data visualization guide for business professionals*. Wiley.

Course Outcomes

No	Course Outcomes	Cognitive level
CO1	Understand the fundamental concepts of data analytics, its lifecycle, and its importance in modern business and research.	Understand
CO2	Acquire skills in data collection, cleaning, transformation, and integration.	Apply
CO3	Apply statistical methods and machine learning techniques for data analysis.	Apply / Analyze
CO4	Work with real-world datasets and solve practical data analysis problems.	Analyze / Evaluate

Mapping of CO's with PSO's

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
CO1	2	2	3	–	1	1	–	2	2	1	2
CO2	2	3	3	–	2	2	–	2	1	–	3
CO3	3	3	3	1	2	2	1	3	3	2	3
CO4	3	3	3	1	3	2	2	3	3	3	3

Mapping of CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	2	2	1	2	1
CO2	2	3	1	1	2	3	–	2	–
CO3	3	3	2	2	3	3	1	2	1
CO4	3	3	2	3	3	3	2	3	2

Correlation levels:

Level	Correlation
-	Nil
1	Slightly/Low
2	Moderate/Medium
3	Substantial/High

Assessment Rubrics

Quiz/Assignment/Discussion/Seminar
Final Exam

Mapping of COs to Assessment Rubrics

	Assignment	End Semester examination
CO1	✔	✔
CO2	✔	✔
CO3	✔	✔
CO4	✔	✔

M25CA01PR : PROJECT

AIM

- To equip the learner to be fit to be employed in the IT industry with exposure to software development and project management scenarios through a real life project facing constraints in terms of deliverables, time and any other relevant.

OBJECTIVES

- To apply the knowledge gained through various courses in dealing with the requirements emerging in software development.
- To practice different phases of state-of-the-art software/system development life cycle
- To provide an opportunity to practice and perform with time, resource and person management.

PROJECT GUIDELINES

The project work shall help the learner to get exposure to developing industry-standard applications or utility software to be deployed over the web or mobile services.

In order to get the experience of working in a team, it is recommended to do the project as a group of a maximum of three members. But in exceptional cases the learners may be allowed to do individual projects.

PROJECT GUIDE

The project shall be guided by one of the Counsellors of the corresponding LSC.

An external supervisor shall monitor the activities and review the documents from time to time.

The external supervisor shall be a faculty member with minimum three years experience in any of the Universities/Colleges imparting programmes in computer science or allied disciplines.

OR

An expert from the IT industry with minimum 5 years of experience.

PROJECT PHASE

The minimal phases for the project are Project feasibility, Investigation of system requirements, Data and Process Modelling, System Design, Program Design, Program coding and unit testing, System

integration, System implementation and acceptance testing.

PLANNING THE PROJECT

The Major Project is an involved exercise which has to be planned well in advance. Related reading, training and discussions should start from semester 5 itself.

SELECTION OF TEAM

The Internal Supervisor is responsible for project team formation. A gender mix is strongly suggested in a team. Teams shall maintain team meeting minutes and ensure that every team member has tasks assigned in writing. Team meeting minutes shall form a part of the Project Report. Even if students are doing projects as groups, each one must independently take up different modules of the work and must submit the reports also independently.

Selection of Tools: No restrictions shall be placed on the students in the choice of platforms/tools/languages to be utilized for their project work, though open source is strongly recommended, wherever possible. No value shall be placed on the use of tools in the evaluation of the project.

Selection of Organization : No restrictions shall be placed on the students in the choice of an organization where project work may be done, in terms of locality, type (public/private) etc.

Project IPR & Utilization: The intellectual property rights in all project work done by the students shall vest with the SGOU, except in cases where some external organizations seek undertaking from students to concede IPR in all work done in their organization or under their guidance. Where possible, students should attempt to obtain at least a joint IPR for the University. In cases where project works are of public utility, students shall be asked to publish their work including source code and documentation, in so far as their rights are clear.

PROJECT EVALUATION

Criteria for continuous internal evaluation of Major Project

The following components are to be assessed for Continuous evaluation.

An interim report after the analysis and design phase is required and a final report should also be submitted. Both these reports shall be assessed.

- Quality of documentation- 50% (milestones tracked-50%, adherence to the format of the report-20%, Documentation of requirements/modules/system inputs and outputs-30%)
- Presentation of work- 50% (Individual involvement & teamwork/ Attendance- 50% , Timely submission-20%, assessment of 2 interim reports -30%)

END SEMESTER EVALUATION OF THE MAJOR PROJECT

External evaluation will be done by external examiners appointed by the University.

- Quality of documentation- 40% (Project deliverables achieved-40%, Gantt chart-30%, reports-20%, Test cases designs-10%)
- Presentation of work- 30%
- Viva – 30%

Note: Further details will be provided by the counsellors of the LSC from time to time

Thank you