

MAZHARUL ULOOM COLLEGE (AUTONOMOUS)

(Established & Managed by the Ambur Muslim Educational Society)

Accredited by NAAC with Grade 'A' CGPA 3.23 in Cycle 3

Affiliated to Thiruvalluvar University, Vellore

Ambur- 635802 (Tirupattur District)



COURSE STRUCTURE & SYLLABUS

(For the students admitted from year 2025-2026 onwards)

Programme: B.Sc.

Course: DATA SCIENCE

III and IV Semester

At the end of the B.Sc. Data Science Programme, the student will:

Program Outcomes (POs)	
PO Code	Program Outcome Statement
PO1	Disciplinary Knowledge Acquire detailed knowledge and expertise in all the disciplines of the subject.
PO2	Communication Skills Ability to express thoughts and ideas effectively in writing, listening and confidently Communicate with others using appropriate media
PO3	Critical Thinking Students will develop aptitude Integrate skills of analysis, critiquing, application and creativity.
PO4	Analytical Reasoning Familiarize to evaluate the reliability and relevance of evidence, collect, analyzes and interprets data.
PO5	Problem Solving Capacity to extrapolate the learned competencies to solve different kinds of non-familiar problems.
PO6	Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO7	Moral and ethical awareness and Lifelong Learning: Upholds moral and ethical values, considers diverse perspectives on ethical issues, and applies ethical practices in all work. Committed to lifelong learning, career growth, and adapting to changing personal, professional, and societal needs.

After the successful completion of the programme, the students are expected to

Program Specific Outcomes (POs)	
PSO Code	Program Specific Outcome Statement
PSO1	Obtain ability to specify, design, develop, test and maintain usable software systems that behave reliably and efficiently and satisfy all the requirements that customers have defined for them.
PSO2	Gain skill to develop software systems that would perform tasks related to research, Education and training and /or E-Governance.
PSO3	Expertise in determining and optimizing the performance of a given algorithm on a given platform.
PSO4	Acquire capacity to anticipate the changing direction of information technology and evaluate and communicate the likely utility of new technologies to an individual or organization.
PSO5	Make the students capable in decision making at personal and professional level

Cognitive Levels of Learning

The cognitive domain is the first and most common hierarchy of learning objectives (Bloom, 1956). It focuses on the acquisition and application of knowledge and is widely used in the educational setting. It aims to develop the mental skills and the acquisition of knowledge of the individual. The cognitive domain encompasses of six categories which include remembering, understanding, applying, analyzing, evaluating and creating.

Level	Definition	Key Actions
K1 : Remembering	Ability to recall or recognize facts, terms, basic concepts, or answers without necessarily understanding them.	Retrieve, Memorize, Repeat, Define, Identify, Recognize
K2 : Understanding	Comprehending the meaning of information, interpreting or translating knowledge into your own words.	Explain, Describe, Summarize, Interpret, Paraphrase
K3 : Applying	Using knowledge in new situations, such as solving problems or applying theories to real-world situations.	Use, Demonstrate, Implement, Calculate, Practice
K4 : Analyzing	Breaking information into parts to explore understandings and relationships; identifying motives or causes.	Compare, Contrast, Categorize, Distinguish, Examine, Organize
K5 : Evaluating	Making judgments based on criteria and standards, often involving checking and critiquing.	Judge, Critique, Justify, Assess, Prioritize, Recommend
K6 : Creating	Putting elements together to form a new coherent whole or original product.	Design, Develop, Invent, Compose, Construct, Generate

Department of Data Science

SYLLABUS AND SCHEME OF EXAMINATIONS – III & IV SEMESTER

Sem	Course Code	Part	Course Category	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
							CIA	ESE	
Semester III		I	Language–I (Tamil / Urdu)	Urdu-III / Tamil-III	6	3	25	75	100
		II	English	English-III	6	3	25	75	100
		III	Core-VI	Programming with Java	5	5	25	75	100
		III	Core-VI	Practical: Programming with Java Lab	5	5	25	75	100
		IV	Elective–III	a) Operating Systems b) RDBMS	5	3	25	75	100
		V	Skill Enhancement Course (SEC) - IV	Computational Data Structures and Algorithms	1	1	25	75	100
			Skill Enhancement Course (SEC) - V	Data Engineering and Analytics Lab	2	2	25	75	100
			Compulsory	Environmental Studies	2	2	25	75	100
	Total				32	24	800		800
Semester IV		I	Language–I (Tamil / Urdu)	Urdu-IV / Tamil-IV	6	3	25	75	100
		II	English	English-IV	6	3	25	75	100
		III	Core-VII	Foundations of Artificial Intelligence	5	5	25	75	100
		III	Core-VIII	Practical: Artificial Intelligence Programming Lab	5	5	25	75	100
		IV	Elective–IV	a) Cloud Computing b) Data Mining and Warehousing	6	3	25	75	100
		IV	Skill Enhancement Course (SEC) - VI	Indian Knowledge Systems in Data Analytics and Decision Making	2	2	25	75	100
		IV	Skill Enhancement Course (SEC) - VII	Statistical Data Visualization Lab	2	2	25	75	100
	Total				32	23	700		700

Semester - III

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III		CC- V	5	5	25	75	100
Course Title		Programming with Java					

Learning Objectives	
LO1	To understand the fundamentals of Java programming language, operators, expressions and control statements.
LO2	To develop Java programs using classes, objects, methods, constructors and arrays.
LO3	To acquire knowledge on interfaces, packages and object-oriented programming concepts in Java.
LO4	To understand multithreading, exception handling and error management techniques in Java applications.
LO5	To design and develop Java applets and simple event-driven applications using Java programming concepts.

SYLLABUS		
Unit	Contents	Hours
I	Overview of Java Language: Introduction-Java Program Structure - Java Tokens - Java Statements - Implementing a Java Program - Java Virtual Machine - Command Line Arguments- Operators and Expressions: Introduction - Arithmetic Operators - Relational Operators - Logical Operators - Assignment Operators - Increment and Decrement Operators - Conditional Operator - Bitwise Operators.	15
II	Decision Making and Branching: Introduction - Decision Making with If Statement -Simple If Statement - The If...Else Statement - Nesting of If...Else Statements - The Else If Ladder - The Switch Statement -The ?: Operator. Decision Making and Looping: Introduction - while Statement - do Statement - for statement. Classes, Objects and Methods: Introduction - Defining a Class - Methods Declaration - Creating Objects - Accessing Class Members - Constructors - Method Overloading – Method Overriding	15
III	Arrays, Strings and Vectors: Introduction - One-dimensional Arrays - Creating an Array - Two-dimensional Arrays - Interfaces: Multiple Inheritance: Introduction - Defining Interfaces - Extending Interfaces - Implementing Interfaces - Accessing Interface Variables. Packages - Java API Packages - Using System Packages - Creating Packages - Accessing a Package - Adding a Class to a Package	15
IV	Multithreaded Programming: Introduction - Creating Threads - Extending the Thread Class - Stopping and Blocking a Thread - Life Cycle of a Thread - Managing Errors and Exceptions: Introduction - Types of Errors - Exceptions - Syntax of Exception Handling Code - Multiple Catch Statements - Using finally Statement - Throwing Our Own Exceptions.	15
V	Introduction to Applets – Difference between Applets and Applications – Applet Life Cycle – Building and Running Applets – Applet Tag and Adding Applets to HTML Files – Introduction to Swing – Swing Components: JFrame, JLabel, JButton, JTextField – Event Handling – Designing simple GUI applications using Swing.	15

Text Book(s):
1. E.Balagurusamy (2015), <i>Programming with Java - A Primer</i>, 7th Edition, McGraw Hill Company, India. 2. Dr.P.Rizwan Ahmed(2023), <i>Java Programming</i>, 3rd Edition, Margham Publications, Chennai. India.

Reference Book(s):
1. Debasish Jana. (2008). <i>Java and Object-Oriented Programming Paradigm</i> , Prentice Hall of India Private Limited, New Delhi. 2. Y. Daniel Liang. (2010). <i>Introduction to Java Programming</i> , 7 th Edition, Pearson Education India 3. Dr. Somasundaram. (2013). <i>Introduction to Java Programming</i> , 1 st Edition, Jaico Publishing House, India.
Web Resource(s):
1. https://javabeginnerstutorial.com/core-java-tutorial 2. http://docs.oracle.com/javase/tutorial/ 3. https://www.coursera.org/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Explain the structure and features of Java programs and apply operators, expressions and control statements effectively.	K1,K2,K3
CO 2	Develop Java applications using classes, objects, methods, constructors and arrays.	K2,K3
CO 3	Implement interfaces, packages and inheritance concepts in object-oriented Java programming.	K2,K3,K4
CO 4	Apply multithreading and exception handling mechanisms to build reliable Java applications.	K3,K4,K5
CO 5	Design and execute Java applets and web-based Java programs using applet life cycle methods.	K3,K5,K6

Relationship Matrix:

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	3	2	2	3	3	2	3	3	2	2	3	2	2.50
CO 2	3	3	3	2	3	3	2	3	2	3	2	2	2.58
CO 3	3	3	3	3	3	2	3	3	2	3	2	2	2.67
CO 4	2	3	2	3	3	3	3	2	3	2	2	3	2.58
CO 5	3	2	3	3	3	3	3	3	2	3	3	3	2.83
Mean Overall Score													2.63
Correlation													High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III		CC-VI	5	5	25	75	100
Course Title		Programming with Java Lab					

Learning Objectives	
LO 1	To understand the fundamentals of Java programming language and object-oriented programming concepts.
LO 2	To develop Java programs using classes, objects, inheritance, interfaces and packages.
LO 3	To acquire practical knowledge in handling strings, arrays, matrices and exception handling techniques.
LO 4	To understand multithreading concepts and develop concurrent Java applications.
LO 5	To design graphical applications and applets using Java programming techniques.

SYLLABUS	
Contents	Hours
- Write a Java program to print all the prime numbers between two limits. - Write a Java program to reverse the digits of a given number and check whether it is a palindrome or not. - Write a Java program to print Pascal's Triangle. - Write a Java program to count the odd and even numbers in a given array. - Write a Java program to transpose a given matrix. - Write a Java program to find the sum of elements in an array. - Write a Java program to calculate the volume of three different shapes using the Method Overloading concept. - Write a Java program to perform the following String Manipulation operations: - Find the length of a string - Concatenate two strings - Find a character at a particular position - Compare two strings - Write a Java program to perform the following operations using the StringBuffer class: - Find the length of a string - Reverse a string - Delete a substring from a given string - Write a Java program to prepare a student mark sheet using the Single Inheritance concept. - Write a Java program to prepare an EB bill for a customer using the Multilevel Inheritance concept. - Write a Java program to perform arithmetic operations using packages. - Write a Java program to prepare the pay bill of an employee using the Interface concept. - Write a Java program to implement a multithreaded application that generates odd and even numbers using two threads. - Write a Java program to implement a multithreaded application that uses the same method asynchronously to print numbers from 1 to 10 using Thread1 and numbers from 90 to 100 using Thread2. - Write a Java program to demonstrate the use of the following exceptions: - ArithmeticException - NumberFormatException - ArrayIndexOutOfBoundsException	75

d. NegativeArraySizeException 17. Write a Java program to handle a user-defined exception. 18. Write a Java Applet program to simulate a traffic light. 19. Write a Java Applet program to draw the National Flag of India in the AppletViewer screen. 20. Write a Java Applet program to draw basic shapes such as Line, Rectangle, Oval, and Arc.	
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Text Book(s):

1. E.Balagurusamy (2015), *Programming with Java - A Primer*, 7th Edition, McGraw Hill Company, India.
2. P.Rizwan Ahmed(2023), *Java Programming*, 3rd Edition, Margham Publications, Chennai. India.

Reference Book(s):

1. Debasish Jana. (2008). *Java and Object-Oriented Programming Paradigm*, Prentice Hall of India Private Limited, New Delhi.
2. Y. Daniel Liang. (2010). *Introduction to Java Programming*, 7th Edition, Pearson Education India
3. Dr. Somasundaram. (2013). *Introduction to Java Programming*, 1st Edition, Jaico Publishing House, India.

Web Resource(s):

1. <https://javabeginnerstutorial.com/core-java-tutorial>
2. <http://docs.oracle.com/javase/tutorial/>
3. <https://www.coursera.org/>

Course Outcomes

Upon successful completion of this course ,the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
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CO 1	Develop Java programs using operators, control structures, arrays and string handling techniques.	K2,K3
CO 2	Apply object-oriented programming concepts such as inheritance, polymorphism, interfaces and packages in Java applications.	K2,K3
CO 3	Implement exception handling and multithreading concepts to create reliable Java programs.	K2,K3,K4
CO4	Design and execute Java applets and graphical programs for real-time applications.	K3,K4,K5
CO 5	Build Java-based applications for mathematical, business and graphical problem solving.	K3,K5,K6

Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	3	3	3	3	2	2	2	3	2.58
CO2	3	3	3	3	3	3	2	3	2	3	2	2	2.67
CO3	3	3	3	3	3	2	3	3	2	2	2	2	2.58
CO4	3	3	3	3	3	3	3	3	2	3	3	2	2.83
CO5	3	2	3	3	3	3	3	3	3	3	3	3	2.92
Mean Overall Score													2.72
Correlation													High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III		Elective-III	5	3	25	75	100
Course Title		a) Operating Systems					

Learning Objectives	
LO1	To understand the basic concepts, functions and architecture of operating systems.
LO2	To acquire knowledge on process management, CPU scheduling and interprocess communication techniques.
LO3	To understand memory management concepts including paging, segmentation and virtual memory.
LO4	To analyze deadlock handling methods and page replacement algorithms in operating systems.
LO5	To learn file management, file allocation methods and disk scheduling algorithms used in modern operating systems.

SYLLABUS		
Unit	Contents	Hours

I	Introduction to Operating System – Functions and Services of Operating System – Types of Operating Systems – Operating System Architecture – Process Management – Process Scheduling – Context Switching – Interprocess Communication.	15
II	CPU Scheduling – Scheduling Criteria – Scheduling Algorithms: FCFS, SJF, Priority, Round Robin, Multilevel Queue and Multilevel Feedback Queue – Deadlock – Deadlock Prevention, Avoidance, Detection and Recovery.	15
III	Memory Management – Address Binding – Logical and Physical Address Space – Memory Allocation – Fragmentation and Compaction – Swapping – Paging – Segmentation – Segmentation with Paging.	15
IV	Virtual Memory – Demand Paging – TLB – Inverted Page Table – Page Replacement Algorithms: FIFO, Optimal, LRU, Clock and Counting Based Algorithms.	15
V	File Management – File Concepts and Access Methods – Directory Structures – File Protection – File Allocation Methods – Disk Scheduling Algorithms: FCFS, SSTF, SCAN and C-SCAN.	15

Text Book(s):

1. Operating System Concepts –Abraham Silberschatz Peter B. Galvin, G. Gagne, Sixth Edition, Addison Wesley Publishing Co., 2003.
2. Operating System – P.Rizwan Ahmed, Margham Publications ,2019

Reference Book(s):

1. Operating systems – Internals and Design Principles”, W. Stallings, 6th Edition, Pearson.
2. Modern Operating Systems”, Andrew S.Tanenbaum, Second Edition Addison Wesley, 2001.
3. Fundamentals of Operating System”, Prof. R. Sriddhar, Dynaram Publication, Bangalore Company

Web Resource(s):

1. <https://www.geeksforgeeks.org/operating-systems/>
2. https://www.tutorialspoint.com/operating_system/index.htm
3. <https://www.javatpoint.com/os-memory-management>
4. <https://www.studytonight.com/operating-system/virtual-memory-in-operating-system>
5. <https://www.guru99.com/operating-system-tutorial.html>

Course Outcomes

Upon successful completion of this course ,the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Explain the structure, functions and types of operating systems.	K1,K2,K3
CO 2	Apply process scheduling algorithms and analyze process management techniques.	K2,K3
CO 3	Demonstrate memory management concepts such as paging, segmentation and virtual memory.	K2,K3,K4
CO 4	Analyze deadlock prevention, avoidance and recovery mechanisms along with page replacement algorithms.	K3,K4,K5
CO 5	Implement file management concepts, file allocation methods and disk scheduling techniques in operating systems.	K3,K5,K6

Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	2	2	3	2	2	2	3	2	2.25
CO2	3	3	3	2	3	3	3	3	2	2	3	2	2.67

CO3	3	3	3	3	3	3	3	3	3	2	2	3	2.83
CO4	3	3	3	3	3	3	3	2	3	3	2	3	2.83
CO5	3	3	3	3	3	3	3	3	2	3	2	3	2.83
Mean Overall Score													2.68
Correlation													High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III		Elective -III	5	3	25	75	100
Course Title		b) RDBMS					

Learning Objectives	
LO1	To understand the fundamental concepts, architecture and features of Database Management Systems.
LO2	To acquire knowledge on relational database models, normalization and database design techniques.
LO3	To develop skills in SQL commands, table creation and data manipulation operations in Oracle databases.
LO4	To understand SQL functions, joins, set operations and fundamentals of PL/SQL programming.
LO5	To implement PL/SQL control structures, cursors, procedures, functions, packages and triggers for database applications.

SYLLABUS		
Unit	Contents	Hours
I	Database Concepts – Purpose and Features of Database System – Data Abstraction – Database Languages – DBMS and its Features – Types of DBMS – Database Users and DBA – Data Independence – DBMS Architecture – Characteristics, Advantages and Limitations of DBMS	15
II	Relational Data Model – Integrity Rules – Relational Algebra and Relational Calculus – Normalization: 1NF, 2NF, 3NF, BCNF, 4NF and 5NF – Database Design and Denormalization. Entity Relationship Model – Elements of E-R Model – E-R Diagram – Data Models	15
III	Oracle Tables and DDL Commands – Naming Rules and Data Types – Constraints – Creating, Altering, Renaming, Truncating and Dropping Tables – Select, Update and Delete Commands – Operators in SQL – Data Manipulation Language (DML) – Inserting, Updating, Deleting and Retrieving Data – WHERE Clause – Sorting – DEFINE Command	15
IV	Built-in Functions – Numeric, Character, Date and Conversion Functions – Group and Aggregate Functions – Grouping Data – Multiple Tables and Joins – Set Operators – Introduction to PL/SQL – Features and Fundamentals of PL/SQL – Block Structure – Data Types – Variable Declaration – Bind and Substitution Variables – Arithmetic Operators	15

V	Control Structures in PL/SQL – Conditional and Looping Statements – Nested Blocks – SQL in PL/SQL – Transaction Control Statements – Cursors: Implicit and Explicit Cursors – Exceptions and Types of Exceptions – PL/SQL Records, Tables and Varrays – Procedures – Functions – Packages – Triggers.	15
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Text Book(s):

1. Abraham Silberschatz, Henry Korth, S.Sudarshan, Database Systems Concepts, Sixth Edition, McGraw Hill, 2010.
2. P Rizwan Ahmed, RDBMS using Oracle, Margham Publications, Chennai, 2019

Reference Book(s):

1. Raghu Ramakrishnan and Johannes Gehrke, Database management systems, Third Edition, 2002
2. Bipin Desai, An Introduction to database systems, Galgotia Publications, 2010
3. RamezElamassri, Shankant B-Navathe, Fundamentals of Database Systems, Pearson, 7th Edition, 2015

Web Resource(s):

1. <https://docs.oracle.com/en/database/oracle/oracle-database/19/sqlrf/index.html>
2. <https://www.geeksforgeeks.org/dbms/>
3. <https://www.tutorialspoint.com/dbms/index.htm>
4. <https://www.javatpoint.com/dbms-tutorial>
5. <https://www.w3schools.com/sql/>

Course Outcomes

Upon successful completion of this course ,the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Explain the concepts, architecture and advantages of Database Management Systems and relational data models.	K1,K2,K3
CO 2	Apply normalization techniques and design efficient relational databases using E-R models.	K2,K3
CO 3	Create and manage database tables using SQL and perform data manipulation operations effectively.	K2,K3,K4
CO 4	Use SQL functions, joins and PL/SQL programming concepts to develop database applications.	K3,K4,K5
CO 5	Develop PL/SQL programs using control statements, cursors, exceptions, procedures, functions and triggers.	K3,K5,K6

Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	3	3	2	3	3	2	3	2	2	2.50
CO2	3	3	3	3	3	3	3	3	2	3	2	2	2.75
CO3	3	3	3	3	3	3	3	3	2	3	3	2	2.83
CO4	3	3	3	3	2	3	3	3	2	3	2	2	2.67
CO5	3	3	3	3	2	3	3	3	2	3	3	3	2.83

	Mean Overall Score		2.72
	Correlation		High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III		Skill Enhancement Course (SEC-IV)	1	1	25	75	100
Course Title		Computational Data Structures and Algorithms					

Learning Objectives	
LO 1	To understand the fundamentals of data structures, algorithms and complexity analysis.
LO 2	To acquire knowledge on linear data structures such as stacks, queues and linked lists.
LO 3	To understand non-linear data structures including trees and graphs with traversal techniques.
LO 4	To learn searching and sorting techniques for efficient data processing.
LO 5	To understand algorithm design techniques and computational complexity concepts.

SYLLABUS		
Unit	Contents	Hours
I	Introduction to Data Structures and Algorithms – Time and Space Complexity – Arrays – Strings – Pointers – Recursion	3
II	Stack –Representation – Implementation- Operations - Queue: Operations – Circular Queue – Linked Lists: Singly, Doubly and Circular Linked Lists – Applications.	3
III	Trees – Binary Trees – Binary Search Trees – Heap – Graphs – BFS and DFS Traversal Techniques.	3
IV	Searching Techniques – Linear Search – Binary Search – Hashing – Sorting Techniques: Bubble, Selection, Insertion, Merge and Quick Sort.	3
V	Algorithm Design Techniques – Divide and Conquer – Greedy Method – Dynamic Programming – Backtracking – Computational Complexity and NP Problems.	3

Text Book(s):
1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education, 2nd Edition, 2008. 2. P.Rizwan Ahmed, C++ and Data Structure, Margham Publications, Chennai.
Reference Book(s):
1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C,

- Universities Press, 2nd Edition, 2008.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, MIT Press, 3rd Edition, 2009.
 3. Reema Thareja, Data Structures Using C, Oxford University Press, 2nd Edition, 2014.

Web Resource(s):

<https://www.geeksforgeeks.org/data-structures/>
https://www.tutorialspoint.com/data_structures_algorithms/index.htm
<https://visualgo.net/en>
<https://www.programiz.com/dsa>
<https://www.javatpoint.com/data-structure-tutorial>

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Apply suitable data structures and analyze the time and space complexity of algorithms.	K1,K2,K3
CO 2	Implement linear data structures such as stacks, queues and linked lists for problem solving.	K2,K3
CO 3	Demonstrate tree and graph traversal techniques using appropriate algorithms.	K2,K3,K4
CO 4	Apply searching, hashing and sorting techniques for efficient data organization and retrieval.	K3,K4,K5
CO 5	Analyze algorithm design methods such as divide and conquer, greedy and dynamic programming techniques to solve computational problems.	K3,K5,K6

Relationship Matrix:

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	3	3	3	2	2	2	3	2.67
CO2	3	3	3	3	2	3	3	2	3	2	3	2	2.67
CO3	3	3	3	3	3	3	2	3	2	3	2	2	2.67
CO4	3	2	3	2	3	2	2	3	2	2	3	2	2.42
CO5	3	2	3	3	3	3	2	3	2	2	2	3	2.58
Mean Overall Score													2.6
Correlation													High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III		Skill Enhancement Course (SEC-V)	2	2	25	75	100
Course Title		Data Engineering and Analytics Lab					

Learning Objectives	
LO 1	To understand the fundamentals of Python programming for data science applications.
LO 2	To acquire practical knowledge in data collection, preprocessing and transformation techniques using Python libraries.
LO 3	To perform data analysis and visualization using Pandas, Matplotlib and Seaborn.
LO 4	To apply statistical and machine learning techniques for data analysis and prediction.
LO 5	To develop skills in handling real-world datasets and generating analytical reports.

SYLLABUS	
Contents	Hours
1. Read a CSV file and display the first 10 records. 2. Load an Excel file and display the column names and dataset information. 3. Convert a JSON file into a DataFrame and display the data. 4. Identify missing values in a dataset and replace them with appropriate values. 5. Identify and remove duplicate records from a dataset. 6. Perform data type conversion and rename selected columns in a dataset. 7. Filter records based on a given condition and sort the dataset. 8. Create new columns using existing data and apply suitable functions. 9. Perform GroupBy operations and compute aggregate functions such as sum, mean, and count. 10. Merge two datasets using a common key and concatenate datasets. 11. Visualize data using Matplotlib by creating line chart, bar chart, histogram, and pie chart. 12. Visualize data using Seaborn by creating boxplot, heatmap, and pairplot. 13. Perform DateTime operations and compute rolling mean on time-series data. 14. Perform statistical analysis and detect outliers using the IQR method. 15. Export a DataFrame into CSV and Excel file formats. 16. Normalize numerical data in a dataset. 17. Convert categorical data into numerical format using encoding techniques. 18. Perform random sampling and slicing operations on a dataset. 19. Generate a summary report of a dataset using descriptive statistics. 20. Linear Regression using Python	30

Text Book(s):
1. Wes McKinney, <i>Python for Data Analysis</i>, O'Reilly Media, 2017, 2nd Edition. 2. Jake VanderPlas, <i>Python Data Science Handbook</i>, O'Reilly Media, 2016.
Reference Book(s):
1. Wes McKinney, <i>Python for Data Analysis</i>, O'Reilly Media, 2017. 2. Al Sweigart, <i>Automate the Boring Stuff with Python</i>, No Starch Press, 2019.

Web Resource(s):	
1.	https://pandas.pydata.org/docs/
2.	https://numpy.org/doc/
3.	https://matplotlib.org/stable/tutorials/
4.	https://seaborn.pydata.org/tutorial.html

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Import, process and manage datasets from different file formats using Python.	K1,K2,K3
CO2	Apply data cleaning, transformation and preprocessing techniques for effective data analysis.	K2,K3
CO3	Create meaningful visualizations and statistical summaries using Python libraries.	K2,K3,K4
CO4	Implement basic machine learning techniques such as linear regression and data normalization.	K3,K4,K5
CO5	Analyze datasets and generate reports for data-driven decision making using Python tools.	K3,K5,K6

Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	3	2	3	3	2	3	2	2	3	2.5
CO2	3	3	3	2	3	3	3	3	2	3	2	2	2.67
CO3	3	3	3	3	3	3	2	3	2	2	3	2	2.67
CO4	3	3	2	3	3	3	3	3	2	3	2	2	2.67
CO5	3	3	3	3	3	3	3	3	2	3	2	2	2.75
Mean Overall Score													2.65
Correlation													High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

SEMESTER – IV

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV		CC-VII	5	5	25	75	100
Course Title		Foundations of Artificial Intelligence					

Learning Objectives	
LO1	To understand the fundamental concepts, history and applications of Artificial Intelligence.
LO2	To acquire knowledge on search techniques and knowledge representation methods used in AI systems.
LO3	To understand machine learning concepts and algorithms for intelligent decision making.
LO4	To learn neural networks, deep learning and natural language processing techniques.
LO5	To explore expert systems, fuzzy logic, robotics and emerging applications of Artificial Intelligence.

SYLLABUS		
Unit	Contents	Hours
I	Introduction to Artificial Intelligence – History and Applications of AI – Characteristics of Intelligent Agents – Types of AI – Problem Solving in AI – State Space Representation – Production Systems – AI Programming Environments – Applications of AI in Real World.	15
II	Uninformed Search Techniques – Breadth First Search – Depth First Search – Informed Search Techniques – Best First Search – A* Algorithm – Hill Climbing – Knowledge Representation – Predicate Logic – Semantic Networks – Frames and Rules	15
III	Introduction to Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Reinforcement Learning – Classification and Regression – Decision Trees – Naïve Bayes – Clustering Techniques – Evaluation Metrics.	15
IV	Artificial Neural Networks – Structure of Neural Networks – Perceptron – Multilayer Neural Networks – Deep Learning Basics – Natural Language Processing – Text Processing – Tokenization – Sentiment Analysis – Chatbots and AI Assistants.	15
V	Expert Systems – Components of Expert Systems – Fuzzy Logic – Genetic Algorithms – Robotics – Computer Vision – Ethical Issues in AI – Explainable AI – Applications of AI in Healthcare, Education, Business and Industry.	15

Text Book(s):
1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 4th Edition, 2021. 2. P.Rizwan Ahmed, Artificial Intelligence, Margham Publications, Chennai, 2017
Reference Book(s):
1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, McGraw Hill Education, 3rd Edition, 2017. 2. Andreas C. Müller and Sarah Guido, Machine Learning with Python, O'Reilly Media, 2016. 3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
Web Resource(s):
1. https://www.geeksforgeeks.org/artificial-intelligence/ 2. https://www.tutorialspoint.com/artificial_intelligence/index.htm 3. https://developers.google.com/machine-learning/crash-course 4. https://scikit-learn.org/stable/ 5. https://www.tensorflow.org/learn

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Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Explain the concepts, characteristics and applications of Artificial Intelligence systems.	K1,K2,K3
CO 2	Apply search algorithms and knowledge representation techniques for AI problem solving.	K2,K3
CO 3	Implement machine learning techniques such as classification, regression and clustering.	K2,K3,K4
CO 4	Analyze neural networks, NLP and deep learning methods used in intelligent applications.	K3,K4,K5
CO 5	Evaluate the role of expert systems, robotics and ethical issues in modern AI applications.	K3,K5,K6

Relationship Matrix:

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	1	1	2	2	2	1	2	1	2	2	1	1.58
CO2	2	2	1	2	2	2	2	2	1	2	2	2	1.83
CO3	2	2	2	1	1	1	3	3	2	3	3	2	2.08
CO4	2	2	2	2	2	3	2	3	2	2	2	2	2.16
CO5	2	2	2	1	3	2	2	3	2	2	3	2	2.16
Mean Overall Score													1.96
Correlation													Medium

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV		CC-VIII	5	5	25	75	100
Course Title		AI Programming Lab					

Learning Objectives

LO1	To understand the implementation of Artificial Intelligence algorithms using Python programming.
LO2	To develop problem-solving skills using search techniques and state space representation methods.
LO3	To acquire practical knowledge in machine learning and classification algorithms.
LO4	To understand neural networks, natural language processing and chatbot development concepts.

LO5	To gain hands-on experience in developing AI-based applications using Python libraries and tools.
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SYLLABUS	
Contents	Hours
1. Write a Python program to implement Breadth First Search (BFS). 2. Write a Python program to implement Depth First Search (DFS). 3. Implement the A* Search Algorithm for path finding. 4. Develop a program for Hill Climbing Algorithm. 5. Write a Python program for Tic-Tac-Toe using AI concepts. 6. Implement Water Jug Problem using state space search. 7. Develop a simple Expert System using rule-based approach. 8. Write a Python program to demonstrate Predicate Logic representation. 9. Implement Decision Tree Classification using Scikit-learn. 10. Implement Naïve Bayes Classification for sample dataset. 11. Perform K-Means Clustering using Python. 12. Develop a simple Artificial Neural Network using TensorFlow/Keras. 13. Perform Sentiment Analysis on text data. 14. Create a simple Chatbot using Python. 15. Write a Python program to implement simple Pattern Matching using Regular Expressions.	75

Text Book(s):
3. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 4th Edition, 2021. 4. P.Rizwan Ahmed, Artificial Intelligence, Margham Publications, Chennai, 2017
Reference Book(s):
1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, McGraw Hill Education, 3rd Edition, 2017. 2. Andreas C. Müller and Sarah Guido, Machine Learning with Python, O'Reilly Media, 2016. 3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
Web Resource(s):
1. https://www.geeksforgeeks.org/artificial-intelligence/ 2. https://www.tutorialspoint.com/artificial_intelligence/index.htm 3. https://developers.google.com/machine-learning/crash-course 4. https://scikit-learn.org/stable/ 5. https://www.tensorflow.org/learn

Course Outcomes		
Upon successful completion of this course ,the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Implement AI search algorithms such as BFS, DFS, A* and Hill Climbing using Python.	K1,K2,K3
CO 2	Develop AI problem-solving applications such as Water Jug Problem, Tic-Tac-Toe and Expert Systems.	K2,K3
CO 3	Apply machine learning techniques including Decision Tree, Naïve Bayes and K-Means Clustering.	K2,K3,K4
CO 4	Build AI applications using neural networks, sentiment analysis and chatbot techniques.	K3,K4,K5

CO 5	Develop Python programs for pattern matching, knowledge representation and intelligent data processing.	K3,K5,K6
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Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	2	3	3	3	3	2	3	2	2	2.58
CO2	3	3	3	2	2	3	3	2	2	2	3	2	2.5
CO3	3	3	3	3	3	3	3	3	2	3	2	2	2.75
CO4	2	3	3	3	3	3	3	3	2	2	3	2	2.67
CO5	3	3	2	3	3	3	3	3	2	3	2	2	2.67
	Mean Overall Score												2.63
	Correlation												High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV		Elective-IV	6	3	25	75	100
Course Title		a) Cloud Computing					

Learning Objectives	
LO 1	Understand the basic concepts and architecture of cloud computing.
LO 2	Learn different cloud service models such as SaaS, PaaS, and IaaS.
LO 3	Analyze cloud virtualization, storage, and security technologies.
LO 4	Study cloud applications in business, healthcare, and scientific fields.
LO 5	Understand cloud deployment, migration, and future cloud technologies.

SYLLABUS		
Unit	Contents	Hours
I	Introduction: Cloud Computing Basics: Cloud Computing Overview - Applications of cloud computing - Intranets and the cloud – First movers in the cloud - Benefits - limitations of cloud computing – Security Concerns	18
II	Cloud Computing with the titans– the business case for going to cloud.Cloud Computing Technology: Hardware and Infrastructure – Clients – Security – Network – Services – Accessing the cloud.	18
III	Cloud Storage – Overview-cloud storage providers -standards Cloud Models Cloud Computing at work: Software as a Service – Software Plus Services – Developing Applications	18
IV	Local cloud and thin clients-Cloud virtualization technology-definition-benefits-server virtualization architecture-hypervisor management software-LPAR-VIO server- Infrastructure requirements.	18

		Correlation		High
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3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV		Elective-IV	6	3	25	75	100
Course Title		b)Data Mining and warehousing					

Learning Objectives	
LO 1	To understand the fundamentals of data mining and data preprocessing techniques.
LO 2	To acquire knowledge on data warehouse concepts and OLAP operations.
LO 3	To understand association rule mining and frequent pattern analysis methods.
LO 4	To learn classification techniques and advanced data mining methods.
LO 5	To understand clustering techniques and their applications in data analysis.

SYLLABUS		
Unit	Contents	Hours
I	Introduction: Data mining – Kinds of data mined – Kinds of Patterns mined. Data Preprocessing: An Overview – Data Cleaning – Data Integration – Data Reduction.	18
II	Data Warehouse and Online Analytical Processing: Data Warehouse: Basic Concepts – Data Warehouse Modeling: Data Cube and OLAP – Data Generalization by Attribute – Oriented Induction.	18
III	Mining frequent patterns, Associations and Correlations: Basic Concepts and Methods Basic Concepts – Frequent Itemset Mining Method – Pattern Evaluation methods.	18
IV	Classification: Basic Concepts – Decision Tree Induction - Attribute Selection Measures -Tree Pruning. Advanced Methods: Classification by Back Propagation.	18
V	Cluster Analysis: : Cluster Analysis – Partitioning Methods - Hierarchical Methods – Density Based Methods	18

Text Book(s):
1. Jiawei Han and Micheline Kamber, Jian Pei. (2016). <i>Data Mining Concepts and Techniques</i> , 3 rd Edition, New Delhi: Morgan Kaufmann Publishers, An imprint of Elsevier
Reference Book(s):

1. Mehmed Kantardzic. (2011). *Data mining Concepts, Models, Methods, and Algorithms*, 2nd Edition, New Delhi: Wiley Inter science
2. Alex Berson, & Stephen J. Smith. (2016). *Data Warehousing, Data Mining and OLAP*, Mumbai: Tata McGraw Hill Edition, 35th Reprint 2007
3. Soman, K.P. Shyam Diwakar and Ajay, V. (2014). *Insight into Data Mining Theory and Practice*, New Delhi: PHI Learning Private Limited, Eastern Economy Edition, Seventh Printing.

Web Resource(s):

1. <https://www.geeksforgeeks.org/data-mining/>
2. https://www.tutorialspoint.com/data_mining/index.htm
3. <https://www.ibm.com/topics/data-mining>
4. <https://www.javatpoint.com/data-mining>
5. <https://www.kdnuggets.com/data-mining-tutorials>

Course Outcomes

Upon successful completion of this course ,the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Explain the concepts, tasks and preprocessing techniques used in data mining.	K1,K2,K3
CO 2	Apply data warehouse and OLAP concepts for multidimensional data analysis.	K2,K3
CO 3	Implement frequent pattern mining and association rule techniques for discovering relationships in data.	K2,K3,K4
CO 4	Apply classification algorithms such as decision trees and back propagation methods for predictive analysis.	K3,K4,K5
CO 5	Analyze and implement clustering techniques including partitioning, hierarchical and density-based methods.	K3,K5,K6

Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	2	3	3	3	2	3	2	2	2.58
CO2	3	3	3	3	3	3	3	3	2	3	2	2	2.75
CO3	3	3	3	3	3	2	3	3	2	3	2	2	2.67
CO4	3	3	3	3	2	2	3	3	2	3	2	2	2.58
CO5	3	3	3	3	3	3	3	3	2	3	2	2	2.75
	Mean Overall Score												2.67
	Correlation												High

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

			Hours		Marks for Evaluation
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			/ Week		CIA	ESE	Total
IV		Skill Enhancement Course (SEC) - VI	2	2	25	75	100
Course Title	Indian Knowledge Systems in Data Analytics and Decision Making						

Learning Objectives	
LO 1	To understand the foundations, scope and relevance of Indian Knowledge Systems in the context of data science and analytics.
LO 2	To acquire knowledge on ancient Indian mathematical concepts and their contribution to analytical reasoning and data representation.
LO 3	To understand Indian logical systems and decision-making approaches in comparison with modern data-driven models.
LO 4	To explore traditional Indian systems for pattern recognition, classification and holistic analysis.
LO 5	To analyze the applications of Indian Knowledge Systems in ethical data practices, analytics and decision support systems.

SYLLABUS		
Unit	Contents	Hours
I	Foundations of Indian Knowledge Systems: Meaning and scope of IKS – Sources of IKS: Vedas and Upanishads – Contributions of ancient India to knowledge systems – Relevance of IKS in data analytics and decision-making.	6
II	Indian Mathematics and Analytical Thinking: Ancient Indian mathematicians: Aryabhata and Brahmagupta – Concept of zero and decimal number system – Place value system – Mathematical thinking in data representation and analytical reasoning.	6
III	Logic and Decision-Making in IKS: Nyaya logic system – Panchavayava reasoning model – Indian approaches to inference and decision-making – Comparison with modern decision-making systems.	6
IV	Pattern Recognition and Systems Thinking: Traditional knowledge systems and pattern identification – Ayurveda as a classification system – Astronomy and observational analysis – Systems thinking and holistic analysis.	6
V	Applications of IKS in Data Analytics: Conceptual parallels between IKS and data analytics – Ethical decision-making based on Dharma – Ethical data practices – Digital preservation of traditional knowledge – Case studies on Indian contributions to analytics and decision systems.	6

Text Book(s):
1. . Kapil Kapoor and Michel Danino (2019), <i>Indian Knowledge System</i>, D.K. Printworld, New Delhi. 2. U. C. Gupta (2009), <i>Indian Mathematics and Astronomy: Some Landmarks</i>, Indian National Science Academy, New Delhi.
Reference Book(s):
1. S. Chatterjee and D. Datta, <i>An Introduction to Indian Philosophy</i>, University of Calcutta 2. Debiprasad Chattopadhyaya (1977), <i>Science and Technology in Ancient India</i>, Firma KLM Pvt. Ltd., Calcutta. 3. B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R.N. (2022), <i>Introduction to Indian Knowledge System: Concepts and Applications</i>, PHI Learning, New Delhi.
Web Resource(s):
1. https://iksindia.org/images/Guidelines-wiki.pdf 2. http://snggdcdg.ndl.gov.in/handle/123456789/1592

3. <https://iksindia.org/wp-content/uploads/2021/03/IKS-Framework.pdf>
4. https://www.aicte-india.org/sites/default/files/Indian_Knowledge_Systems.pdf
5. https://www.researchgate.net/publication/391209217_Indian_Knowledge_Systems_IKS
6. <https://www.ijert.org/indian-knowledge-systems-iks-bridging-ancient-wisdom-with-modern-education-and-technology-ijertv15is031142>
7. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID4589986_code3578217

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Explain the concepts, sources and significance of Indian Knowledge Systems in modern data science applications.	K1,K2,K3
CO 2	Analyze the contributions of ancient Indian mathematics to computational thinking and data representation.	K2,K3
CO 3	Apply Indian logical and reasoning models for problem solving and decision-making processes.	K2,K3,K4
CO 4	Interpret traditional knowledge systems such as Ayurveda and astronomy from the perspective of pattern recognition and systems analysis.	K3,K4,K5
CO 5	Evaluate the role of Indian Knowledge Systems in ethical analytics, digital preservation and intelligent decision systems.	K3,K5,K6

Relationship Matrix:

Course Outcomes (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	1	1	1	1	2	2	2	2	2	2	1.66
CO2	2	1	1	1	2	2	2	1	1	2	1	1	1.41
CO3	2	1	1	2	1	2	2	2	2	3	2	2	1.83
CO4	2	2	2	2	2	2	3	3	2	2	2	2	2.16
CO5	3	3	3	3	3	3	3	3	2	3	3	2	2.83
Mean Overall Score													1.98
Correlation													Medium

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV		Skill Enhancement Course (SEC) - VII	2	2	25	75	100
Course Title		Statistical Data Visualization Lab					

Learning Objectives	
LO 1	To understand the fundamentals of data visualization and graphical representation techniques.
LO 2	To acquire practical knowledge in creating different types of charts and graphs for data analysis.
LO 3	To develop skills in analyzing trends, comparisons and relationships using visualization tools.
LO 4	To understand interactive visualization techniques such as dashboards, pivot charts and dynamic charts.
LO 5	To apply visualization methods for effective interpretation and presentation of business and statistical data.

SYLLABUS	
Contents	Hours
- Create a Bar Chart to represent student marks in different subjects and identify the highest scorer. - Construct a Pie Chart to show the percentage distribution of students across different departments. - Develop a Line Chart to analyze monthly sales data and identify trends over a year. - Create a Column Chart to compare sales performance of different products. - Design an Area Chart to represent growth in website traffic over time. - Prepare a Stacked Bar Chart to show category-wise sales contribution across regions. - Construct a Combo Chart to compare revenue and profit using dual axes. - Generate a Histogram to analyze the distribution of student exam scores. - Create a Scatter Plot to study the relationship between study hours and marks obtained. - Apply Conditional Formatting (Heatmap) to visualize variations in sales data across regions and months. - Create a Pivot Table and Pivot Chart to summarize and visualize large datasets. - Design an Interactive Dashboard using charts and slicers for sales analysis. - Add a Trendline to a dataset and perform forecasting for future values. - Construct a Box and Whisker Plot to analyze the distribution of marks across different classes. - Develop an Interactive Chart using dropdown (Data Validation) to switch between datasets dynamically.	30

Text Book(s):
- Wayne L. Winston. (2019). <i>Microsoft Excel Data Analysis and Business Modeling</i>, Microsoft Press, USA. - Michael Alexander and Richard Kusleika. (2018). <i>Excel 2019 Bible</i>, Wiley India Pvt. Ltd., New Delhi.

Reference Book(s):	
1. Dick Kusleika. (2015). <i>Data Visualization with Excel Dashboards and Reports</i> , Wiley, USA. 2. Cole Nussbaumer Knafllic. (2015). <i>Storytelling with Data: A Data Visualization Guide for Business Professionals</i> , Wiley, USA. 3. Juliet Clark. (2020). <i>Practical Data Visualization with Excel</i> , Packt Publishing Ltd., Birmingham, UK.	
Web Resource(s):	
1. https://support.microsoft.com/excel 2. https://learn.microsoft.com/en-us/training/browse/?products=excel 3. https://www.excel-easy.com/ 4. https://trumpexcel.com/ 5. https://www.contextures.com/excelcharts.html	

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO 1	Create various charts and graphs to represent and analyze datasets effectively.	K1,K2,K3
CO 2	Apply visualization techniques to identify trends, patterns and relationships in data.	K2,K3
CO 3	Develop pivot tables, pivot charts and dashboards for summarizing large datasets.	K2,K3,K4
CO 4	Implement forecasting, trend analysis and statistical visualization methods using charts.	K3,K4,K5
CO 5	Design interactive and dynamic visualizations for business intelligence and decision-making applications.	K3,K5,K6

Relationship Matrix:

Course Outcome s (COs)	Program Outcomes (POs)							Program Specific Outcomes(PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	1	1	1	2	1	1	1	2	2	1	2	1.33
CO2	2	2	2	2	1	2	2	2	2	1	1	2	1.75
CO3	3	2	2	2	3	3	2	3	2	2	2	2	2.33
CO4	3	2	2	2	2	2	2	2	2	3	2	2	2.16
CO5	3	2	3	2	2	2	2	3	2	2	2	2	2.25
Mean Overall Score													1.96
Correlation													Medium

3 – Strong, 2- Medium, 1- Low

Mean Overall Score	Correlation
<=1	Low
>1 & <=2	Medium
>2 & <=3	High