

SIPNA COLLEGE OF ENGINEERING & TECHNOLOGY, AMRAVATI

An Autonomous Institute Affiliated to

Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

(Approved by AICTE, New Delhi and Recognized by DTE, Maharashtra)

(Accredited With 'A+' Grade by NAAC)



Bachelor of Technology (B. Tech.)

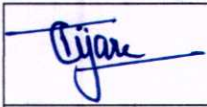
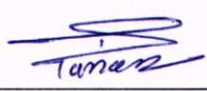
Syllabus -Semester III & Semester IV

Department of Artificial Intelligence (AI) & Data Science

Effective from Academic Year 2025-26

Prepared by: Boards of Studies- Artificial Intelligence (AI) & Data Science

Approved by: Academic Council Sipna COET, Amravati

			05/07/2025	1.00
Chairman Board of Studies	Dean Academics	Chairman Academic Council	Date of Release	Version



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:		III		
Course:	Mathematics-III			Code:		BTADBS07SH3T		
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3		3	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Attendance & Assignment								
Course Objectives: The objective of this course is to expose students to understand the basic concepts of Measures of Central Tendency, Measures of Dispersion, Probability and Testing of Hypothesis.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level (L1 to L6)
CO-1	Develop a foundational understanding of data by calculating Measures of Central Tendency.							L3
CO-2	Find measures of dispersion to evaluate data variability.							L1
CO-3	Apply probability concepts to solve real-world problems.							L3
CO-4	Select appropriate probability distribution for solving problems.							L3
CO-5	Choose test for hypothesis testing to make data-driven decisions.							L5
CO-6	Analyze relationships between variables using correlation and regression techniques.							L4

Unit I: Measures of Central Tendency

(6 Hrs.)

Concept of population, Sample, Qualitative and Quantitative data, Cross sectional and time series data, Discrete and continuous variable, Frequency distribution, Graphical distribution of frequency distribution, Arithmetic mean, median, mode, Partition Values(Quartile, Decile & Percentile).

Unit II: Measures of Dispersion

(6 Hrs.)

Concept of Measures of Dispersion, Range, Interquartile Range, Mean Deviation, Standard deviation & Variance, Numerical Problems on measures of Dispersion.

Unit III: Probability

(6 Hrs.)

Definition of probability, Relative Frequency Approach of probability, Axiomatic Approach of probability, Conditional probability and Bayes theorem.

Unit IV: Probability Distribution

(6 Hrs.)

Concept of Probability Distribution, Discrete Probability Distribution, Continuous Probability Distribution, Binomial distribution, Poisson distribution, Normal Distribution.

Unit V : Hypothesis Testing

(6 Hrs.)

Null hypothesis, Alternate hypothesis, Type-I & Type-II errors, t-Test for single mean, Paired t-test, F-test, Chi-square test.

Unit VI: Correlation, Regression

(6 Hrs.)

Method of Least Square: Fitting of Straight Line & Second-Degree parabola, Coefficient of Correlation, Line of Regression.

Total: 36 Hrs.



Text Books:

1. Fundamentals of Mathematical statistics, S. C. Gupta, V. K. Kapoor
2. Mathematical Statistics by J.N. Kapur & H.C. Saxena
3. Advanced Engineering Mathematics by Ervin Kreyszig

Reference Books

1. Probability & Statistics, Murray R. Spiegel, John Schiller, R. Alu Srinivasan
2. Higher Engineering Mathematics by Dr. B.S. Grewal.
3. Engineering Mathematics by Veerarajan T.
4. A Textbook of Engineering Mathematics by N.P. Bali & Manish Goyal

MOOC Links:

1. [Probability Theory for Data Science - Course](#)
2. [NPTEL : NOC:Engineering Statistics \(Multi-Disciplinary\)](#)
3. [318 Economics Eng Lesson9.pdf](#)
4. [UGC MOOCs: A Vertical of SWAYAM](#)



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:	III			
Course:	Data Structures and Algorithms			Code:	BTADPC02AD3T			
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives:

To understand the linear and nonlinear data Structures and its memory representations.
To perform different operations on data structures such as insertion, deletion, searching and traversing.
To understand various data searching and sorting methods with its complexity.
To introduce various techniques for representation of the data in the real world.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Apply various linear and nonlinear data structures	L4
CO-2	Demonstrate operations like insertion, deletion, searching and traversing on various data structures	L5
CO-3	Examine the usage of various structures in approaching the problem solution.	L4
CO-4	Choose appropriate data structure for specified problem domain.	L4
CO-5	To create trees and understand its applications.	L5
CO-6	To implement graph and sorting algorithms.	L4

Unit I: Introduction to Data Structures

(6 Hrs.)

Introduction to Data structures, Data Structure Operations, Algorithmic Notation, Complexity of algorithms. String processing: storing strings, character data type, string operations, word processing, and pattern matching algorithms.

Unit II: Array & Record Structure

(6 Hrs.)

Linear arrays : Memory Representation of arrays, traversing linear arrays, insertion & deletion operations, Bubble sort, Linear search and Binary search algorithms. Multi-dimensional arrays, Pointer arrays. Record structures and Matrices.

Unit III: Linked lists

(6 Hrs.)

Linked lists: Memory Representation of Linked List, traversing a linked list, searching a linked list. Memory allocation & garbage collection. Insertion & deletion operations on linked lists. Header linked lists, Two- way linked lists.

Unit IV: Stack & Queue

(6 Hrs.)

Stacks: Sequential Memory Representation of Stack, Arithmetic expressions: Polish notation. Quick sort, Recursion, Tower of Hanoi.

Queues: Sequential Memory Representation of Queue, DeQueue, Priority queues.

Unit V: Trees

(6 Hrs.)

Introduction to Trees, Binary trees, Memory Representation of Binary Tree, Traversing binary trees, Header nodes, Binary Search Tree, Heap and heapsort, Path length & Huffman's algorithm.



Unit VI: Graphs & Sorting Algorithms

(6 Hrs.)

Introduction to Graphs, Memory representation of graphs, Warshalls' algorithm, operations on Graphs, Breadth First Search, Depth First Search. **Sorting** : Insertion Sort, Selection Sort, Radix sort, Merge Sort.

Total: 36 Hrs

Textbooks:

1. Seymour Lipschutz: Data Structures, Schaum's Outline Series, McGraw-Hill, International Editions.
2. Trembley, Sorenson: An Introduction to Data Structures with Applications, McGraw Hill.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni: Fundamentals of Data Structures, CBS Publications.
2. Data Structure Using C, Balagurusamy.
3. Standish: Data Structures in Java, Pearson Education.

MOOC Links:

1. NPTEL Course: Data Structures and Algorithms:
<https://archive.nptel.ac.in/courses/106/102/106102064/>
2. NPTEL Course: Programming and Data Structure:
<https://archive.nptel.ac.in/courses/106/105/106105085/>



Program:		B. Tech. (Artificial Intelligence (AI) & Data Science)		Semester:	III	
Course:		Data Structures & Algorithm – Lab		Code:	BTADPC03AD3P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50
Course Objectives: To apply and analyze data structures such as arrays, linked lists, stacks, queues, trees, and graphs; and implement algorithms for sorting, searching, and traversal operations.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO1	Apply the concepts of array data structure for searching algorithms and pattern matching algorithm.					L3
CO2	Analyze and implement different sorting algorithms techniques.					L4
CO3	Understand and implement operations on Linked List data structure.					L2
CO4	Execute the concept of Stack, Queue data structure, and Recursion.					L3
CO5	Evaluate and examine the concept of Tree data structure.					L5
CO6	Design and implement the concept of Graph for DFS algorithm.					L6

General Guidelines: Example:- Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

1. Write a program to determine the largest element from an array and its location.
2. Implement insertion and deletion operations on strings using array data structures.
3. Develop a program to implement Binary Search algorithm.
4. Implement Bubble Sort Algorithm using an array.
5. Understand the Stack data structure and execute push and pop operations.
6. Study the Queue data structure and execute insertion and deletion operations.
7. Understand the concept of recursion and write a program to calculate factorial of a number using recursion.
8. Design a program to implement First Pattern Matching Algorithm.
9. Study and implement various operations on singly linked list:
 - a) Traversing a linked list
 - b) Searching a linked list
10. Implement the concept of Insertion Sort Algorithm using an array.
11. Write a program for the implementation of Selection Sort Algorithm.
12. Design a program to implement Preorder Tree Traversal Algorithm.
13. Implement the concept of Depth First Search (DFS) algorithm.
14. Design a program to implement Quick Sort Algorithm.
15. Develop a program to implement Merge Sort Algorithm.



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Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:	III			
Course:	Object Oriented Programming			Code:	BTADPC04AD3T			
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives:

- Study of the basic concepts of Java such as operators, classes, objects, inheritance, packages and exception handling.
- Study of concepts like enumerations, generics, logging, API, assertions, Applets, AWT.
- Preparing the students to learn Object Oriented Programming Methodology

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Apply Object Oriented approach to design software.	L4
CO-2	Implement programs using classes and objects.	L5
CO-3	Specify the forms of inheritance and use them in programs.	L4
CO-4	Analyze polymorphic behaviour of objects.	L4
CO-5	Design and develop GUI programs.	L3
CO-6	Develop Applets for web applications	L4

Unit I: Introduction to Object Oriented Programming:

(6 Hrs.)

Introduction, Need of OOP, Principles of Object- Oriented Languages, Procedural Language Vs OOP, Application of OOP, Java Virtual Machine, Java features, Program Structures. Java Programming Constructs: Variables, Primitive data types, Identifier, Literals, Operators, Expressions, Precedence Rules and Associativity, Primitive Type Conversion and Casting, Flow of Control.

Unit II: Classes and Objects:

(6 Hrs.)

Classes, Objects, Creating Objects, Methods, Constructors, Cleaning up Unused Objects, Class Variable and Methods, this keyword, Arrays, Command Line Arguments.

Unit III: Inheritance:

(6 Hrs.)

Inheritance vs. Aggregation, Polymorphism, Method Overloading Method Overriding, super keyword, final keyword, Abstract class. Interfaces, Packages and Enumeration: Interface, Packages, java.lang package, Enum type.

Unit IV: Exception:

(6 Hrs.)

Introduction, Exception handling Techniques, User-defined exception, Exception Encapsulation and Enrichment. Input/ Output: The java.io.file Class, Reading and Writing data, Randomly Accessing a file, Reading and Writing Files using I/O Package.

Unit V: Multithreading & Stream API:

(6 Hrs.)

Introduction, Multithreading, Thread Life Cycle, Thread Methods, Daemon Threads. Stream API: Core Operation on Stream, Creating Streams, Filtering, Mapping, and Reducing Data.



Unit VI: Java Design Patterns:

(6 Hrs.)

Introduction, Creational Patterns: Singleton, Factory, Builder, Prototype and related case study

Total: 36 Hrs

Textbooks:

1. Sachin Malhotra and Saurabh Choudhary: Programming in Java, Oxford University Press 2010.

Reference Books:

1. Herbert Schildt: Java Complete References (McGraw Hill)
2. E. Balagurusamy: Programming with Java (McGraw Hill)
3. Khalid Mughal: A Programmer's Guide to Java Certification, 3rd Edition (Pearson)
4. Liang: A text Book of Java Programming, (PHI).

MOOC Links:

1. **Course name:** Core Java Specialization
Link: <https://www.coursera.org/specializations/core-java>
2. **Course name:** Object Oriented Programming in Java Specialization
Link: <https://www.coursera.org/specializations/object-oriented-programming>
3. **Course name:** Java Programming - Master Java Basics
Link: <https://www.udemy.com/course/java-programming-master-java-basics-learnit/>
4. **Course name:** Java Collection Framework
Link: <https://online.codingblocks.com/courses/java-collections-framework?>



Program:		B. Tech (Artificial Intelligence (AI) & Data Science)		Semester:		III
Course:		Object Oriented Programming – Lab		Code:		BTADPC05AD3P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50
Course Objectives: Students will be expected to create program from their understanding of Object Oriented programming using java.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO1	State the basics of object-oriented Programming and debug a simple program by using different arithmetic operators and decision making statements in java.					L1
CO2	Make the use of array and array of objects.					L3
CO3	Illustrate the concept of encapsulation, abstraction, inheritance, and Polymorphism.					L4
CO4	Identify the different exception handling mechanism by applying it in a java program.					L2
CO5	Develop Java program to implement data structures using Collection Framework.					L5
CO6	Create a program for multithreading and thread synchronization techniques					L5

General Guidelines:

1. Minimum 8 practicals are to be conducted covering entire syllabus.
2. The following list of practicals may be considered, but it is not limited to these.

Experiment List

- 1) Develop Java program using keywords, identifiers, operators, expressions.
- 2) Implementation of conditional, looping, and branching statements using Java Programming.
- 3) Implementation of encapsulation in Java Programming.
- 4) Perform Java program to demonstrate uses of constructors.
- 5) Demonstrate various types of inheritance using java programs.
- 6) Develop Java program to demonstrate polymorphism.
- 7) Demonstrate utilization of Packages in Java programs.
- 8) Develop Java program to demonstrate Exception Handling mechanism.
- 9) Demonstrate String handling mechanism in Java.
- 10) Develop Java program to implement data structures using Collection Framework.
- 11) Define JAVA. Write a program to print a message "Hello World. .."Using Scanner Class
- 12) Illustrate use of arithmetic operators in java.
- 13) Make a use of different control statements in java.
- 14) Develop a Program on various ways to accept data through keyboard.
- 15) Build a program for constructor in java.
- 16) Test for arrays of objects in java.
- 17) Classify different types of inheritance and test for super keyword
- 18) Compare method overloading and method overriding.
- 19) Interpret the Abstract Class in java
- 20) Create a program for Exception Handling Mechanism.



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:	III			
Course:	Introduction to Artificial Intelligence			Code:	BTADPC06AD3T			
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of foundation of Artificial Intelligence by being able to do each of the following:								
1. To present an overview of Artificial Intelligence (AI) principles and approaches.								
2. To understand the historical evolution of Artificial Intelligence.								
3. To learn various searching techniques and identify to address a particular problem.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level
CO-1	Explain concepts of Artificial Intelligence and different types of intelligent agents and their architecture.							L2
CO-2	Formulate problems as state space search problem & efficiently solve them							L3
CO-3	Summarize the various searching techniques, constraint satisfaction problem and example problems - game playing techniques.							L2
CO-4	Apply AI techniques in applications which involve perception, reasoning and learning.							L3
CO-5	Compare the importance of knowledge, types of knowledge, issues related to knowledge acquisition and representation.							L4

Unit I: Introduction to AI (6 Hrs.)

Introduction: What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Risks and Benefits of AI,
Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit II: Problem Solving Through AI (6 Hrs.)

Introduction, Representation the AI Problems, Production System, Algorithm of Problem Solving, Examples of AI Problems, Nature of AI Problems.

Unit III: Uninformed Search Strategies (6 Hrs.)

Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies: Breadth-First Search, Uniform-Cost Search, Depth First Search, Bidirectional Search.

Unit IV: Informed Search Strategies (6 Hrs.)

Basic Concept of Heuristic Search and Knowledge, Designing of Heuristic Function, Heuristic Search Strategies: Generate-And-Test, Best-First Search, Problem Reduction, Hill Climbing Algorithm, A* Algorithm, AO* Algorithm.

Unit V: Adversarial Search & Games (6 Hrs.)

Game Theory, Optimal Decisions in Games, Mini-Max Search, Alpha Beta Pruning, Additional Refinements, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms.



Unit VI: Introduction to Knowledge

(6 Hrs.)

Introduction, Types of Knowledge, Knowledge Representation, Knowledge Storage, Knowledge Acquisition, Knowledge Organization and Management, Basic Concepts of Knowledge Engineering.

Total: 36 Hrs

Textbooks:

1. Artificial Intelligence by Ela Kumar (Wiley Publication)
2. Artificial Intelligence: A Modern Approach by Stuart Russell & Peter Norvig (Pearson - 4th Ed.)

Reference Books:

1. Artificial Intelligence by Elaine Rich and Kevin Knight (Tata McGraw Hill - 3rd Ed.)
2. A First Course in Artificial Intelligence by Deepak Khemani (Tata McGraw Hill - 1st Ed.)
3. Artificial Intelligence and Expert Systems by Patterson (PHI)

MOOC Links:

1. <https://www.coursera.org/learn/introduction-to-ai#modules>
2. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3. https://onlinecourses.swayam2.ac.in/cec20_cs10/preview



Program:		B. Tech. (Artificial Intelligence (AI) & Data Science)		Semester:		III
Course:		Computer Skill Lab – I		Code:		BTADPC07AD3P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	2	30	20	50
Course Objectives: To introduce the fundamental concepts, techniques, and applications of Artificial Intelligence, enabling students to design intelligent agents, solve problems using search strategies, and understand knowledge representation and game theory.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO1	Explain the fundamentals, history, and scope of Artificial Intelligence.					L2
CO2	Represent AI problems and apply production systems to solve them.					L3
CO3	Implement uninformed search strategies like BFS, DFS, and UCS to solve real-world problems.					L3
CO4	Analyze and implement informed search strategies including A* and AO* algorithms.					L4
CO5	Evaluate adversarial search methods and game-playing strategies including Mini-Max and Alpha-Beta Pruning.					L5
CO6	Demonstrate understanding of knowledge representation, acquisition, and organization in AI systems.					L3

General Guidelines:

1. Minimum 8 practicals are to be conducted covering entire syllabus.
2. The following list of practicals may be considered, but it is not limited to these.

Experiment List

1. Create a presentation/report on real-world applications of AI.
2. Design a timeline of key milestones in the history of AI.
3. Simulate a simple intelligent agent (e.g., vacuum cleaner agent).
4. Represent an AI problem using state-space representation (e.g., 8-puzzle, water jug problem).
5. Implement a basic production rule system in Python.
6. Model a real-life scenario as an AI problem.
7. Implement Breadth-First Search (BFS) to solve a maze or 8-puzzle.
8. Solve a weighted graph problem using Uniform Cost Search.
9. Implement Depth-First Search (DFS) and compare with BFS.
10. Implement Bidirectional Search for shortest path problems.
11. Design heuristic functions for AI problem solving.
12. Implement A* algorithm for grid-based pathfinding.
13. Implement AO* algorithm for solving AND-OR graphs.
14. Apply Hill Climbing for mathematical function optimization.
15. Implement Mini-Max algorithm for a simple game (e.g., Tic-Tac-Toe).
16. Enhance Mini-Max with Alpha-Beta Pruning.
17. Simulate Monte Carlo Tree Search (MCTS) for a simple turn-based game.



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18. Represent knowledge using semantic networks or frames.
19. Develop a mini expert system using forward chaining.
20. Create a basic ontology using Protégé or any ontology editor.
21. Acquire domain-specific knowledge and represent it as rule sets or a knowledge base.



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Program:	B. Tech (Artificial Intelligence (AI) & Data Science)			Semester:		III		
Course:	Management Information Systems			Code:		BTADHM01AD3T		
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
2	-	2	2	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives: To summarize the key principles of Information and Information Security.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level
CO-1	Describe the role of MIS and its impact on management and digital organizations.							L2
CO-2	Analyze the structure of digital firms and differentiate key e-business components.							L4
CO-3	Classify types of information and evaluate their role in business intelligence.							L5
CO-4	Apply system concepts and design user-focused interfaces for real-time systems.							L3

Unit I: MIS in Digital Age

(6 Hrs.)

MIS in digital age, MIS Defined, Why MIS?, MIS coverage, MIS support to the Management, Evolving Business and MIS relationship, Changing role of MIS managers in the digital age, Constituents of MIS, Evolution of MIS development approaches - Two-Speed IT, Management effectiveness and MIS Organization as a system, MIS for a digital firm.

Unit II: E-business Enterprise: A digital firm

(6 Hrs.)

Introduction to E-business Enterprise: A digital firm, Organisation of Business in Digital Firm, Business, E-Commerce, E-Communication, E-Collaboration, Real Time Enterprise, What are the technology options for becoming a real time Enterprise?, Enterprise Social Platform (ESP), Customer Experience Management.

Unit III: Information, Knowledge, Business Intelligence

(6 Hrs.)

Information Concepts, Information: A quality Product, Classification of the Information, Methods of Data and Information Collection, Value of the Information, General Model of a Human as an Information Processor, Summary of Information Concepts and their Implications, Knowledge and Knowledge Management Systems, Business Intelligence, MIS and the Information and Knowledge.

Unit IV: Technology of Information System

(6 Hrs.)

Introduction, Data Processing, Transaction Processing, Application Processing, Information System Processing, TQM of Information System, Human Factors and User Interface, Real Time systems and Good Design, Case Tools and I-case.

Total: 24 Hrs

Textbooks:

1. "Management Information Systems: Text and Cases" by Waman S Jawadekar and Sanjiva Shankar Dubey, 6th Edition, McGraw Hill

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Academic Council Meeting
Dated:- 05/07/2025



Reference Books:

1. "Management Information Systems: Managerial Perspectives" by D P Goyal, MacMillan Publication, 4th Edition
2. "Management Information Systems: Managing the Digital Firm" by Kenneth C. Laudon and Jane P. Laudon, Pearson Publication, 17th edition, published in 2022
3. "Management Information Systems" by Ramesh Behl, 11th Edition, McGrawHill
4. "MIS: Managing Information Systems in Business, Government, and Society" by Hossein Bidgoli, Cengage
5. MIS: Managing Information Systems in Business, Government, and Society by Rahul De, 2nd Edition

MOOC Links:

1. NPTEL Course : Management Information System
https://onlinecourses.nptel.ac.in/noc24_mg96/preview
2. edX : Introduction to Management Information Systems (MIS): A Survival Guide
<https://www.edx.org/learn/information-systems/universidad-carlos-iii-de-madrid-introduction-to-management-information-systems-mis-a-survival-guide>
3. Coursera : Information Systems Specialization
<https://www.coursera.org/specializations/information-systems>



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:			IV	
Course:	Theory of Computation			Code:			BTADPC08AD4T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives:								
To understand different automata theory and its operation.								
To understand mathematical expressions for the formal languages.								
To study computing machines and comparing different types of computational models.								
To understand the fundamentals of problem decidability and Un-Decidability.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes						BT Level	
CO-1	Construct finite state machines (FSMs) to model and solve computational problems.						L3	
CO-2	Develop regular expressions for representing and recognizing formal languages.						L6	
CO-3	Apply well-defined parsing techniques for syntax analysis in compiler design						L3	
CO-4	Design and evaluate Pushdown Automata and Turing Machines for language recognition and problem solving.						L5	
CO-5	Demonstrate understanding of the Chomsky Hierarchy and its relevance to language classification.						L2	
CO-6	Analyze problems for decidability and undecidability in the context of computation theory.						L4	

Unit I: Finite State Machines

(6 Hrs)

Alphabet, String, Formal and Natural Language, Operations, Definition and Design DFA (Deterministic Finite Automata), NFA (Non Deterministic Finite Automata), Equivalence of NFA and DFA: Conversion of NFA into DFA, Conversion of NFA with epsilon moves to DFA, Minimization Of DFA, Definition and Construction of Moore and Mealy Machines, Inter-conversion between Moore and Mealy Machines. Minimization of Finite Automata. (Construction of Minimum Automaton)

Unit II: Regular Expression and Regular Grammar

(6 Hrs)

Definition and Identities of Regular Expressions, Construction of Regular Expression of the given Language, Construction of Language from the RE, Conversion of FA to RE using Arden's Theorem, Inter-conversion RE to FA, Pumping Lemma for RL, Closure properties of RLs(proofs not required), Regular grammar, Equivalence of RG (RLG and LLG) and FA.

Unit III: Context Free Grammar and Languages

(6 Hrs)

Introduction, Formal Definition of Grammar, Notations, Derivation Process: Leftmost Derivation, Rightmost Derivation, Derivation Trees, Construction of Context-Free Grammars and Languages, Pumping Lemma for CFL, Simplification of CFG, Normal Forms (CNF and GNF), Chomsky Hierarchy.



Unit IV: Pushdown Automata

(6 Hrs)

Introduction and Definition of PDA, Construction of PDA, Acceptance of CFL, Equivalence of CFL and PDA: Inter-conversion, Introduction of DCFL and DPDA, Enumeration of properties of CFL, Context Sensitive Language, Linear Bounded Automata.

Unit V: Turing Machines

(6 Hrs)

Formal definition of a Turing Machine, Design of TM, Computable Functions, Church's hypothesis, Counter machine, Variants of Turing Machines: Multi-tape Turing machines, Universal Turing Machine.

Unit VI: Decidability and Un-Decidability

(6 Hrs)

Decidability of Problems, Halting Problem of TM, Un-Decidability: Recursive enumerable language, Properties of recursive & non-recursive enumerable languages, Post Correspondence Problem, Introduction to Recursive Function Theory.

Total: 36 Hrs

Textbooks:

1. Hopcraft H.E. & Ullman J: Introduction to Automata Theory, Languages and Computation
2. Peter Linz: An Introduction to Formal Languages and Automata

Reference Books:

1. Rajesh K. Shukla: Theory of Computation, CENGAGE Learning, 2009.
2. K V N Sunitha and N Kalyani: Formal Languages and Automata Theory, McGraw Hill, 2010.
3. Lewis H.P. and Papadimitriou C.H.: Elements of Theory of Computation.
4. Mishra & Chandrashekharan: Theory of Computation.
5. C. K. Nagpal: Formal Languages and Automata Theory, Oxford University Press, 2011.
6. Vivek Kulkarni: Theory of Computation, OUP India, 2013.

MOOC Links:

1. <https://nptel.ac.in/courses/106/106/106106049/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-045j-automata-computability-and-complexity-spring-2011/>
3. <https://www.udemy.com/course/theory-of-computation-automata-theory/>



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)	Semester:	IV
Course:	Machine Learning	Code:	BTADPC09AD4T
Teaching Scheme			
Lecture	Tutorial	Hours	Credit
3	-	3	3

Evaluation Scheme				
TA	MSE-I	MSE-II	ESE	Total
10	15	15	60	100

Methods of Teacher Assessment (TA): Assignment/Quizzes, Attendance, Viva-VOCE

Course Objectives:

- To understand the fundamental concepts of machine learning
- To apply preprocessing techniques to enhance data quality for machine learning models.
- To develop the ability to select, train, and evaluate machine learning models
- To analyze various classification and regression algorithms and understand their working principles
- To Differentiate between supervised and unsupervised learning approaches and apply clustering and association rule
- To understand the fundamentals of neural networks

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Explain the fundamental concepts, types, applications, tools, and challenges of machine learning.	L2
CO-2	Apply data preprocessing techniques to improve data quality for machine learning models.	L3
CO-3	Analyze different machine learning models, evaluate their performance, and optimize them using feature engineering.	L4
CO-4	Implement classification and regression algorithms to solve supervised learning problems.	L3
CO-5	Differentiate between supervised and unsupervised learning and apply clustering and association rule techniques for pattern discovery.	L4
CO-6	Describe the fundamentals of neural networks, including artificial neurons, activation functions, and architectures.	L2

Unit I: Introduction to Machine Learning

(6 Hrs)

Human Learning, Definition Machine Learning, Types of Machine Learning, Applications of Machine Learning, Tools in Machine Learning, Issues in Machine Learning

Unit II: Preparing Machine Learning Model

(6 Hrs)

Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing

Unit III: Modelling and Evaluation

(6 Hrs)

Introduction, Selecting a Model, Training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model, Introduction of Feature Engineering, Feature Transformation.



Unit IV: Supervised Learning

(6 Hrs)

Classification: Classification Model, Classification Learning Steps, Classification Algorithms: k-Nearest Neighbour (kNN), Decision tree, Random Forest model.

Regression: Introduction of Regression Algorithms, Regression Algorithms: Simple linear regression, Multiple linear regression, Logistic Regression, PCA

Unit V: Unsupervised Learning

(6 Hrs)

Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering, Finding Pattern using Association Rule

Unit VI: Basics of Neural Network

(6 Hrs)

Introduction, Understanding the Biological Neuron, Exploring the Artificial Neuron, Types of Activation Functions, Architectures of Neural Network

Total: 36 Hrs

Textbooks:

1. Saikat Dutt, Subramaniam Chandramauli - Machine Learning , Pearson Publication.

Reference Books:

1. Chris Albon –Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning
2. Andreas C. Müller & Sarah Guido –Introduction to Machine Learning with Python: A Guide for DataScientists.
3. Sebastian Raschka, and Vahid Mirjalili –Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and Tensor Flow.

MOOC Links:

1. <https://nptel.ac.in/courses/106/106/106106202/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-036-introduction-to-machine-learning-fall-2020/>



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)				Semester:		IV	
Course:	Discrete Mathematics				Code:		BTADPC10AD4T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
2	-	2	2	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives: To understand the basic concepts of discrete structure.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level
CO-1	Analyze and express logic sentence in terms of predicates, quantifiers, and logical connectives.							L4
CO-2	Determine the solution for a given problem using set theory.							L5
CO-3	Classify algebraic structure for a given mathematical problem.							L2
CO-4	List Boolean algebra operations on Boolean variables using expansion methods.							L1
CO-5	Perform operation on trees data structures.							L3
CO-6	Develop the given problem as graph networks and solve with techniques of graph theory.							L6

Unit I: The Foundations: Logic and Proofs

(6 Hrs.)

Propositions, Truth Tables, Compound Propositions, Logical Operators, Logic and Bit Operations; Logical Equivalences, DeMorgan's Laws, Satisfiability: Applications and Solving Problems; Predicates, Quantifiers, Precedence, Logical Equivalences; Rules of Inference for Propositional Logic, Use to Build Arguments.

Unit II: Sets, Functions and Relation

(6 Hrs.)

Introduction, Venn Diagrams, Subsets, Size of a Set, Power Sets, Cartesian Products, Set Notation with Quantifiers, Truth Sets and Quantifiers, Set Operations, Functions, Inverse Functions, Compositions and Graphs of Functions; Countable Sets, An Uncountable Set; Functions as Relations, Relations on a Set, Properties of Relations, Combining Relations; Representing Relations Using Matrices; Representing Relations, Closures of Relations, Equivalence Relations.

Unit III: Algebraic Structures

(6 Hrs.)

Algebraic Systems: Examples and General Properties; Semigroups and Monoids: Homomorphism of Semigroups and Monoids, Groups: Definitions, Subgroups and Homomorphisms, Cosets and Lagrange's Theorem, Normal Subgroups, algebraic Systems with Two Binary Operations; Group Codes: The Communication Model and Basic Notions of Error Correction, Hamming Distance.

Unit IV: Boolean Algebra

(6 Hrs.)

Boolean Algebra: Boolean Functions, Representing Boolean Functions, sum of product expansions, Product of sum, Logic Gates, Combinations of Gate, Minimization of Circuits, Karnaugh Maps.

Total: 24 Hrs



Textbooks:

1. Kenneth H. Rosin: Discrete Mathematics and Its Applications, 7th Edition, McGraw-Hill.
2. T.Veerarajan : Discrete Mathematics ,McGraw-Hill.
3. G.Shanker Rao: Discrete Mathematical Structures,New age International Publishers ,2nd Edition

Reference Books:

1. Norman L. Biggs: Discrete Mathematics, 2nd Edition, Oxford University Press.
2. Seymour Lipschutz and Marc Lars Lipson: Schaum's Outline of Theory and Problems of Discrete Mathematics, 3rd Edition, Schaum's Outlines Series, McGraw-Hill.
3. C. L. Liu and D. P. Mohapatra: Elements of Discrete Mathematics: A Computer Oriented Approach, 3rd Edition, Tata McGraw-Hill, Mc-Graw Hill.

MOOC Links:

1. https://onlinecourses.swayam2.ac.in/cec24_ma18/preview.
2. https://onlinecourses.nptel.ac.in/noc25_cs27/preview.



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)			Semester:	IV			
Course:	Operating Systems			Code:	BTADPC11AD4T			
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives: To provide students with a comprehensive understanding of the fundamental concepts and working of operating systems.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level
CO-1	Gain insight into the fundamental concepts and evolution of operating systems.							L1
CO-2	Analyse and compare various process scheduling algorithms.							L4
CO-3	Develop solutions for process synchronization and deadlock management							L6
CO-4	Implement memory management techniques and virtual memory concepts.							L3
CO-5	Explore file system architectures and manage file operations							L3
CO-6	Analyse storage management and disk scheduling techniques.							L4

Unit I: Introduction to Operating System

(6 Hrs)

Introduction: Operating System definition, Operating System Evolution, Components and Services, Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Interprocess Communication, Threads Overview, Multithreading Models, Threading Issues, Java Threads

Unit II: Process Scheduling

(6 Hrs)

Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR, Priority, Multilevel Queue, Multilevel Feedback Queue Scheduling

Unit III: Process Synchronization

(6 Hrs)

Process Synchronization Basics: The Critical-Section Problem, Synchronization Hardware, Semaphores, Monitors, Deadlocks: Definition & Characterization, Deadlocks Prevention, Avoidance, Detection and Recovery from Deadlock

Unit IV: Memory Management

(6 Hrs)

Memory Management Background, Swapping, Contiguous Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Management: Background, Demand paging scheme, Process Creation, Page Replacement Policies, Allocation of Frames, Thrashing

Unit V: File System

(6 Hrs)

File-System Interface; Directory Structure, File-System Mounting, File Sharing & Protection, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management. File Recovery



Unit VI: Storage management

(6 Hrs)

Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, System Protection: Goals, Principles, Domain of Protection, Access Matrix, Access Control

Total: 36 Hrs

Textbooks:

1. Avi Silberschatz, P. B. Galvin, G. Gagne: "Operating System Concepts" (10/e) John-Wiley & Sons.

Reference Books:

1. A.S. Tanenbaum "Modern Operating Systems" Pearson Education.
2. William Stallings "Operating Systems" Prentice-Hall.
3. D. M. Dhamdhare "Operating Systems" Tata McGraw-Hill.
4. P. Balkrishna Prasad: "Operating Systems" Scitech Publications (I) Pvt

MOOC Links:

1. <https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs44/>
2. <https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs88/>
3. <https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs72/>



Program:		B. Tech. (Artificial Intelligence (AI) & Data Science)		Semester:		IV
Course:		Operating System Lab		Code:		BTADPC12AD4P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives: To provide foundational knowledge of OS structure, functions, scheduling algorithms, and memory management.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO1	Illustrate memory management issues like external fragmentation, internal fragmentation.					L2
CO2	Illustrate multithreading and its significance.					L2
CO3	List various protection and security mechanisms of OS.					L1
CO4	Analyze and solve the scheduling algorithms.					L4
CO5	Analyze the deadlock situation and resolve it.					L5
CO6	Compare various types of operating systems.					L4

General Guidelines: Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

- 1) To study...
 - a. UNIX
 - b. Difference between LINUX and UNIX
 - c. UNIX system organization
 - d. Types of shell
- 2) Study of Unix Shell and Environment Variables
- 3) To study and execute basic commands related to open-source Ubuntu OS.
- 4) Write a program for parent creating child process by using fork system call.
- 5) To simulate First Come First Serve process scheduling algorithm
- 6) To simulate Shortest Job First process scheduling algorithm
- 7) To implement Priority Based Process Scheduling Algorithm
- 8) To simulate producer-consumer problem using semaphores
- 9) To implement following memory management techniques: FIRST Fit
- 10) To implement following memory management techniques: Best Fit
- 11) Simulate File Mounting and Unmounting



- 12) To simulate the Single level directory file organization technique
- 13) To implement FCFS Disk Scheduling algorithm
- 14) To implement SCAN Disk Scheduling algorithm
- 15) To implement LOOK Disk Scheduling algorithm



Program:		B.Tech (Artificial Intelligence (AI) & Data Science)		Semester:		IV
Course:		Computer Skill Lab – II		Code:		BTADPC13AD4P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives: To introduce the fundamental concepts of Machine Learning, including data preprocessing, model evaluation, supervised and unsupervised learning, basics of neural networks, and practical implementation using standard tools and libraries.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO1	Describe the scope, applications, and challenges in Machine Learning.					L1
CO2	Apply data preprocessing techniques and evaluate ML models.					L3
CO3	Implement classification and regression models using standard libraries.					L3
CO4	Apply unsupervised learning techniques for clustering and association rules.					L3
CO5	Understand basic structure and functionality of artificial neural networks.					L2
CO6	Analyze the performance of machine learning models and suggest improvements.					L4

General Guidelines: Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

1. Install and set up Python and relevant ML libraries such as NumPy, Pandas, Scikit-learn, Matplotlib, and Seaborn.
2. Demonstrate types of data including categorical, numerical, and ordinal types.
3. Explore data using statistical methods such as mean, median, mode, and correlation.
4. Perform data cleaning by handling missing values, duplicate data, and outliers.
5. Apply data preprocessing techniques such as normalization, standardization, and encoding.
6. Implement a k-Nearest Neighbors (kNN) classifier on sample data.
7. Build and evaluate a Decision Tree classifier.
8. Train a Random Forest model and analyze its performance.
9. Apply Simple and Multiple Linear Regression techniques on real-world datasets.
10. Use Logistic Regression for binary classification tasks.
11. Evaluate machine learning models using accuracy, precision, recall, F1 score, and ROC curve.
12. Perform K-Means Clustering and visualize the resulting clusters.
13. Implement Association Rule Mining using the Apriori Algorithm.
14. Build a basic Artificial Neural Network using appropriate ML libraries.
15. Compare various activation functions such as Sigmoid, ReLU, and Tanh in a simple neural network.



Program:	B. Tech. (Artificial Intelligence (AI) & Data Science)				Semester:		IV	
Course:	Big Data Analytics				Code:		BTADVS04AD4P	
Teaching Scheme				Evaluation Scheme				
Practical	Tutorial	Hours	Credit	INT	EXT	Total	Practical	Tutorial
2	-	2	1	30	20	50	2	-
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives: To equip students with the knowledge of fundamental concepts, tools, and analytical techniques in Big Data, enabling them to explore large-scale data integration, processing, and research applications.								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes						BT Level	
CO-1	Describe the fundamental concepts of Big Data and its analytics lifecycle.						L2	
CO-2	Apply Big Data tools and frameworks like Hadoop and Spark for data storage and processing.						L3	
CO-3	Analyze data using clustering and classification algorithms.						L4	
CO-4	Evaluate the performance of predictive models and recommendation systems on large datasets.						L5	
CO-5	Develop real-time data analytics solutions using tools like Spark Streaming.						L6	
CO-6	Demonstrate understanding and usage of NoSQL databases for Big Data management.						L2	

General Guidelines: Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

1. Installation and setup of Hadoop and HDFS.
2. Word Count program using MapReduce.
3. Basic operations on HDFS (create, copy, delete files).
4. Data preprocessing and cleaning using PySpark.
5. Exploratory Data Analysis (EDA) using Spark DataFrames.
6. Hypothesis testing and statistical evaluation using Python.
7. Linear Regression model implementation using Spark MLlib.
8. Logistic Regression classification using Spark MLlib.
9. Naïve Bayes classifier for text classification.
10. K-means clustering implementation using Spark MLlib.
11. Apriori algorithm for association rule mining.
12. Working with Hive: creating tables and running SQL queries.
13. NoSQL database operations using HBase.
14. Real-time data processing using Spark Streaming.
15. Recommender system implementation using Apache Mahout.



Program:	B. Tech. (AI &DS)			Semester:	IV			
Course:	Entrepreneurship Development			Code:	BTADHN02AD4T			
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE I	MSE II	ESE	Total
2	-	2	2	10	15	15	60	100
Methods of Teacher Assessment (TA): Assignment/Quizzes, Attendance, Viva-Voce								
Course Objectives:								
• To create awareness about entrepreneurship • To simulate the potential to develop entrepreneurial orientation through innovation and creativity • To understand relationship between business, market, and society • To understand the role of management in creating and maintaining business								
Course Outcomes: After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level (L1 to L6)
CO-1	Gain awareness about entrepreneurship.							L1
CO-2	Simulate the potential to develop entrepreneurial orientation through innovation and creativity.							L3
CO-3	Understand the relationship between business, market, and society.							L2
CO-4	Understand the role of management in creating and maintaining business.							L2

Unit I: Entrepreneurship

(6 Hrs)

Concept, value creation, entrepreneurial mindset-innovation and creativity, entrepreneurial decision making-use of biases and heuristics, risk bearing, social and commercial entrepreneurship.

Unit II: Business

(6 Hrs)

Concept, types, facilitators and inhibitors of business, role of e-commerce and m-commerce, technological innovation and its viability, ethical considerations.

Unit III: Market and Society

(6 Hrs)

Generation and utilization of resources, concept of market, exploring and segmenting the market, demand and supply factors, understanding customer adoption process.

Unit IV: Management

(6 Hrs)

Concept, function and culture of management, innovation and technology, role of incentives and managing human resource

Total: 24 Hrs

Textbooks:

- Business, Entrepreneurship and Management: Rao, V.S.P.; Vikas Publishing House Pvt. Ltd.
- Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row

Reference Books:

- Entrepreneurship: Roy Rajeev; OUP.
- Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan Publication



MOOCs Links and additional reading, learning, video material:

1. <https://www.coursera.org/specializations/innovationfia>