Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts (AUTONOMOUS), Thane (W)

S.Y.B.Sc. (AI & ML) 2026-27

	Semester III	Credits		Semester IV	Credits
Major			**Major**		
BAID301	Data Mining	2	BAIB401	Big Data Analytics	2
BAIDP302	Data Mining Practical	2	BAIBP402	Big Data Analytics Practical	2
BAIF303	Fundamentals of Artificial Intelligence	2	BAIM403	Machine Learning	2
BAIFP304	Fundamentals of Artificial Intelligence Practical	2	BAIMP404	Machine Learning Practical	2
Minor			**Minor**		
BAIP305	Data Structure & Algorithm using Python	2	BAID405	Data Analysis &Visualization	2
BAIPP306	Data Structure & Algorithm using Python Practical	2	BAIDP406	Data Analysis &Visualization Practical	2
OE			**OE**		
BAIR307	Research Methodology	2	BAIF407	Fuzzy Logic	2
BAIL308	Linear Algebra	2	BAIT408	Testing of Hypothesis	2
BAIE309	Fundamentals Of Digital Electronics	2	BAIE409	Econometrics	2
VSC BAIRP310	R Programming	2	**SEC** BAIW410	Web Development	2
AEC BAIH311/ BAIM311	Hindi/Marathi	2	**AEC** BAIH411/ BAIM411	Hindi/ Marathi	2
FP BAIFP312	FP	2	**CEP** BAICE412	CEP	2
CC BAIN313/ BAIY313	NSS/ Sports/ Cultural/ Yoga	2	**CC** BAIN413/ BAIY413	NSS/ Sports/ Cultural/ Yoga	2
	Total	**22**			**22**

Dr. Yogeshwari Patil
Department Coordinator

Prof. Heena Chande
NEP Coordinator

Dr. Dilip Patil
Principal

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Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: **B.Sc(AI & ML)**	**Semester:III**
Course Category: Major	
Name of the Dept: Science & Technology	
Course Title: Data Mining	
Course Code: BAID301	Course Level:4.5
Type : Theory	
Course Credit: 02	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives : 1. To understand data warehouse with architectural types, architectural building blocks, aggregate tables and data mining classification. 2. To learn basics of unsupervised learning clustering & association rule use of various data mining algorithms	
Course Outcomes : After the completion of the course, the learners would be able to: **CO1:** demonstrate knowledge of data warehouse with clear understanding of architectural types & Data manning techniques for classification. **CO2:** gain knowledge of using various Data Mining techniques for unsupervised learning clustering & association rule for analyzing the datasets using tools like Weka , R or Python	
Description of the course:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	**DATA WAREHOUSE:** The Building Blocks: Defining Features, Data Warehouses and Data Marts, Architectural Types, Overview of The Components, Metadata in The Data Warehouse **DIMENSION MODELLING:** The Star Schema, keys, The Snowflake Schema, Aggregate Fact Tables **INTRODUCTION TO DATA MINING:** Introduction, Data Mining Applications, Data Mining Process, Data Mining Techniques **BEGINNING WITH WEKA AND IRIS DATASET IN R:** Understanding Fisher's Iris Flower Dataset **CLASSIFICATION:** Introduction to Classification, Types of Classification, Input and Output, , Introduction to the Decision Tree Classifier, Naive Bayes Method, Understanding Metrics to Assess the Quality of Classifiers	15
II	**CLUSTER ANALYSIS:** Introduction to Cluster Analysis, Applications of Cluster Analysis, Partitioning Clustering, Hierarchical Clustering, Introduction to Modern Search Engines, Working of a Search Engine, PageRank Algorithm, Precision and Recall **INTRODUCTION TO ASSOCIATION RULE MINING:** : Defining Association Rule Mining, Representations of Items for Association Mining **THE APRIORI ALGORITHM:** The Apriori–TID Algorithm for Generating Association Mining Rules Direct Hashing and Pruning (DHP), Dynamic Itemset Counting (DIC), Mining Frequent Patterns without Candidate Generation (FP Growth)	15
	Total Hours	**30**

References:

1. "DATA WAREHOUSING FUNDAMENTALS FOR IT PROFESSIONALS " by PAULRAJ PONNIAH of "Wiley Second edition 2010"

2. "Data Mining and Data Warehousing : Principles and Practical Techniques" by Parteek Bhatia Cambridge University Press First 2019

4. "Data Mining and Data Warehousing" by S.K. Mourya Shalu Gupta published "Alpha Science International Ltd First edition 2013"

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Programme Name: **B.Sc(AI & ML)**	**Semester:III**
Course Category: Major	
Name of the Dept: Science & Technology	
Course Title: Data Mining Practical	
Course Code: BAIDP302	Course Level:4.5
Type: Practical	
Course Credit: 02	
Hours Allotted: 60 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand data warehouse with architectural types, architectural building blocks, aggregate tables and data mining classification. 2. To learn basics of unsupervised learning clustering & association rule use of various data mining algorithms	
Course Outcomes: After the completion of the course, the learners would be able to: **CO1**: demonstrate knowledge of data warehouse with clear understanding of architectural types & Data manning techniques for classification. **CO2**: gain knowledge of using various Data Mining techniques for unsupervised learning clustering & association rule for analyzing the datasets using tools like Weka or R	
Description of the course:	This course introduces the fundamentals of **data warehousing and data mining**. It covers data warehouse architecture, key components, and aggregate tables, along with classification techniques. The course also focuses on **unsupervised learning methods** such as clustering and association rule mining. Students gain hands-on experience using tools like **Weka and R** to analyze datasets and support data-driven decision-making.

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content (List of Practicals)	Hours
1	**Performing classification on data sets using Weka.**	
a	Building a Decision Tree Classifier in Weka	
b	Applying Naïve Bayes on Dataset for classification	
2	**Performing classification on data sets using R.**	
a	Decision Tree Operation with R	
b	Naïve Bayes Operation using R	
3	**Implementing Apriori Algorithm with R and Weka**	
a	Applying the Apriori Algorithm in Weka on a Real-World Dataset	
b	Applying the Apriori Algorithm on a Numeric Dataset	
4	**Implementing Clustering with Weka.**	
a	Clustering Fisher ‘s Iris Dataset with the Simple k-Means Algorithm	
b	Results Analysis after Applying Clustering	
5	**Implementing Clustering with R.**	
a	Clustering in R using Simple k-Means	
b	Clustering in R using Simple k-Means on numeric dataset.	
6	**Implementing Association Mining with R.**	
a	Applying Association Mining in R	
b	Application of Association Mining on Numeric Data in R	
7	**Implementing Association Mining with Weka.**	
A	Perform Association technique on Agriculture dataset.	
b	Perform Association technique on Weather dataset.	
8	**Web Mining**	
a	Implement Hyperlink Induced Topic Search (HITS) algorithm	
b	Implement PageRank Algorithm	
	Total Hours	**60**

References:

1. “DATA WAREHOUSING FUNDAMENTALS FOR IT PROFESSIONALS “ by PAULRAJ PONNIAH of “Wiley Second edition 2010”

2. “Data Mining and Data Warehousing : Principles and Practical Techniques” by Parteek Bhatia Cambridge University Press First 2019

3. “Data Mining and Data Warehousing” by S.K. Mourya Shalu Gupta published "Alpha Science International Ltd First edition 2013"

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Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: **B.Sc. (AI and ML)**	**Semester: III**
Course Category: Major	
Name of the Dept.: Science & technology	
Course Title: Fundamentals of Artificial Intelligence	
Course Code: BAIF303	Course Level:4.5
Course Credit: 2	
Hours Allotted: 30 Hours	Total Marks: 50 Marks
Course Objectives: 1. Comprehensive understanding of intelligent systems, AI problem-solving techniques, search algorithms, and the development of intelligent agents using various search methods and reasoning strategies. 2. To explore uncertainty reasoning, probabilistic models like Bayesian networks, and machine learning techniques, including supervised learning, decision trees, neural networks, and deep learning for solving real-world problems	
Course Outcomes: After the completion of the course, the learners would be able to: CO1: design and implement intelligent agents, apply various search techniques, and formulate AI problems effectively to solve complex challenges using both uninformed and informed search strategies. CO2: effectively apply uncertainty reasoning and advanced machine learning techniques, including probabilistic models, decision trees, neural networks, and deep learning, to solve complex real-world problems.	
Description of the course:	This course introduces the fundamentals of Artificial Intelligence (AI), focusing on intelligent agents, problem-solving techniques, and search algorithms. It covers uninformed and informed search methods, uncertainty reasoning using Bayesian networks, and key machine learning concepts like decision trees, neural networks, and support vector machines. Students will learn to apply these techniques in real-world AI applications. The course emphasizes both theoretical understanding and practical implementation.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	**Intelligent Systems and Intelligent Agents**: Introduction to AI, AI Problems and AI techniques, Solving problems by searching, Problem Formulation. State Space Representation Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. **Searching Techniques**: Uninformed Search: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. Informed Search: Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A*	15
II	**Uncertainty and Reasoning**: Uncertainly, Representing Knowledge in an Uncertain Domain, Bayesian Network, Conditional Probability, Joint Probability, Bayes‘ theorem, Belief Networks **Machine Learning:** Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Support Vector Machines, Introduction to deep learning.	15
	Total Hours	**30**

References:

Sr. No	Title	Author	Publisher	Edition	Year
1.	Artificial Intelligence: A Modern Approach	Stuart J. Russell and Peter Norvig	Pearson	Fourth Edition	2020
2.	Artificial Intelligence: Foundations of Computational Agents	David L Poole, Alan K. Mackworth	Cambridge University Press	Second Edition	

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Programme Name: **B.Sc (AI and ML)**	**Semester: III**
Course Category: Major	
Name of the Dept: Science and Technology	
Course Title: Fundamentals of Artificial Intelligence Practical	
Course Code: BAIFP304	Course Level: 4.5
Course Credit: 02	
Total Hours: 60 Hours	
Total Marks: 50 Marks	

Course Objectives:

1. To teach students how to implement search algorithms and AI techniques to solve problems like the Water Jug Problem, N-Queen, and machine learning tasks such as decision trees and classification.
2. To provide practical experience in applying AI algorithms and creating PL/SQL triggers and packages for efficient problem-solving and database management.

Course Outcomes:

After the completion of the course, the learners would be able to:

CO1: implement various search algorithms and AI techniques to solve complex problems and optimize solutions in real-world scenarios.

CO2: gain practical skills in machine learning, decision trees, and PL/SQL, enabling them to build intelligent systems and manage databases effectively.

Description of the Course:	This course focuses on advanced AI techniques and algorithms, emphasizing search strategies, problem-solving, and decision-making. Students will learn and implement both uninformed and informed search algorithms like DFS, BFS, Hill Climbing, and A*. The course also covers machine learning techniques, including linear regression, classification, and decision trees, along with game theory concepts like Alpha-Beta pruning. Practical applications include solving classic AI problems like the N-Queens, map coloring, and the water jug problem. By the end, students will be equipped with the tools to apply AI in real-world scenarios and optimization problems.

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Sr No.	Content(List of Practicals)	Hours
1	**Generate the state-space possibilities for the following problems** a. Water jug problem b. Number puzzle	
2	**Write the program to compute the following Uninformed Search Algorithms for suitable problem** a. Depth First Search b. Breadth First Search	
3	**Write the program to compute the following Informed Search Algorithms for suitable problem** **a.** Hill Climbing b. Simulated Annealing **c.** A* algorithm	
4	**Write the program to compute the following Algorithms for suitable problem** a. Simulate solution for 4-Queen / N-Queen problem **b.** Constraint satisfaction problem: Map Coloring	
5	**Write the program to compute the following Search Algorithms for suitable problem** a. Alpha Beta Pruning **b.** Water jug problem	
6	**Write the program to compute the following Algorithms for suitable problem** **a.** Simple Inferencing	
7	**Write the program to compute the following Algorithms for suitable problem** a. Linear Regression **b.** Classification problem	
8	**Write the program to implement decision tree for suitable problem.** a. Two Class decision **b.** Multi Class decision	
	Total Hours	**60**

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Syllabus: NEP 2020 w.e.f 2026-27

<table>
<tr><td colspan="2">Programme Name: B.Sc (AI and ML) SEMESTER III</td></tr>
<tr><td colspan="2">Course Category: Minor</td></tr>
<tr><td colspan="2">Name of the dept.: Science and Technology</td></tr>
<tr><td colspan="2">Course Title: Data Structure and Algorithm Using Python</td></tr>
<tr><td>Course Code: BAIP305</td><td>Course Level:4.5</td></tr>
<tr><td colspan="2">Type: Theory</td></tr>
<tr><td colspan="2">Course Credit: 02</td></tr>
<tr><td colspan="2">Hours Allotted: 30 Hours</td></tr>
<tr><td colspan="2">Marks Allotted: 50 Marks</td></tr>
<tr><td colspan="2">Course Objectives:
1. To learn the significant Python implementation of popular data structures.
2. To learn about various data structure algorithms and design paradigms.</td></tr>
<tr><td colspan="2">Course Outcomes:
After the completion of the course, the learners would be able to:
CO1: choose appropriate data structure in Python for specified Problems and algorithms.
CO2: implement Linked list, Stack, Queue, Tree data structure and various sorting algorithms.</td></tr>
<tr><td>Description of the course:</td><td>Data Structures and Algorithms using Python covers the fundamental concepts of organizing and manipulating data efficiently. This subject explores various data structures like linked lists, stacks, queues, trees, along with essential algorithms for searching, sorting, and optimization. By applying these concepts in Python, students learn to design and analyze solutions to real-world computational problems with an emphasis on performance and scalability.</td></tr>
</table>

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	**Python Objects & Object-Oriented Programming:** Classes and object programming, Class Definitions, Inheritance, Data encapsulation and properties, Namespaces and Object-Orientation. **Principles of Algorithm Design:** An introduction to algorithms, Algorithm design paradigms Recursion and backtracking, Backtracking, Divide and conquer - long multiplication The recursive approach Runtime analysis Asymptotic analysis Big O notation, Composing complexity classes Omega notation, Theta notation, Amortized analysis. **Lists and Pointer Structures**: Arrays-Pointer structures **Singly linked lists**-Singly linked list class, The append operation, A faster append operation, Getting the size of the list, Improving list traversal, Deleting nodes, List search, Clearing a list **Doubly and circular linked lists**-A doubly linked list node Doubly linked list class, creating a circular list.	15
II	**Stacks**: Stack implementation, Push operation, Pop operation, Peek operation, Bracket-matching application. **Queues**: List-based queues, Stack-based queues Node-based queues, Application of queues Media player queues **Trees**: Terminology, Tree nodes, **Tree traversal**, Depth-first traversal-In-order traversal and infix notation, Pre-order traversal and prefix notation, Post-order traversal and postfix notation, Breadth-first traversal. **Binary trees**-Binary search trees, Binary search tree Implementation, Binary search tree operations, Finding the minimum and maximum nodes Inserting nodes Deleting nodes. **Sorting:** Sorting algorithms- Bubble sort algorithms, Insertion sort algorithms, Selection sort algorithms, Quick sort algorithms	15
	Total Hours	**30**

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Programme Name: **B.Sc (AI and ML)**	**Semester: III**
Course Category: Minor	
Name of the Dept.: Science and Technology	
Course Title: Data Structure and Algorithm Using Python Practical	
Course Code: BAIPP306	Course Level: 4.5
Type: Practical	
Course Credit: 2 credits	
Hours Allotted: 60 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To provide students with hands-on experience in implementing and applying various data structures and algorithms. 2. students will gain proficiency in designing efficient solutions for real-world computational problems, understanding time and space complexities, and optimizing code performance.	
Course Outcomes: After the completion of the course, the learners would be able to: **CO 1**. implement and manipulate various data structures (linked lists, stacks, queues using Python. **CO2**. apply different algorithms for searching, sorting, and tree traversal to solve practical problems.	
Description of the course:	Data Structure and Algorithm using Python practica course offers students the opportunity to implement and experiment with various data structures and algorithms in Python. Through hands-on coding exercises, students wil strengthen their understanding of key concepts such as searching, sorting, and optimizing algorithms while developing problem-solving skills in real-world scenarios.

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content(List of Practicals)	Hours
1	Write Python Program to demonstrate OOP Concepts including Class, Objects, Inheritance and encapsulation.	
2	a. Write Python Program to create singly linked list and various operations on it. b. Write Python Program to create doubly linked list. c. Write Python Program to create circular linked list.	
3	Write Python Program to implement stack and demonstrate push, pop and peek operations.	
4	a. Write Python Program to implement list based queues and demonstrate various operations on it. b. Write Python Program to implement stack based queues and demonstrate various operations on it.	
5	Write Python Program to implement Node based queues and demonstrate various operations on it.	
6	a. Write Python Program to implement tree data structure and demonstrate depth first traversal. b. Write Python Program to implement tree data structure and demonstrate breadth first traversal.	
7	a. Write Python Program to implement binary search tree to find the minimum node. b. Write Python Program to implement binary search tree to find the maximum node.	
8	a. Write a Python implementation to demonstrate the insert and delete method to add/delete the nodes in the BST. b. Python implementation to search the node in the BST.	
9	a. Write a Python Program for implementing Insertion Sort. b. Write a Python Program for implementing Bubble Sort. c. Write a Python Program for implementing Quick Sort. d. Write a Python Program for implementing Selection Sort.	
	Total hours	**30**

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Programme Name: **B.Sc (AI and ML)**	**Semester: III**
Course Category/Vertical: Open Elective	
Name of the Dept: Science and Technology	
Course Title: Research Methodology	
Course Code: BAIR307	Course Level: 4.5
Type: Theory	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To impart analytical skill in solving complex problems and to foster the ability to critically think in developing robust, extensible and highly maintainable solutions to simple and complex problems. 2. To explore the unknown and unlock new possibilities in different dimensions of the System and to portray accurately the characteristics of a particular individual, situation or a group under study.	
Course Outcomes: After the completion of the course, the learners would be able to: **CO1:**understands the reasons for doing research, the applications of research, characteristics and requirements of the research process, types of research and Research paradigms and also applying major approaches to information gathering, the relationship between attitudinal and measurement scales Methods for exploring attitudes in research. **CO2**: analyze data in qualitative and quantitative studies, write a research report and use application of AI and ML in data analysis & Research	
Description of the course:	Research methodology is a systematic framework that outlines the techniques and procedures used to conduct research, ensuring the study remains objective and unbiased, and allows readers to evaluate the validity and reliability of the research.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	**Research Methodology-An Introduction:** Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs. **Sampling Design:** Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? Random Sample from an Infinite Universe, Complex Random Sampling Designs **Methods of Data Collection:** Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method,	15
II	**Processing and Analysis of Data:** Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes, Other Measures, Summary Chart Concerning Analysis of Data **Sampling Fundamentals:** Need for Sampling, Some Fundamental Definitions, Important Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's *A*-test, Concept of Standard Error, Estimation, Estimating the Population Mean (m), Estimating Population Proportion, Sample Size and its Determination, Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level, Determination of Sample Size through the Approach, Based on Bayesian Statistics **Interpretation of Data and Paper Writing** – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? UGC-CARE, Web of Science, SCOPUS, IEEE, ACM, Ethical issues related to publishing, Copyright, Data Privacy, Plagiarism and Self-Plagiarism, Software for detection of Plagiarism. ShodhShudhhi (PDS), smallseotools.com	15
	Total Hours	**30**

Books and References:

Sr. No	Title	Author/s	Publisher	Edition
1.	Research Methodology – Methods and techniques	C. R. Kothari	New Age International (P) Ltd., Publishers	---
2.	Business Research Methods	Donald R. Cooper Pamela Schindler	McGraw- Hill/Irwin	McGraw - Hill/Irwin
3.	Business Research Methods	Allan Bryman Emma Bell	OXFORD University Press	---
4.	Research Methods for Business Students	Mark Saunders Philip Lewis Adrian Thornhill	Pearson Education Limited	---

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Programme Name: **S.Y.BSc (AI & ML)**	**Semester: III**
Course Category/Vertical: OE	
Name of the Dept: Artificial Intelligence and Machine Learning	
Course Title: Linear Algebra	
Course Code: BAIL308	Course Level:4.5
Type: Theory	
Course Credit: 2	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	

Course Objectives:

1. To develop a strong foundation in matrices, Gaussian elimination, vector spaces, linear transformations, and orthogonality, enabling students to understand and apply linear algebra techniques for solving systems of linear equations and representing data in high-dimensional spaces used in Artificial Intelligence and Machine Learning.
2. To equip students with knowledge of determinants, eigenvalues, eigenvectors, and matrix decompositions, enabling them to apply these concepts in machine learning algorithms, dimensionality reduction techniques, and optimization problems used in AI systems.

Course Outcomes:

After the completion of the course, the learners would be able to:

CO1. perform matrix operations, solve systems of linear equations using Gaussian elimination, analyze vector spaces, and apply orthogonality and projection techniques for solving problems related to data representation and analysis in AI and ML.

CO2.analyze matrix properties, compute eigenvalues, eigenvectors, and singular value decomposition (SVD), and apply these techniques in machine learning models, neural networks, data compression, and optimization algorithms used in artificial intelligence.

Description of the course:	This course provides a strong foundation in linear algebra with a focus on applications in Artificial Intelligence and Machine Learning. It introduces key mathematical concepts such as matrices, vector spaces, orthogonality, determinants, eigenvalues, eigenvectors, and singular value decomposition (SVD). These concepts play a critical role in many AI and ML techniques including data representation, dimensionality reduction, optimization, and model training. By the end of the course, students will develop the mathematical understanding required to analyze and implement machine learning algorithms, perform data transformations, and understand the theoretical foundations behind AI models.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	**Matrices and Gaussian Elimination:** Introduction, The Geometry of Linear Equations, An Example of Gaussian Elimination, Matrix Notation and Matrix Multiplication, Triangular Factors and Row Exchanges, Inverses and Transposes, Special Matrices and Applications. **Vector Spaces:** Vector Spaces and Subspaces, Solving $Ax = 0$ and $Ax = b$, Linear Independence, Basis, and Dimension, Linear Transformations. **Orthogonality:** Orthogonal Vectors and Subspaces, Cosines and Projections onto Lines, Projections and Least Squares, Orthogonal Bases and Gram-Schmidt, The Fast Fourier Transform.	15
II	**Determinants:** Introduction, Properties of the Determinant, Formulas for the Determinant, Applications of Determinants. **Eigenvalues and Eigenvectors:** Introduction, Diagonalization of a Matrix, Complex Matrices, Similarity Transformations. **Positive Definite Matrices:** Minima, Maxima, and Saddle Points, Tests for Positive Definiteness, Singular Value Decomposition, Minimum Principles, The Finite Element Method.	15
	Total Hours	**30**

References:

Sr. No.	Title	Author/s	Publisher	Edition
1	Linear Algebra and Its Applications	Gilbert Strang	Cengage Publication	Fourth Edition
2	Advanced Linear Algebra	David Surowski		
3	Linear Algebra, Theory and Applications	Kenneth Kuttlet		

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Programme Name: **B.Sc. (AL & ML)**	**Semester: III**
Course Category: Open Elective	
Name of the Dept: Science & Technology	
Course Title: Fundamentals of Digital Electronics	
Course Code: BAIE309	Course Level:4.5
Course Credit: 2	
Hours Allotted: 30 Hours	Total Marks:50 Marks
Course Objectives: 1. To understand the basic concepts of digital electronics and logic design. 2. To relate digital electronics fundamentals with computing systems used in AI & ML applications.	
Course Outcomes: After the completion of the course, the learners would be able to: **CO1**: apply number systems, Boolean algebra, and logic gates to design and simplify basic digital circuits. **CO2**: analyze combinational and sequential circuits and relate their applications to computing systems used in AI and ML.	
Description of the course:	This course introduces the fundamental concepts of digital electronics required for understanding modern computing systems. It covers number systems, Boolean algebra, logic gates, combinational and sequential circuits. The course builds foundational knowledge of digital hardware that supports processors, memory systems, and AI-based computing architectures.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	**Introduction to Digital Electronics and Number System** Analog vs Digital systems, Advantages of digital systems, Applications of digital electronics in computing and AI systems, Introduction to Number systems, Positional Number systems, Conversions (converting between bases), non-positional number systems, 1's complement and 2's complement **Logic Gate and Logic Circuits** Basic Gates, Universal Gates, Exclusive Gates **Boolean Algebra and Gate Level Minimization** Introduction, Postulates of Boolean Algebra, Two valued Boolean Algebra, SOP & POS forms, Principle of Duality, De Morgans Laws, Boolean Functions and their Representation, K-Map, Simplification of Boolean expressions	15
II	**Combinational Circuits** Introduction to Combinational Logic, Types of Combinational Circuit: Half and Full Adder, Half and Full Subtractor, Multiplexer and Demultiplexer, Encoder and Decoder. **Sequential Circuits** Introduction to Combinational Circuits, Flip-Flops (SR, JK, D, T), Registers and its types, Counters and its types. **Applications in Computing & AI Hardware** Digital logic in processors and AI chips, Binary data representation in AI systems, Memory systems for AI data, Digital circuits in IoT and embedded AI, Applications in robotics, smart systems, and automation.	15
	Total Hours	30

References:

Sr. No.	Title	Author	Publisher	Edition	Year
1	Digital Fundamentals	Thomas L. Floyd	Pearson Education	11th	2015
2	Digital Design	M. Morris Mano, Michael D. Ciletti	Pearson Education	5th	2013
3	Fundamentals of Logic Design	Charles H. Roth Jr., Larry L. Kinney	Cengage Learning	7th	2013
4	Modern Digital Electronics	R. P. Jain	McGraw Hill Education	4th	2010
5	Digital Systems: Principles and Applications	Ronald J. Tocci, Neal Widmer, Gregory Moss	Pearson Education	12th	2017

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Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts (AUTONOMOUS), Thane (W)

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: **B.Sc. (AI & ML)**	**Semester: III**
Course Category: VSC	
Name of the Dept: Science & Technology	
Course Title: R Programming Practical	
Course Code: BAIRP	Course Level:4.5
Type: Practical	
Course Credit: 2	
Hours Allotted :60 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. Read Structured Data into R from various sources , Control structure & Functions in R 2. Understand basic graphical function & Import- Export data to & from R	
Course Outcomes: After completion of the course, learners would be able to: **CO1**:understand R Studio and explore the features & functions of R programming **CO2**: work with import and use the data and represent the data into tables, manipulating Data Frames & plot the graph using basic graphical function	
Description of the course:	R programming is highly relevant in various industries and fields due to its robust statistical and data analysis capabilities. This introductory R programming course insights into its relevance and demand in the industry.

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Unit No.	Content (List of Practicals)	Hours
I	**1. Working with numeric data** a. Create Matrices and perform matrix operations like addition and multiplication. b. Create Arrays and perform operations on it c. Demonstrate matrix subtraction and transpose **2. Lists and Data Frames** a. Create lists and access the elements from the list b. Create data frames and perform operations on it. c. Create a student data frame with Name, Age and Score columns and add column Passed in the same **3. Functions in R** a. Use in built functions in R and explore their arguments b. Create simple user defined function and test it c. Write an R function that takes two numbers as input and returns their sum, difference, product, and quotient. **4. Control Flow and Loops** a. Demonstrate 'if ', 'else', and 'switch' conditions to control program flow. b. Use 'for' and 'while' loops to iterate over a vector and print its values. c. Write a script that generates a sequence of numbers from 1 to 100 and prints "Even" if a number is even and "Odd" if it is odd. **5. Writing and Debugging Functions** a. Create a function that calculates the factorial of a number. b. Write a function that takes a numeric vector as input and returns the sum of all even numbers in the vector. **6.Managing and Manipulating Data** a. Read and write data from a CSV file using 'read.csv()' and 'write.csv()'. b. Perform basic operations like filtering, sorting, and summarizing data. c. Download a sample dataset and perform the above operations. **7.Managing and Manipulating Excel Data** a. Read and write data from and to excel b. Perform basic operations like filtering, sorting, and summarizing data. c. Download a sample dataset and perform the above operations. **8. Data Transformation with dplyr** a. Use 'mutate()' to create new columns in an existing dataset. b. Apply 'filter()', 'select()', and 'arrange()' to manipulate datasets. c. Write an R script that groups a dataset by a categorical variable (e.g., department) and calculates the average value of a numeric column (e.g., salary) **9. Data Visualization in R –** a. Create simple plots using 'plot()', 'hist()', and 'boxplot()'. b. Customize plots with colors, labels, and titles.	

	c. Take a sample dataset and plot histogram for the same **10. Data Visualization in R –** a. Create a bar chart and scatter plot using ggplot2 b. Customize plots with colors, labels, and titles. c. Create an interactive visualization using plotly	
	Total Hours	**60**

References:

1. Introduction to Programming and Statistical Modelling in R,Aedin Culhane, HARVARD SCHOOL,1st Edition 2013
2. Statistics - An introduction using R. John Wiley, Crawley, M. J. (2006).,London
3. R Data Science Quick Reference, Thomas Mailund Apress 1st Edition 2019
4. THE BOOK OF R, Tilman M. Davies No starch press 1st 2016

Scheme of Examination

Course with Credit	External Examination	Internal Examination	Total
Credit 4	**60 marks**	**40 marks**	**100 marks**
Credit 2	**30 marks**	**20 marks**	**50 marks**

Internal Examination Structure(Theory)

Internal examination	40 marks	20 marks
Project Presentation/Case Study /Quiz/Group Discussion	10 marks	5 marks
Assignment /Active class Participation/Attendance	10 marks	5 marks
Class test	20 marks	10 marks
Total	40 marks	20 marks

Structure for Class Test(For 10 Marks)

For 10 Marks	
Q1. Multiple Choice Questions	**5 Marks**
Q2. Answer in one or two sentences	**5 Marks**

Structure for Class Test(For 20 Marks)

For 20 Marks	
Q1. Multiple Choice Questions	**10 Marks**
Q2. Answer in one or two sentences	**10 Marks**

External Examination (For 60 Marks)

Q. No.	External	Marks: 60
Q .1	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 3	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 4	Answer the following questions (Any 3) A B C D E **F**	15 Marks

External Examination (For 30 Marks)

Q. No.	External	Marks: 30
Q .1	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2	Answer the following questions (Any 3) A B C D E F	15 Marks

Practical External Exam: 50 marks
A Certified copy journal is essential to appear for the practical examination.

1	Practical Question 1	20
2	Practical Question 1	20
3	Journal	5
4	Viva Voce	5

OR

1	Practical Question 1	40
2	Journal	5
3	Viva Voce	5