

# SEMESTER - III

*B.Tech. CSE - AI & DS (Hons.): Approved in 2<sup>nd</sup> meeting of Academic Council held on 28.06.2025*



# Panipat Institute of Engineering and Technology

An Autonomous Institute affiliated to Kurukshetra University, Kurukshetra

Scheme of Studies & Examination (w. e. f. session 2025-2026)

B.Tech 2nd Year (Semester – III): Bachelor of Technology (CSE-AI&DS)

## 3rd Semester

S. No.	Course No.	Course Title	Teaching Schedule /Week			Continuous Internal Evaluation (CIE) Max	Semester End Examination (SEE)		Total	Credits	Duration of Exam (Hrs)
			L	T	P		Theory	Practical			
<b>Basic Science Course (BS)</b>											
1	ASH-MAT-205A	Probability & Statistical Methods for Data Science	3	1	-	40	60	-	100	4	3
<b>Engineering Science Course (ES)</b>											
2	BT- AIDS-201A	Data Structures	3	-	-	40	60	-	100	3	3
3	BT-ECE-223A	Digital System Design	3	-	-	40	60	-	100	3	3
<b>Program Core Course (PC)</b>											
4	BT- AIDS-203A	Database Management System	3	-	-	40	60	-	100	3	3
5	BT- AIDS-205A	Foundations of Data Science	3	-	-	40	60	-	100	3	3
<b>Basic Science Course (BS) Lab</b>											
6	ASH-MAT-275A	Probability & Statistical Methods for Data Science Lab	-	-	2	50	-	50	100	1	3
<b>Engineering Science Course (ES) Lab</b>											
7	BT- AIDS-271A	Data Structures Lab	-	-	4	50	-	50	100	2	3
8	BT- ECE-279A	Digital System Design Lab	-	-	2	50	-	50	100	1	3
<b>Program Core Course (PC) Lab</b>											
9	BT- AIDS-273A	Database Management System Lab	-	-	2	50	-	50	100	1	3
<b>Employment Enhancement Course (EEC)</b>											
10	BT- AIDS-277A	Summer Internship - I	-	-	-	50	-	50	100	2	3
<b>Total</b>			<b>15</b>	<b>1</b>	<b>10</b>	<b>450</b>	<b>300</b>	<b>250</b>	<b>1000</b>	<b>23</b>	<b>30</b>

Note: 6-8 weeks Summer Internship Training mandatory at the end of 2nd semester (before the commencement of 3rd semester)

  
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Course Code	Course Title	L	T	P	Credits									
ASH-MAT-205A	Probability & Statistical Methods for Data Science	3	1	-	4									
		CIE	SEE		Total									
		40	60		100									
<b>Course Outcomes</b>														
CO1	Understand basic statistical concepts, research process, types of data, sampling methods, and mathematical expectations.													
CO2	Apply discrete and continuous probability distributions to compute statistical measures.													
CO3	Analyze and evaluate statistical hypotheses and perform ANOVA for different population parameters.													
CO4	Develop regression and multivariate models and apply data analysis techniques like decision trees and clustering.													
<b>Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	-	-	-	1	-	2	2
CO2	3	2	3	2	-	-	-	-	-	-	1	-	3	2
CO3	3	3	2	3	2	-	-	-	-	-	1	-	2	3
CO4	3	3	2	3	3	-	-	-	2	-	2	-	3	3

### COURSE CURRICULAM

#### Course Outline

<b>Unit: I</b>	Basics Concepts of Statistics	Contact Hours:12
Introduction to basic concepts of Statistics, The Scientific Method, Basic Steps of the Research Process, Experimental Data and Survey Data, Populations and Samples, Census and Sampling Method, Parameter and Statistic, Independent and Dependent Variables. Mathematical expectations and their properties.		
<b>Unit: II</b>	Some Advanced Distribution for Data Science	Contact Hours:12
Probability Distributions: Definition of Density and Distribution functions. Discrete Distributions: Negative Binomial Distribution, Geometric Distribution, mean, variance and rth moment, memoryless property of G.D. Continuous Distributions: Uniform Distribution, Exponential Distribution, Beta and Gamma distribution, mean, variance and rth moment. Memoryless property of exponential distribution.		
<b>Unit: III</b>	Decision Analysis	Contact Hours:12
Introduction: Null and Alternative Hypothesis, Type I and Type II Error, The Procedure of Hypothesis Testing; Hypothesis Testing of a Population Mean: Sample, a proportion (One Sample), Population Variance, Population Mean: Two Independent Samples, Dependent Samples (Paired Samples), Two Population Proportion, Two Population Variances; Analysis of Variance (ANOVA).		
<b>Unit: IV</b>	Regression Analysis	Contact Hours:10
Introduction, Partial Correlation, Residuals and Plots, Multiple Regression Model, Repeated Measures, Non-linear Regression, Polynomial Regression Models, Decision Trees, Neural Networks, Cluster Analysis, Factor Analysis.		

#### Suggested Books:

1. Probability for Statistics and Machine Learning: Anirban Das Gupta – 2011.
2. Fundamental Mathematical Statistics: S.C Gupta and V.K Kapoor, Sultan Chand & Sons
3. An Introduction to Statistics with Python with Applications in Life Sciences by Thomas Haslwanter, 2016.
4. Applied Statistics: A handbook of techniques- Zenon Reynarowych, springer verlag.
5. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media Media.
6. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
7. Applied Statistics principles and Examples-D. R. Cox and E. J. Snell.
8. Applied statistical methods, Irving W. Burr, Academic press.

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9. Probability, Statistics and Random process, Dr. K. Murugesan & P. Gurusamy by Anuradha Agencies,
  10. Deepthi publications.
  11. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
  12. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann
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**NOTE: 1.** For the semester examination, nine questions are to be set by the examiner. Question no. 1, containing 5-7 short answer type questions, will be compulsory & based on the entire syllabus. Rest of the eight questions is to be set by setting two questions from each of the four units of the syllabus. The candidates will be required to attempt five questions in all, selecting one from each unit AND Question no. 1. All questions will carry equal marks.

**2.** The students will be allowed to use non-programmable scientific calculator. However, sharing /ex-change of calculator or any other items are prohibited in the examinations. No programmable calculators, mobile phones or other electrical/ electronic items are allowed in the examination

Course Code	Course Title	L	T	P	Credits									
BT- AIDS-201A	Data Structures	3	-	-	3									
		CIE	SEE		Total									
		40	60	100										
<b>Course Outcomes</b>														
CO1	To introduce the basic concepts of Data structure, basic data types, searching and sorting based on array data types.													
CO2	To introduce the structured data types like Stacks and Queue and its basic operations' implementation													
CO3	To introduce dynamic implementation of linked list.													
CO4	To introduce the concepts of Tree and graph and implementation of traversal algorithms.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1	-	-	1	2	2	3
CO2	2	1	1	-	-	1	-	2	-	-	-	1	2	2
CO3	2	2	2	1	1	2	1	1	-	-	1	1	2	2
CO4	2	1	2	1	1	-	1	1	-	-	2	2	2	2

## COURSE CIRRICULAM

### Course Outline

<b>Unit: I</b>	<b>Introduction to Data Structures and arrays</b>	Contact Hours:9
Introduction to Data Structures, Data Types, Built in and User Defined Data Structures, Applications of Data Structure, Algorithm Analysis, Worst, Best and Average Case Analysis, Notations of Space and Time Complexity, Basics of Recursion. Arrays, One Dimensional Arrays, Two Dimensional Arrays and Multi-Dimensional Arrays, Sparse Matrices, searching from array using Linear and Binary Searching Algorithm, sorting of array using Selection, Insertion, Bubble, Radix Algorithm		
<b>Unit: II</b>	<b>Strategic Knowledge about stacks and queues</b>	Contact Hours:9
Stacks: Definition, Implementation of Stacks and Its Operations, Evaluation of Infix, prefix and Postfix Expression, Inter- conversion of Infix, Prefix and Post-Fix Expression, Implementation of Merge Sort and Quick Sort Algorithm. Queues: Definition, Sequential Implementation of Linear Queues and Its Operations, Circular Queue and Its Implementation, Priority Queues and Its Implementation, Applications of queues.		
<b>Unit: III</b>	<b>Linked Lists and Dynamic Implementation of Primitive Operations</b>	Contact Hours: 10
Linked Lists: Need of Dynamic Data Structures, Single Link List and Its Dynamic Implementation, Traversing, Insertion, Deletion Operations on Single Link Lists. Comparison between Static and Dynamic, Implementation of Linked List. Circular Link Lists and Doubly Link List, Dynamic Implementation of Primitive Operations on Doubly Linked Lists and Circular Link List. Dynamic Implementation of Stacks and Queues.		

  
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Unit: IV	<b>Introduction to Binary Search Trees and Introduction to Binary Search Trees</b>	Contact Hours: 8
<p>Trees: Definition, Basic Terminology, Binary Tree, External and Internal Nodes, Static and Dynamic Implementation of a Binary Tree, Primitive Operations on Binary Trees, Binary Tree Traversals: Pre-Order, In-Order and Post-Order Traversals. Representation of Infix, Post-Fix and Prefix Expressions using Trees.</p> <p>Introduction to Binary Search Trees: B+ trees, AVL Trees, Threaded Binary trees, Balanced Multi-way search trees, Implementation of Heap Sort Algorithm.</p> <p>Graphs: Basic Terminology, Definition of Undirected and Directed Graphs, Memory Representation of Graphs, Minimum-Spanning Trees, Marshal Algorithm, Graph Traversals Algorithms: Breadth First and Depth First.</p>		

**Textbook/s:**

1. Theory and Problems of Data Structures by Jr. Seymour Lipschitz, Schaum's outline, TMH.
2. Data Structures and Algorithms by PAI, TMH.
3. Fundamentals of Data structures by Ellis Horowitz and Sartaj Sahni, Pub, 1983, AW.

**Reference Books:**

1. Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman, Original edition, Addison-Wesley, 1999, Low Priced Edition
2. Reference Books:
3. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein (CLRS)
4. "The Algorithm Design Manual" by Steven S. Skiena
5. "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles" by Narasimha Karumanchi

**Online Learning Resources/URLs:**

1. Google Tech Dev Guide - Data Structures & Algorithms: <https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/>
2. CodeChef: <https://www.codechef.com/>

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**2.** The students will be allowed to use non-programmable scientific calculator. However, sharing /ex-change of calculator or any other items are prohibited in the examinations. No programmable calculators, mobile phones or other electrical/ electronic items are allowed in the examination

  
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Course Code	Course Title	L	T	P	Credits									
BT-ECE-223A	Digital System Design (AIDS, AIML)	3	0	0	3									
		CIE	SEE		Total									
		40	60	100										
<b>Course Outcomes</b>														
CO1	Design and analysis of different type of combinational circuits.													
CO2	Design and analysis of synchronous and asynchronous sequential circuits using flip flops.													
CO3	Illustrate the working of different A/D and D/A converters.													
CO4	Develop skill to build various programmable logic devices.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	-	1	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	1	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-	1	-
CO4	3	1	3	1	-	-	-	-	-	-	-	-	1	1
Avg	2.75	2	2.75	1.5	-	-	-	-	-	-	-	-	1	1

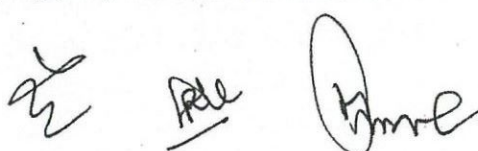
## COURSE CURRICULAM

### Course Outline

<b>Unit: 1</b>	<b>Fundamentals of Digital Systems and Combinational Circuits</b>	<b>Contact Hours:12</b>
<b>Fundamentals of Digital Systems:</b> Review of logic gates, Universal Gates, Standard representation of logic functions: SOP and POS forms, Simplification of switching functions using K-map and Quine-McCluskey tabular methods, Don't care conditions. <b>Combinational Digital Circuits:</b> Design procedure: Half adder, Full Adder, Half subtractor, Full subtractor, Parallel binary adder, parallel binary Subtractor, BCD adder, Multiplexer and De-multiplexer, Realization of function using Multiplexer and De-multiplexer.		
<b>Unit: 2</b>	<b>Sequential Circuits</b>	<b>Contact Hours:12</b>
<b>Sequential circuits:</b> A 1-bit memory, Latch, the clocked SR flip flop, J- K, T and D types flip flops, Interconversion of flipflops, applications of flip flops, shift registers, Bi-directional Shift Register, Synchronous and Asynchronous counter, Mod -N counter.		
<b>Unit: 3</b>	<b>Converters</b>	<b>Contact Hours:10</b>
<b>Code Convertors:</b> Encoders, Decoders, parity checker, parity generators, Magnitude Comparator. <b>A/D and D/A Converters:</b> Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, analog to digital converters: quantization and encoding, A/D converter, successive approximation A/D converter, Dual slope A/D converter specifications for A/D converters.		
<b>Unit: 4</b>	<b>Memory Devices</b>	<b>Contact Hours:08</b>
<b>Classification of memories:</b> ROM, RAM, PROM, EPROM, EEPROM, EAPROM, Programmable Logic Devices - Programmable Logic Array (PLA), Programmable Array Logic (PAL), Implementation of PLA, PAL using ROM.		

### Textbook/s:

1. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 8th Edition, TMH, 2003.M.
2. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.



3. A. A. Kumar: Fundamentals of digital circuits, Prentice Hall of India.

**Reference Books:**

1. A.K. Maini, Digital Electronics, Wiley India
2. John F. Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
3. John. M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
4. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006.

**Online Learning Resources/URLs:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_ee10/preview](https://onlinecourses.nptel.ac.in/noc21_ee10/preview)

Three handwritten signatures in black ink are located in the middle of the page. The first signature on the left is a stylized, cursive 'E'. The middle signature is a cursive 'Ase'. The signature on the right is a cursive 'Kumar'.

Course Code	Course Title										L	T	P	Credits
BT-AIDS-203A	Database Management System										3	-	-	3
											CIE	SEE	Total	
											40	60	100	
<b>Course Outcomes</b>														
CO1	To explain DBMS concepts, advantages, users, and E-R modelling.													
CO2	To apply relational algebra, calculus, and SQL for database operations.													
CO3	To analyze normalization for eliminating anomalies in database design.													
CO4	To evaluate transaction processing, serializability, and concurrency control.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	-	2	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	2	3	3
CO3	3	3	2	1	1	-	-	-	-	-	-	2	3	3
CO4	3	3	1	2	2	-	-	-	-	-	-	2	3	3

## COURSE CURRICULAM

### Course Outline

<b>Unit: I</b>	<b>DBMS Basics &amp; E-R Modelling</b>	Contact Hours: 10 Hrs.
Introduction: Concept & Overview of DBMS, Advantages of DBMS over file processing system, Database Languages, Responsibilities of Database Administrator, Database Users, Three Schema architecture of DBMS & Data Independence, Data Models. Entity-Relationship Model: Basic concepts, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features: Specialization and Generalization.		
<b>Unit: II</b>	<b>Relational Model &amp; SQL Basics</b>	Contact Hours: 10 Hrs.
The Relational Data Model & Algebra: Relational Model: Structure of relational Databases, Relational Algebra & various operations (Set operation, select, project, joins, division), Relational Calculus: Domain, Tuple. Integrity Constraints & Introduction to SQL: Domain Constraints, Referential Integrity Constraints, Basic Structure & Concept of DDL, DML, DCL, Aggregate Functions, Null Values, Introduction to views, creating, modifying and deleting views.		
<b>Unit: III</b>	<b>Normalization &amp; Functional Dependencies</b>	Contact Hours: 8 Hrs.
Relational Database Design: Functional Dependency, Different anomalies in designing a Database., Normalization – 1NF, 2NF, 3NF, Boyce-CODD Normal Form, Normalization using multi-valued dependencies, 4NF, 5NF.		
<b>Unit: IV</b>	<b>Transaction Processing &amp; Concurrency Control</b>	Contact Hours: 9 Hrs.
Transaction Processing Concept: Introduction to transaction processing, transaction model properties, serializability: -Serial, non-serial and Serializable Schedules, Conflict Serializability. Concurrency Control: Need for concurrency control, Different concurrency control Techniques: locking based, timestamps-based technique. Deadlock handling and Recovery Techniques: - Deferred update/ immediate update, shadow paging.		

#### Textbook/s:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Addison-Wesley
2. Silberschatz, and Korth, "Database System Concepts", McGraw-Hill

#### Reference Books:

1. Bhattacharyya, "Database Management Systems", Tata McGraw-Hill Publishing.
2. Ramakrishnan, R., & Gehrke, J., "Database Management Systems," McGraw-Hill Education, 3rd Edition.
3. Groff, J.R., & Weinberg, P.N., "SQL: The Complete Reference", McGraw-Hill Education, Latest Edition.

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**Online Learning Resources/URLs:**

1. NPTEL (National Programme on Technology Enhanced Learning): <https://nptel.ac.in/>

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-205A	Foundations of Data Science	3	-	-	3									
		CIE	SEE		Total									
		40	60	100										
<b>Course Outcomes</b>														
CO1	Understand the fundamentals and processes of data science.													
CO2	Learn to describe data effectively within the data science workflow.													
CO3	Explore relationships between different data variables.													
CO4	Utilize Python libraries for data wrangling tasks.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	1	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	1	3	2
CO3	2	1	2	1	-	-	-	-	-	-	-	1	3	2
CO4	3	1	3	1	-	-	-	-	-	-	-	2	2	3

## COURSE CURRICULAM

### Course Outline

<b>Unit: I</b>	<b>Introduction To Data Science</b>	<b>Contact Hours:12</b>
Benefits and uses of Data Science, Facets of data, Overview of the Data Science Process, Defining research goals, Data retrieval and preparation, Exploratory Data Analysis (EDA), Model building and application development Data Mining and Data Warehousing		
<b>Unit: II</b>	<b>Describing Data</b>	<b>Contact Hours:10</b>
Types of data and variables, Descriptive statistics: tables, graphs, averages, Measures of variability, Normal distributions and z-scores, measure of dispersion, Data distribution and shape, Frequency Distributions and Tabulation		
<b>Unit: III</b>	<b>Relationships Descriptions</b>	<b>Contact Hours:14</b>
Correlation and scatter plots, Computational formula for correlation coefficient, Regression analysis: regression lines, least squares method, Standard error of estimate, Interpretation of $R^2$ (coefficient of determination), Multiple regression equations, Regression towards the mean		
<b>Unit: IV</b>	<b>Python Libraries for Data Wrangling</b>	<b>Contact Hours:08</b>
Basics of NumPy arrays, Aggregations and computations on arrays, Comparisons, masks, and Boolean logic, Fancy indexing and structured arrays, Data manipulation with Pandas: indexing, selection, operations, handling missing data Hierarchical indexing, combining datasets, Aggregation, grouping, and pivot tables		

#### Textbook/s:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, *Introducing Data Science*, Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, *Statistics*, 11th Edition, Wiley Publications, 2017.
3. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly, 2016.

#### Reference Books:

1. Allen B. Downey, *Think Stats: Exploratory Data Analysis in Python*, Green Tea Press, 2014

Online Learning Resources/URLs:

1. <https://www.coursera.org/browse/data-science>

  
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Course Code	Course Title			L	T	P	Credits							
ASH-MAT-275A	Probability & Statistical Methods for Data Science Lab			-	-	2	1							
				CIE	SEE		Total							
				50	50		100							
<b>Course Outcomes</b>														
CO1	Understand the application of different regression techniques													
CO2	Understand various probability distribution for real word problem													
CO3	Analysis the covariance and correlation of big data.													
CO4	Apply the hypothesis testing with real time applications													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	-	-	1	-	3	3	1	-
CO2	3	3	3	3	3	1	-	-	1	-	1	1	1	-
CO3	3	2	3	3	3	1	-	-	1	-	3	3	1	-
CO4	3	2	3	3	3	1	-	-	1	-	3	3	1	-

Sr. No.	Name of Experiments
1	Calculation of Coefficient of Correlation using sample datasets (Pearson's method).
2	Determination of the Covariance matrix for large data set.
3	Calculation of Spearman's Rank Correlation for non-parametric data.
4	Fitting the Uniform, Exponential, Beta, and Gamma Distributions and compute their mean, variance, and moments.
5	Determination of the Simple Linear Regression: Estimation of slope, intercept, regression coefficients, and residual analysis.
6	Determination of the Polynomial regression and regression estimates.
7	Determination of the Residual Plots and Regression Diagnostics: Detecting non-linearity, outliers, and leverage points.
8	Determination the multiple Linear Regression: Estimation of multiple regression coefficients and prediction accuracy.
9	Calculation of Type I and Type II Error Probabilities in Hypothesis Testing and Graphical Plotting of Critical Region Size and Power Function.
10	Calculation of size of critical region, power of the test for the mean of a normal distribution with known and unknown variance and plotting graph of the power function.
11	Determination of Shortest Confidence Interval for Mean (known and unknown variance cases).
12	Determination of Shortest Confidence Interval for Variance (mean known/unknown scenarios).
13	Analyze a data for overfitting/underfitting through residual plots and do its Linear Regression Modeling and Diagnostics (advanced practical).
14	Simulate data from a Poisson distribution (e.g., number of events in a fixed interval, $\lambda=3$ ). Generate a large sample and repeat the plotting and comparison steps as with the Binomial distribution.
15	To empirically demonstrate the Central Limit Theorem (CLT) by showing that the distribution of sample means approaches a normal distribution, regardless of the shape of the original population distribution, as the sample size increases.

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-271A	Data Structures Lab	-	-	4	2									
		CIE	SEE	Total										
		50	50	100										
<b>Course Outcomes</b>														
CO1	Implement linear and non-linear data structures using linked list.													
CO2	Apply various data structures such as stack, queue and tree to solve the problems.													
CO3	Implement various searching and sorting techniques.													
CO4	Choose appropriate data structure while designing the applications and analyze the complexity of the algorithms.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	3	-	-	-	2	2	-	2	3	3
CO2	3	2	3	1	2	-	-	-	2	2	-	2	1	2
CO3	2	3	2	2	3	-	-	-	2	2	-	2	3	3
CO4	3	2	2	2	3	-	-	-	2	3	-	3	3	2

Sr. No.	Name of Experiments
1	Write a program for Binary search methods.
2	Write a program for insertion sort, selection sort and bubble sort.
3	Write a program to implement Stack and its operation.
4	Write a program for quick sort.
5	Write a program for merge sort.
6	Write a program to implement Queue and its operation.
7	Write a program to implement Circular Queue and its operation.
8	Write a program to implement singly linked list for the following operations: Create, Display, searching, traversing and deletion.
9	Write a program to implement doubly linked list for the following operations: Create, Display, inserting, counting, searching, traversing and deletion.
10	Write a program to implement circular linked list for the following operations: Create, Display, inserting, counting, searching, traversing and deletion.
11	Write a program to implement insertion, deletion and traversing in B tree
12	Write a program to Implement AVL Tree with Insertion and Rotations.
13	Write a program to Implement Radix Sort.
14	Write a program to Implement Dijkstra's Algorithm for Shortest Path in a Graph
15	Write a program to Implement Depth First Search (DFS) and Breadth First Search (BFS) Traversals on a Graph

  
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Course Code	Course Title											L	T	P	Credits		
BT-ECE-279A	Digital System Design Lab (AIML, AIDS, IT)											0	0	2	1		
												CIE		SEE		Total	
												50		50		100	
Course Outcomes																	
CO1	Identify various digital ICs and understand their operation																
CO2	Design basic combinational Circuits and verify their functionalities																
CO3	Apply the design procedures to design basic sequential circuits using Flip-Flops																
CO4	Understand the concept of encoders and decoders and verify their operation																
Course Outcomes (CO) to Programme Outcomes (PO) mapping (Scale 1: Low, 2: Medium, 3: High)																	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2			
CO1	3	-	-	-	-	-	-	2	2	1	-	1	3	-			
CO2	3	2	3	1	-	-	-	2	2	1	-	1	3	2			
CO3	3	2	3	1	-	-	-	2	2	1	-	1	3	2			
CO4	3	2	3	1	-	-	-	2	2	1	-	1	3	2			
Avg	3	2	3	1	-	-	-	2	2	1	-	1	3	2			

#### List of experiments:

1. Familiarization with Digital Trainer Kit and associated equipment.
2. Study of TTL gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
3. Design and realize a given function using K-Maps and verify its performance.
4. To verify the operation of Multiplexer and De-multiplexer.
5. To verify the operation of Comparator.
6. To verify the truth table of S-R, J-K, T, D Flip-flops.
7. To verify the operation of Bi-directional shift register.
8. To design and verify the operation of 3-bit asynchronous counter.
9. To design and verify the operation of asynchronous Up/down counter.
10. To design and verify the operation of asynchronous Decade counter.
11. Study of Encoder and Decoder.
12. Study of BCD to 7 segment Decoder

Note: At least ten (10) experiments from the above list are mandatory to perform for the students

Course Code	Course Title	L	T	P	Credits
BT-AIDS-273A	Database Management System Lab	-	-	2	1
		CIE	SEE		Total
		50	50	100	

**Course Outcomes**

<b>CO1</b>	To design and implement databases with operations like insertion, deletion, modification, and querying.
<b>CO2</b>	To apply integrity constraints and relational operations for data consistency.
<b>CO3</b>	To develop SQL views, joins, and procedures for complex data retrieval and manipulation.
<b>CO4</b>	To implement triggers and procedures for automated transaction handling and business rules.

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)**


	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	-	-	-	2	2	2	1	3	3
CO2	3	3	2	2	2	-	-	-	-	1	1	1	3	2
CO3	3	2	3	3	3	-	-	-	2	2	2	1	3	3
CO4	3	2	3	3	3	-	-	-	2	2	2	2	3	3

Sr. No.	Name of Experiments
1	Create a database and write the programs to carry out the following operation: 1. Add, Delete and modify a record in the database 2. Generate queries 3. Data operations 4. List all the records of database in ascending order.
2	To perform various integrity constraints on relational database.
3	Create a database and perform the following operations: - 1. Arithmetic and Relational operations 2. Group by & having clauses 3. Like predicate for pattern matching in database
4	Create a view to display details of employees working on more than one project.
5	Create a view to display details of employees not working on any project.
6	Using two tables, create a view which shall perform natural join, equi join and outer joins.
7	Write a procedure to give incentive to employees working on all projects. If no such employee found, give app. Message.
8	Write a procedure for computing the amount for telephone bill on the basis of the following conditions. 1. telephone rent Rs. 205 including the first 105 free units. 2. if extra units > 0 but < 500 then the rate is 80 paise per unit. 3. if extra units > 500 then rate is Rs. 1.20 per unit. For this purpose, create a table with name, Phone No., No. of units consumed, bill amount of a customer.

  
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9	<p>Write a procedure for computing income tax of employees on the basis of following conditions: -</p> <ol style="list-style-type: none"> <li>1. if gross pay <math>\leq 40,000</math> then I.T rate is 0%.</li> <li>2. if gross pay <math>&gt; 40,000</math> but <math>&lt; 60,000</math> then I.T rate is 10%.</li> <li>3. if gross pay <math>&gt; 60,000</math> but <math>&lt; 1,00,000</math> then I.T rate is 20%.</li> <li>4. if gross pay <math>&gt; 1,00,000</math> then I.T rate is 30%.</li> </ol> <p>For this purpose, create a table with name, ssn, gross salary and income tax of the employee.</p>
10	Write trigger for before and after insertion, deletion and updation process on the table.
11	Write programs to demonstrate Transaction control commands (COMMIT, ROLLBACK, SAVEPOINT).
12	Study the impact of creating Indexes on query performance using sample data.
13	Create and execute Stored Procedures for performing common database tasks.
14	Design and implement Triggers to enforce business rules or audit data modifications.
15	Perform Set Operations (UNION, INTERSECT, EXCEPT) on tables and analyze results.

  
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Course Code	Summer Internship -I	L	T/P	Credits										
BT-AIDS-277A		-	-	2										
	Examination Scheme	CIE	SEE	Total										
		50	50	100										
Course Outcomes														
CO1	Understand and Apply Python Programming Basics													
CO2	Develop Programs Using Data Structures and Functions													
CO3	Implement File Handling and Object-Oriented Programming Concepts													
CO4	Analyze Data and Integrate External APIs Using Python Libraries													
Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	1	3	2	3	2
CO2	3	3	2	2	2	-	-	-	-	2	3	3	3	3
CO3	3	3	2	2	3	-	-	-	-	3	2	2	3	2
CO4	3	3	3	3	2	-	-	-	-	3	3	3	3	3

A B.Tech. student will be required to attend Inter/Intra Institute Internship of 3 weeks duration after II<sup>nd</sup> semester and with the following objectives:

- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.

The students are required to be involved in one or more of the followings Inter/ Intra Institutional activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovation Council, eg; IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc. The activity or set of activities shall, in each case, be recommended by Departmental Training Coordinator/In-charge, if any, and/or Class In-charge of the II<sup>nd</sup> year and approved by Head of the Department.

A student will write daily report which will cultivate the habit of documentation of daily observation. After completion of Internship, the student shall prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Training/Internship In-charge/ Faculty Mentor to assign special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the Internship report since much of the information would already be incorporated by the student into the daily diary.

The Internship report will be evaluated on the basis of following criteria:

- Originality (A signed certificate to that effect to be attached by the student in his/her Internship report)
- Adequacy and purposeful write-up.
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience.
- Practical applications, relationships with basic theory and concepts taught in the course.

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**This Internship will be evaluated on the basis of a presentation made by the students by the following committee as per guidelines stipulated in the Ordinance**

- i. Head of the Department**
- ii. In-charge Internship**
- iii. Class In charge**

  
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## MONTHLY ATTENDANCE SHEET

(For Internship I, II & III)

Name and Address of the Organization (Where Internship being held)

Name of Student		
Roll No.		
Name of Course		
Date of Commencement of Internship:		
Date of Completion of Internship		

### Initials of the student

Month & Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	

### Note:

- 1.Attendance Sheet shall remain affixed in Internship report.
- 2.Student shall sign/initial in the attendance column. Do not mark 'P'.
- 3.Holidays should be marked in **Red Ink** in attendance column. Absent should be marked as '**A**' in **Red Ink** by the company/organization Internship In-charge

Signature of Company internship supervisor  
with company stamp/ seal

(Name \_\_\_\_\_) Contact No.

  
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# **SEMESTER - IV**

*B.Tech. CSE - AI & DS (Hons.): Approved in 2<sup>nd</sup> meeting of Academic Council held on 28.06.2025*



# Panipat Institute of Engineering and Technology

An Autonomous Institute affiliated to Kurukshetra University, Kurukshetra

Scheme of Studies & Examination (w. e. f. session 2025-2026)

B.Tech 2nd Year (Semester – IV): Bachelor of Technology (CSE-AI&DS)

## 4th Semester

S. No.	Course No.	Course Title	Teaching Schedule /Week			Continuous Internal Evaluation (CIE) Max	Semester End Examination (SEE)		Total	Credits	Duration of Exam (Hrs)
			L	T	P		Theory	Practical			
<b>Basic Science Course(BS)</b>											
1	ASH-MAT-206A	Probabilistic Modeling and Optimization For Data Analytics	3	1	-	40	60	-	100	4	3
<b>Program Core Course(PC)</b>											
2	BT AIDS-202A	Data Science with R Programming	3	0	-	40	60	-	100	3	3
3	BT-AIDS-204A	Foundations of Artificial Intelligence & Machine Learning	2	0	-	40	60	-	100	2	3
4	BT-AIDS- 206A	Object Oriented Programming Using Java	2	0	-	40	60	-	100	2	3
5	BT- AIDS-208A	Operating Systems	3	0	-	40	60	-	100	3	3
<b>Engineering Science Course(ES)</b>											
6	BT-ECE-202A	Microprocessor Based System Design	3	0	-	40	60	0	100	3	3
<b>Program Core Course(PC) Lab</b>											
7	BT- AIDS-272A	R Programming Lab	-	-	2	50	-	50	100	1	3
8	BT-AIDS- 274A	Foundations of Artificial Intelligence & Machine Learning Lab	-	-	4	50	-	50	100	2	3
9	BT- AIDS-276A	Object Oriented Programming Using Java Lab			4	50	-	50	100	2	3
<b>Engineering Science Course(ES) Lab</b>											
10	BT-ECE-272A	Microprocessor Based System Design Lab	-	-	2	50	-	50	100	1	3
<b>Audit Course(AC)</b>											
11	BT-CE-102A	Environmental Studies	3	-	-	40	60	0	100	-	3
<b>Total</b>			<b>19</b>	<b>1</b>	<b>12</b>	<b>480</b>	<b>420</b>	<b>200</b>	<b>1100</b>	<b>23</b>	<b>33</b>
<b>For Honours Course</b>											
12	BT-AIDS-252A	Business Analytics with Excel & Power BI	3	-	2	40	60	-	100	4	3
<b>Total</b>			<b>22</b>	<b>1</b>	<b>14</b>	<b>520</b>	<b>480</b>	<b>200</b>	<b>1200</b>	<b>27</b>	<b>36</b>
<b>After 4th Semester Exit Course</b>											
1	BT-AIDS-301A	Data Analytics & Visualization	2	-	-	40	60	-	100	2	3
2	BT-AIDS-303A	Design & Analysis of Algorithms	2	-	-	40	60	-	100	2	3
3	BT-AIDS-373A	Data Analytics & Visualization Lab	-	-	4	50	-	50	100	2	3
4	BT-AIDS-375A	Design & Analysis of Algorithms Lab	-	-	4	50	-	50	100	2	3
<b>Total</b>			<b>4</b>	<b>0</b>	<b>8</b>	<b>180</b>	<b>120</b>	<b>100</b>	<b>400</b>	<b>8</b>	<b>12</b>

NOTE: 6-8 weeks Summer Internship Training mandatory at the end of 4th semester (before the commencement of 5th semester)

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Course Code	Course Title	L	T	P	Credits									
ASH-MAT-206A	Probabilistic Modeling and Optimization for Data Analytics	3	1	-	4									
		CIE	SEE	Total										
		40	60	100										
<b>Course Outcomes</b>														
CO1	Understand and apply Bayesian inference, posterior analysis, and model evaluation techniques.													
CO2	Use Bayesian computation methods and regression models for statistical analysis.													
CO3	Formulate and solve basic optimization problems using analytical and search methods.													
CO4	Apply linear programming techniques to solve LPP, transportation, and assignment problems.													
<b>Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	1	-	1	-	2	2
CO2	3	3	2	3	3	-	-	-	1	-	1	-	3	3
CO3	3	3	3	3	2	-	-	-	2	-	2	-	2	3
CO4	3	3	3	3	2	-	-	-	2	-	2	-	2	3

## COURSE CURRICULAM

### Course Outline:

<b>Unit: I</b>	<b>Fundamentals of Bayesian Inference and Data Analysis</b>	Contact Hours:12
<p><b>Probability &amp; Inference:</b> The Bayesian Approach: Bayes' Law and Posterior Distribution, Bayesian Framework, Three Steps of Bayesian Data Analysis, Statistical Inference vs. Bayesian Inference. Applications and Examples: Discrete Probability Examples: Genetics and Spell Checking, Bayesian Inference in Applied Sciences. Bayesian Models: Single and Multivariate Models, Bayesian Networks, Second-order Models (Distributions over Distribution Parameters) Posterior Predictive Checking: Posterior Predictive Checks in Applied Bayesian Statistics, Graphical Posterior Predictive Check. Model Evaluation: Measures of Predictive Accuracy, Information Criteria (e.g., AIC, BIC), Cross Validation. Model Comparison: Based on Predictive Performance, Using Bayes Factors.</p>		
<b>Unit: II</b>	<b>Computation, Approximations and Regression Models</b>	Contact Hours:12
<p><b>Bayesian Computation:</b> Introduction to Bayesian Computation, Distributional Approximations. Simulation Techniques: Markov Chain Simulation, Metropolis and Metropolis-Hastings Algorithms, Gibbs Sampling (R and Win BUGS). Advanced Techniques: Hamiltonian Monte Carlo. Classical and Causal Regression: Bayesian Analysis of Classical Regression Model, Goals of Regression Analysis. Hierarchical Linear Models: Regression Coefficients, Normal Prior Interpretation, Varying Intercepts and Slopes. Generalized Linear Models: Standard GLM Likelihoods, Working with GLMs, Weakly Informative Priors (Logistic Regression).</p>		
<b>Unit: III</b>	<b>Introduction to Optimization</b>	Contact Hours:10
<p>Formulation and classification of optimization problems, overview of analytical solution of unconstrained optimization problems, constrained optimization, convex set, convex functions, convex optimization problem, Kuhn Tucker condition, Search methods: overview of single variable search methods, search methods for multivariable unconstrained problems: optimality criteria, unidirectional search-direct search methods-evolutionary search methods.</p>		
<b>Unit: IV</b>	<b>Optimization technique for LPP</b>	Contact Hours:12
<p>Linear programming problems: formulation, Solution of Linear Programming Problem: Graphical method, Simplex Method, Dual-Simplex Method. Transportation problem: North-west Corner Cell Method, Vogel's Approximation Method (VAM), Least Call Cell Method, Assignment problem.</p>		

### Textbook/s:

- Bayesian Data Analysis (3rd Edition) by Andrew Gelman et al. (Chapman and Hall/CRC): Gold standard for Bayesian theory & applications, covering data analysis, modeling, and computation.

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2. Bayesian Reasoning and Machine Learning by David Barber (Cambridge University Press): Comprehensive introduction with practical focus on Bayesian networks, inference, and ML applications.

**Reference Books:**

1. Bayesian Networks and Decision Graphs by Finn V. Jensen (Springer): Covers theory and practical modeling with Bayesian networks and graphical models.

**Suggested Readings:**

1. Bayesian Methods for Hackers (Free online) by Cameron Davidson-Pilon: Beginner-friendly, code-driven (Python + PyMC3) for understanding Bayesian inference through practical examples.
2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy (MIT Press): Covers Bayesian approaches across a wide range of ML topics including graphical models and nonparametric methods

**NOTE: 1.** For the semester examination, nine questions are to be set by the examiner. Question no. 1, containing 5-7 short answer type questions, will be compulsory & based on the entire syllabus. Rest of the eight questions is to be set by setting two questions from each of the four units of the syllabus. The candidates will be required to attempt five questions in all, selecting one from each unit AND Question no. 1. All questions will carry equal marks.

2. The students will be allowed to use non-programmable scientific calculator. However, sharing /ex-change of calculator or any other items are prohibited in the examinations. No programmable calculators, mobile phones or other electrical/ electronic items are allowed in the examination

Course Code	Course Title	L	T	P	Credits									
BT AIDS-202A	Data Science with R Programming	3	0	-	3									
		CIE	SEE	Total										
		40	60	100										
<b>Course Outcomes</b>														
CO1	Understand the core concepts of data science, types and sources of data, the data analytics lifecycle, and apply statistical and probability techniques to analyze and interpret data.													
CO2	Develop the ability to use R and RStudio for data handling, scripting, and applying fundamental programming constructs to manipulate and manage data efficiently.													
CO3	Apply data wrangling, transformation, and visualization techniques using R to explore datasets, handle missing values, and gain insights through graphical representations.													
CO4	Implement supervised and unsupervised machine learning algorithms in R, evaluate models using appropriate metrics, and perform dimensionality reduction for effective data analysis.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	2	-	-	-	-	-	-	2	3	
CO2	3	-	2	-	3	-	-	-	-	2	-	3	2	3
CO3	3	3	-	3	3	-	-	-	-	2	-	3	2	3
CO4	3	3	3	3	3	-	-	-	-	2	-	3	3	3

## COURSE CURRICULAM

### Course Outline

<b>Unit: I</b>	<b>Introduction to Data Science &amp; Statistical Foundations</b>	Contact Hours: 9 hrs.
Introduction to Data Science, Data Science in various fields, Examples, Impact of Data Science, Data Analytics Life Cycle, Data Science Toolkit, Data Scientist, Data Science Team, Understanding data: Introduction, Types of Data: Numeric, Categorical, Graphical, High Dimensional Data, Classification of digital Data: Structured, Semi-Structured and Unstructured - Example Applications. Sources of Data: Time Series, Transactional Data, Biological Data, Spatial Data, Social Network Data, Data Evolution Statistics & Probability: Measures of Central Tendency and Dispersion, Correlation vs Causation, Simpson's Paradox, Probability Concepts: Conditional Probability, Bayes' Theorem, Random Variables, Normal & Binary Distribution		
<b>Unit: II</b>	<b>Foundations of R Programming</b>	Contact Hours: 9 hrs.
Introduction to R and RStudio, Working with R Console & Scripts, Reading/Writing CSV and Excel files, Setting up your working directory, Arithmetic Operators, Logical Operations, R Data Types: Vectors, Lists, Data Frames, Factors, Operators, Functions, Extracting a subset of a data frame, and Control Structures (if, for, while, repeat), Adding comments and documentation, Handling Missing Data and Special Values, Packages & Libraries in R, Working Directory Setup and File Management Flow Control & Debugging: Writing efficient R scripts for Implementing loops (for, while repeat) and conditional statements (if-else) for structured programming, Debugging tools and techniques like traceback (), browser (), debug (), and try Catch().		
<b>Unit: III</b>	<b>Data Wrangling, Transformation &amp; Visualization</b>	Contact Hours: 8 hrs.
Data Analysis Pipeline, Data Extraction: Raw vs Processed Data, Data Wrangling using dplyr, tidyr, Data Transformation & Feature Engineering, Merging, Sorting, Filtering, and Subsetting Data, Outlier Detection, Combining Multiple Vectors and Lists, Exploratory Data Analysis  Data Visualization using R: Base R graphics & ggplot2, Creating: Bar charts, Dot plots, Histograms, Box plots, Line graphs, Scatter plots, Coloring, Themes, and Aesthetics in Plots		
<b>Unit: IV</b>	<b>Machine Learning with R</b>	Contact Hours: 10 hrs

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Overview of Machine Learning, Model Training and Evaluation in R, Supervised Learning Algorithms: Linear Regression, Logistic Regression, Decision Trees (CART), Random Forests, Naïve Bayes, Support Vector Machines (SVM), Unsupervised Learning Algorithms: K-Means & K-Means++ Clustering, Hierarchical Clustering (Agglomerative), Dimensionality Reduction: PCA (Principal Component Analysis), Model Evaluation Metrics: Confusion Matrix, Accuracy, Precision, Recall, F1 Score, ROC Curve, AUC

**Textbook/s:**

1. R for Data Analysis in Easy Steps by Mike McGrath – 2020
2. R for Data Science by Hadley Wickham & Garrett Golemund – 2017
3. Hands-On Programming with R by Garrett Golemund – 2014
4. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce & Peter Gedeck – 2020 (2nd Edition)
5. Introductory Statistics with R by Peter Dalgaard – 2008 (2nd Edition)
6. Statistics: An Introduction using R by Michael J. Crawley – 2014 (2nd Edition)
7. Hands-On Machine Learning with R by Brad Boehmke & Brandon Greenwell – 2020

**Reference Books:**

1. McGrath, M. (2020). R for data analysis in easy steps. In Easy Steps Limited.
2. Wickham, H., & Golemund, G. (2017). R for data science. O'Reilly Media.
3. Bruce, P., Bruce, A., & Gedeck, P. (2020). Practical statistics for data scientists (2nd ed.). O'Reilly Media.
4. Boehmke, B., & Greenwell, B. (2020). Hands-on machine learning with R. CRC Press.
5. Sievert, C., & Wickham, H. (2020). Interactive data visualization with Shiny. CRC Press

**Online Learning Resources/URLs:**

1. <https://www.coursera.org/learn/foundations-of-data-science>
2. <https://www.khanacademy.org/math/statistics-probability>
3. <https://www.datacamp.com/courses/free-introduction-to-r>
4. <https://www.coursera.org/learn/r-programming>
5. <https://www.datacamp.com/courses/data-manipulation-with-dplyr>
6. <https://www.coursera.org/learn/data-visualization>
7. <https://cognitiveclass.ai/courses/machine-learning-r>

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-204A	Foundations of Artificial Intelligence & Machine Learning	2	0	-	2									
		CIE	SEE		Total									
		40	60	100										
<b>Course Outcomes</b>														
CO1	Describe the fundamental concepts and historical foundations of Artificial Intelligence and its problem-solving techniques.													
CO2	Apply strategic reasoning and knowledge representation techniques using logic-based systems and game-playing algorithms.													
CO3	Demonstrate structured knowledge representation methods and handle uncertainty in AI using logic and probabilistic approaches.													
CO4	Explain the foundations of Machine Learning and apply basic algorithms and evaluation techniques in supervised and unsupervised learning.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	3	-	-	-	1	2	1	2	3	2
CO3	3	3	2	2	2	-	-	-	1	1	-	2	3	2
CO4	3	3	3	3	3	-	-	-	1	2	1	3	3	3

## COURSE CURRICULAM

### Course Outline:

<b>Unit: I</b>	<b>Foundations and Blind Problem Solving in Artificial Intelligence</b>	Contact Hours:9
<p><b>Scope of AI:</b> AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, AI techniques-search knowledge, abstraction.</p> <p><b>Problem Solving (Blind):</b> State space search; production systems, search space control; depth first search, breadth first search. <b>Heuristic Based Search:</b> Heuristic search, Hill climbing, best-first search, branch and bound, Problem Reduction, Constraint Satisfaction End, Means-End Analysis.</p>		
<b>Unit: II</b>	<b>Strategic Reasoning and Knowledge Representation in AI</b>	Contact Hours: 9
<p><b>Game Playing:</b> Game Tree, Minimax Algorithm, Alpha Beta Cutoff, Horizon Effect, Futility Cut-off.</p> <p><b>Knowledge Representation:</b> Inference in First order logic – propositional versus first order logic, Predicate Logic: Syntax and semantics for first order logic, Unification and lifting, Modus Ponens, Modus Tolens, Resolution in Predicate Logic, Conflict Resolution Forward Chaining, Backward Chaining, Resolution, Declarative and Procedural Representation, Rule based Systems.</p>		
<b>Unit: III</b>	<b>AI Learning Techniques and Knowledge-Based Systems</b>	Contact Hours:10
<p><b>Structured Knowledge Representation:</b> Semantic Nets: Slots, exceptions and default frames, conceptual dependency, scripts.</p> <p><b>Handling Uncertainty:</b> Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic.</p> <p><b>Natural Language Processing:</b> Introduction, Syntactic Processing, Semantic Processing, Pragmatic Processing.</p>		
<b>Unit: IV</b>	<b>Machine Learning Foundations</b>	Contact Hours: 8
<p><b>Machine Learning:</b> Introduction to Machine Learning, Forms of Machine Learning, well-posed machine learning problems, Applications of Machine Learning, Regression, Support Vector Machines, Evaluation metrics, clustering and its types, Ensemble Methods, Feature Engineering Content-based recommender systems, Collaborative Filtering,</p>		

### Textbook/s:

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1. Russell, S.J. and Norvig, P., 2021. Artificial Intelligence: A Modern Approach. 4th ed. Harlow: Pearson Education.
2. Alpaydin, E. (2020) *Introduction to Machine Learning*. 4th edn. Cambridge, MA: MIT Press.

**Reference Books:**


1. Padhy, N.P., 2005. Artificial Intelligence and Intelligent Systems. New Delhi: Oxford University Press.
2. Mitchell, T.M., 1997. Machine Learning. New York: McGraw-Hill Education.
3. Bird, S., Klein, E. and Loper, E., 2009. Natural Language Processing with Python. Beijing: O'Reilly Media.
4. Giarratano, J.C. and Riley, G.D., 2005. Expert Systems: Principles and Programming. 4th ed. Boston: Thomson Course Technology.
5. Marsland, S. (2015) *Machine Learning: An Algorithmic Perspective*. 2nd edn. Boca Raton: CRC Press.
6. Murphy, K.P. (2012) *Machine Learning: A Probabilistic Perspective*. Cambridge, MA: MIT Press.

**Online Learning Resources/URLs:**

1. Artificial Intelligence by NPTEL (Prof. P. Dasgupta - IIT KGP)  
<https://nptel.ac.in/courses/106105078>
2. Game Playing & Minimax (Berkeley AI Course - CS188)  
<https://inst.eecs.berkeley.edu/~cs188/fa18/>
3. Semantic Networks & Frames (Stanford AI)  
<https://web.stanford.edu/class/cs124/>
4. Handling Uncertainty in AI (Fuzzy Logic and Probability - NPTEL)  
<https://nptel.ac.in/courses/111105090>
5. Coursera – Machine Learning by Andrew Ng (Stanford University)  
<https://www.coursera.org/learn/machine-learning>
6. Towards Data Science (Medium Blog)  
<https://towardsdatascience.com/>

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Course Code	Course Title	L	T	P	Credits
BT-AIDS- 206A	Object Oriented Programming Using Java	2	0	-	2
		CIE	SEE		Total
		40	60	100	

### Course Outcomes

CO1	Define, understand, differentiate, and apply Object-Oriented and Java Programming concepts on real-time scenarios.
CO2	Use Exception handling and multithreading mechanisms to create efficient software applications.
CO3	Utilize modern tools and collection framework to create Java applications to solve real-world problems.
CO4	Design and develop GUI based applications using applets and swings for internet and system-based applications.

### Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	1	-	-	-	2	1	2	3	2
CO2	2	2	3	2	1	1	-	-	-	1	1	2	3	3
CO3	2	3	3	2	3	2	-	-	-	2	2	3	3	3
CO4	2	2	3	1	2	2	-	-	-	2	1	2	3	3

## COURSE CURRICULAM

### Course Outline

<b>Unit: I</b>	<b>Foundational Java and Object-Oriented Programming</b>	Contact Hours: 08
<p>Introduction: History of Java, Byte code, JVM, Java buzzwords, OOP principles, Data types, Variables, Scope and life time of variables, Operators, Control statements, Type conversion and casting, Arrays. Concepts of classes and objects: Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and method, Access control, this key word, Garbage collection, String class, String Tokenizer.</p> <p>Inheritance: Inheritance basics, Types of inheritance, Member access rules, Usage of super key word, Method overriding, Usage of final, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extended interfaces; Packages - defining, creating and accessing a package, importing packages, access control in packages.</p>		
<b>Unit: II</b>	<b>Exception Handling and Multithreading</b>	Contact Hours: 08
<p>Exception Handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, Creating user defined exception;</p> <p>Multithreading: Concepts of multithreading, Differences between process and thread, Thread life cycle, creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication.</p>		
<b>Unit: III</b>	<b>Collection Framework</b>	Contact Hours: 09
<p>Collection Framework: Collections Overview, Collection Interfaces - List, Set, Map, List – Array List, LinkedList, Vector, Set - HashSet, Tree Set, Map - HashMap, Hash table, Accessing a collection via an Iterator, comparator, comparable. Inheritance, Types of inheritance (single, multilevel, hierarchical), Polymorphism, Abstraction, Encapsulation, Method overriding, Abstract classes, Interfaces</p>		
<b>Unit: IV</b>	<b>GUI programming with swing</b>	Contact Hours: 10
<p>GUI programming with swing: Applets - Applet Class, Applet skeleton, Simple Applet; Delegation event model - Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events. Exploring swing controls: JLabel and Image Icon, JTextField, JButton, JCheckBox, JRadioButton, JTabbed Pane, JList, JCombo Box.</p>		

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**Textbook/s:**

1. Java Fundamentals—A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
2. Core Java: An Integrated Approach – Dr R Nageswara Rao

**Reference Books:**


1. Java for Programmers, P.J.Deitel and H.M.Deitel, PEA (or) Java: How to Program, P.J.Deitel and H.M.Deitel, PHI
2. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
3. Thinking in Java, Bruce Eckel, PE
4. Programming in Java, S. Malhotra and S. Choudhary, Oxford Universities Press.
5. Design Patterns Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides

**Online Learning Resources/URLs:**

1. NPTEL: "Programming in Java" or "Object-Oriented Programming" on the NPTEL website (<https://onlinecourses.nptel.ac.in/>).
2. Coursera: Search for "Java Object-Oriented Programming" on Coursera (<https://www.coursera.org/>). Universities like Duke, Stanford, and others offer relevant courses.

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-208A	Operating Systems	3	0	-	3									
		CIE	SEE		Total									
		40	60		100									
<b>Course Outcomes</b>														
CO1	To understand the structure and functions of Operating system.													
CO2	To learn about processes, threads and scheduling algorithms.													
CO3	To understand the concept of deadlocks and various memory management scheme.													
CO4	To understand file systems and I/O management													
<b>Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	-	1	-	-	-	-
CO2	2	3	2	2	2	1	1	1	-	2	-	-	-	-
CO3	2	3	3	2	1	2	1	2	-	1	-	-	2	2
CO4	3	2	2	3	3	1	1	1	-	1	-	-	2	2

## COURSE CURRICULAM

### Course Outline

<b>Unit: I</b>	<b>Introduction to Operating System</b>	Contact Hours:7
<p><b>Introduction:</b> Introduction to OS. Operating system functions, Different types of O.S.: batch process, multi-programmed, time-sharing, real-time, distributed, parallel.</p> <p><b>System Structure:</b> Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls</p>		
<b>Unit: II</b>	<b>CPU Scheduling and Process Management</b>	Contact Hours:12
<p><b>CPU scheduling:</b> scheduling criteria, pre-emptive and non-pre-emptive scheduling, scheduling algorithms, algorithm evaluation, multi-processor scheduling.</p> <p><b>Threads:</b> overview, benefits of threads, user and kernel threads.</p> <p><b>Process Management:</b> Concept of processes, process states, process control, co-operating processes, inter-process communication.</p> <p><b>Process Synchronization:</b> background, critical section problem, critical region, synchronization hardware, Classical problems of synchronization, semaphores.</p>		
<b>Unit: III</b>	<b>Deadlocks and Memory Management</b>	Contact Hours:10
<p><b>Deadlocks:</b> Concept of deadlock, deadlock characterization, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.</p> <p><b>Memory Management:</b> background, logical vs. physical address space, contiguous memory allocation, paging, segmentation, segmentation with paging. Concept of fragmentation.</p> <p><b>Virtual Memory:</b> background, demand paging, concept of page replacement, page replacement algorithms, allocation of frames, thrashing.</p>		
<b>Unit: IV</b>	<b>File System, I/O Management and Disk Management</b>	Contact Hours:10

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**File Systems:** file concept, file organization and access methods, allocation methods, directory structure, free-space management

**I/O Management:** I/O hardware, polling, interrupts, DMA, kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation)

**Disk Management:** disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN), disk reliability, disk Performance parameters

  
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**Textbook/s:**

1. Operating System Principles by “Peter and Galvin”

**Reference Books:**

1. Operating System Concepts”, Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, Wiley
2. Operating systems: a concept based approach”, Dhananjay M. Dhamdhere, McGraw Hill.
3. Operating Systems : Internals and Design Principles, William Stallings, Pearson
4. Operating Systems Design and Implementation” ,(Prentice Hall Software Series) Andrew S Tanenbaum and Albert S Woodhull.
5. Taub and Schilling, Principles of Communication Systems, TMH.
6. Mithal G K, Radio Engineering, Khanna Pub.
7. Sirnon Haykin, Communication Systems, John Wiley.

**Online Learning Resources/URLs:**

1. edX Operating Systems Courses: <https://www.edx.org/learn/operating-systems>
2. Operating System Tutorial - Tutorialspoint: [https://www.tutorialspoint.com/operating\\_system/index.htm](https://www.tutorialspoint.com/operating_system/index.htm)
3. Lectures on Operating Systems - CSE, IIT Bombay: <https://www.cse.iitb.ac.in/~mythili/os/>
4. CS401: Operating Systems - Saylor Academy: <https://learn.saylor.org/course/view.php?id=94>

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Course Code	Course Title		L	T	P	Credits								
BT-ECE-202A	Microprocessors Based System Design		3	0	0	3								
			CIE	SEE		Total								
			40	60	100									
Course Outcomes														
CO1	To understand the detailed architecture of microprocessor 8086													
CO2	To implement the interfacing of memories to 8086 Microprocessor and study of interrupt.													
CO3	To classify and explain the instruction set and programming concepts in assembly language.													
CO4	To apply the programming tools to Interface peripherals with microprocessor.													
Course Outcomes (CO) to Programme Outcomes (PO) mapping (Scale 1: Low, 2: Medium, 3: High)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	1	-	-	-	-	-	-	1	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
Avg	3	3	3	2	1	-	-	-	-	-	-	1	3	2

## COURSE CURRICULAM

### Course Outline

<b>Unit: 1</b>	<b>8086 CPU Architecture</b>	<b>Contact Hours:11</b>
Introduction to basic computer architecture, Functional units, Basic operational concepts, Harvard architecture, Von-Neumann Architecture, 8086 Block diagram; description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU. 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. WAIT state generation. Microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module.		
<b>Unit: 2</b>	<b>Main Memory System Design</b>	<b>Contact Hours:7</b>
Memory devices, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode. Units of memory capacity, concept of memory banking, Address decoding techniques. Interfacing different configurations of SRAMS, ROMS/PROMS with 8086 based CPU module. Interfacing and refreshing DRAMS.		
Interrupts: 8086 Interrupt mechanism; interrupt types and interrupt vector table. Applications of interrupts		
<b>Unit: 3</b>	<b>8086 Instruction Set and Programming Techniques</b>	<b>Contact Hours:8</b>
Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; Assembler directives. Writing assembly Language programs for logical processing, arithmetic processing, timing delays; loops, data conversions		
<b>Unit: 4</b>	<b>Basic I/O Interface</b>	<b>Contact Hours:10</b>

I/O Intel's 8255 - description and interfacing with 8086. Interfacing of 0808/0809 ADCs and 0800 DACs, Generation of different waveforms. Interfacing of stepper motor, Interfacing LED displays, Interfacing Keyboards, optical encoder with 8086. Universal synchronous asynchronous receiver transmitter- 8251: describing and interfacing with 8086. Intel's 8259. DMA operation, Intel's 8237.

#### Textbook/s:

1. D.V. Hall, Microprocessors and Interfacing, McGraw Hill 2nd ed.
2. Barry B. Brey, "The Intel Microprocessor 8086/8088, 80186", Pearson Education, Eighth Edition, 2009
3. Morris Mano, "Computer System Architecture", PHI.

#### Reference Books:

1. Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2nd Edition, PHI, 2005
2. Kenneth Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Cengage Learning, Indian Edition, 2008
3. Kip Irvine, "Assembly language for IBM PC", PHI, 2nd Edition, 1993
4. Peter Abel, "Assembly language programming", Pearson Edu, 5th Edition, 2002

#### Online Learning Resources/URLs:

1. <https://archive.nptel.ac.in/courses/108/103/108103157/>

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Course Code	Course Title	L	T	P	Credits
BT- AIDS-272A	R Programming Lab	0	0	2	1
		CIE	SEE		Total
		50	50	100	

**Course Outcomes.**


CO1	Apply data handling techniques in R to read, write, and preprocess various types of datasets, including handling missing values.
CO2	Implement fundamental programming concepts in R, such as loops and data manipulation techniques using dplyr and tidyr.
CO3	Perform data analysis using statistical methods, detect outliers using the IQR method, and visualize data using graphical techniques
CO4	Develop machine learning models such as Linear Regression and Decision Trees, apply PCA for dimensionality reduction, and evaluate model performance using various metrics.

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	3	-	-	-	-	-	-	2	3	2
CO2	3	-	2	-	3	-	-	-	-	-	-	2	2	3
CO3	3	3	-	3	3	-	-	-	-	2	-	3	3	2
CO4	3	3	3	3	3	-	-	-	-	2	-	3	3	3

Sr. No.	Name of Experiments
1	Write an R script to read different types of datasets (.txt, .csv, xls, xml) and write data to a specific disk location.
2	Write an R script to perform basic descriptive statistics using summary(), str(), and quantile(), and extract subsets of data using subset() and aggregate() on a sample dataset.
3	Write an R script to handle missing values in datasets using mice package.
4	How to find a correlation matrix and plot the correlation on sample data set. · Plot the correlation plot on dataset and visualize giving an overview of relationships among data. · Analysis of covariance: variance (ANOVA), if data has categorical variables.
5	Write an R script to manipulate datasets using the dplyr and tidyr packages.
6	Write an R script to merge two or more datasets using different join operations (inner, outer, left, right) with the dplyr package.
7	Write an R script to perform inner, left, right, and full merges on two data frames with different key columns and handle missing values effectively.
8	Write an R script to detect outliers in a dataset using the Interquartile Range (IQR) method and visualize them with a boxplot.
9	Write an R script to visualize datasets using various graphical representations.
10	Use PCA in R to reduce the dimensionality of a dataset and visualize the transformed data.
11	Train and visualize a Decision Tree classifier using the rpart package in R.
12	Write an R script to implement a Linear Regression model on a dataset and evaluate model performance.
13	Compute and analyze evaluation metrics like Confusion Matrix, Accuracy, Precision, Recall, F1 Score, ROC Curve, and AUC for different models.
14	Write a program in R to find the list of even numbers from 1 to n using loops.
15	Write an R script to generate the Fibonacci sequence up to a specified number n. Visualize the sequence using a line plot.

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-274A	Foundations of Artificial Intelligence & Machine Learning Lab	-	-	4	2									
		CIE	SEE	Total										
		50	50	100										
<b>Course Outcomes.</b>														
CO1	Understand and apply fundamental programming concepts and algorithms in Python to solve classical AI problems including search, game playing, and optimization.													
CO2	Implement various search techniques such as Depth First Search, Breadth First Search, Best First Search, and Means-End Analysis to solve AI problem scenarios.													
CO3	Develop and evaluate AI models including neural networks and Support Vector Machines, and implement logic-based reasoning systems such as Modus Ponens and Modus Tollens.													
CO4	Perform Natural Language Processing tasks including text preprocessing and syntactic/semantic parsing and apply evaluation metrics to assess the performance of classification models.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	2	2	-	2	3	3
CO2	3	3	3	2	2	-	-	-	2	2	-	2	3	2
CO3	3	3	2	2	3	-	-	-	2	2	-	2	3	3
CO4	3	2	2	2	3	-	-	-	2	3	-	3	3	3
16	Write an R script to print the pattern of stars forming a pyramid using nested for loops.													
17	Write an R script to convert an amount from one currency to another based on a given conversion													

Sr. No.	Name of Experiments
1	Introduction to PYTHON & study of basic commands.
2	Write a program to implement Factorial, Fibonacci of a given number.
3	Write a program to solve 8 queens' problem
4	Solve a problem using Depth First Search.
5	Solve a problem using Breadth First Search.
6	Solve 8 puzzle problem using Best First Search
7	Solve Robot Traversal Problem using Means End Analysis
8	Solve Travelling Salesman Problem.
9	To implement efficient Game tree Search with Alpha-Beta Pruning.
10	Solving mathematical Optimization Problems with Hill Climbing
11	Build a Basic Neural Network for Classification (Use TensorFlow or PyTorch to classify simple data)
12	Implement a Simple Syntactic and Semantic NLP Parser.
13	Implement Modus Ponens and Modus Tollens Rules in real-world logic problems.
14	Perform Text Preprocessing (Tokenization, stemming, POS tagging using NLTK or spaCy) in NLP
15	Build a Game Playing Agent using Minimax Algorithm (Tic-Tac-Toe or Nim Game)
16	Evaluating the accuracy and performance of classification models.
17	Build and evaluate a Support Vector Machine (SVM) classifier for binary classification problems using real datasets.

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Course Code	Course Title	L	T	P	Credits
BT- AIDS -276A	Object Oriented Programming Using Java Lab	-	-	4	2
		CIE	SEE		Total
		50	50	100	

**Course Outcomes**

CO1	Implement fundamental Java programming constructs and object-oriented principles (classes, inheritance, interfaces, packages) to solve basic programming problems.
CO2	Develop robust and efficient Java applications by effectively incorporating exception handling and multithreading concepts.
CO3	Apply appropriate Java Collection Framework data structures to efficiently store and manipulate data for various problem-solving scenarios.
CO4	Design and develop interactive graphical user interface (GUI) applications using Swing components and event handling mechanisms.

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	3	-	-	-	2	-	2	2	3	2
CO2	2	2	1	1	2	-	-	-	1	-	1	2	2	2
CO3	2	2	2	1	3	-	-	-	2	-	1	2	2	2
CO4	2	2	2	1	3	-	-	-	2	-	2	2	3	1

Sr. No.	Name of Experiments
1	Write a Java program to demonstrate different data types, variables, operators, and type casting.
2	Implement programs demonstrating various control statements (if-else, switch, for, while, do-while) with example scenarios.
3	Write a program to create and manipulate one-dimensional and two-dimensional arrays, including passing command-line arguments.
4	Design a Student class with attributes (name, rollNo, marks) and methods (constructor, displayDetails()). Create multiple objects.
5	Demonstrate method overloading by creating a Calculator class with multiple add methods. Implement constructor overloading for a class.
6	Understand and apply the static keyword (variables, methods) and the this keyword in a class (e.g., College and Student classes).
7	Implement various String class methods and demonstrate StringTokenizer to parse a sentence into words.
8	Illustrate single and multilevel inheritance by creating a hierarchy (e.g., Animal -> Dog -> Labrador) and demonstrate method overriding.
9	Implement hierarchical inheritance (e.g., Shape with derived Circle, Rectangle). Use the super keyword to call base class constructors.
10	Define and implement an abstract class (e.g., Vehicle) with an abstract method and create concrete subclasses to demonstrate polymorphism.
11	Create and implement an interface (e.g., Playable) in multiple classes (e.g., AudioPlayer, VideoPlayer) to show interface usage.
12	Create and use custom packages (mypackage.shapes, mypackage.utils). Demonstrate importing classes and access control modifiers.
13	Implement basic exception handling using try, catch, and finally blocks for ArithmeticException and ArrayIndexOutOfBoundsException.
14	Create a user-defined exception (e.g., InvalidAgeException). Demonstrate throw and throws keywords for exception propagation.
15	Implement multithreading by extending the Thread class. Create and run multiple threads concurrently.
16	Implement multithreading by implementing the Runnable interface. Create Thread objects and

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	run them concurrently.
17	Demonstrate thread synchronization using synchronized methods or blocks with a shared resource to prevent inconsistent results.
18	Implement inter-thread communication using wait(), notify(), and notifyAll() to solve the Producer-Consumer problem.
19	Demonstrate List interface implementations (ArrayList, LinkedList). Perform add, remove, access operations and iterate using Iterator and for-each loop.
20	Implement Set (HashSet, TreeSet) and Map (HashMap, Hashtable) interfaces with custom objects. Demonstrate Comparable and Comparator for sorting.
21	Create a simple Swing application using JFrame, JLabel, JTextField, and JButton with an ActionListener for user interaction.
22	Design a GUI using JCheckBox and JRadioButton components. Demonstrate grouping radio buttons using ButtonGroup and handling their selection events.
23	Implement a GUI that utilizes JList and JComboBox for displaying selection options. Show how to retrieve selected items from these components.
24	Develop a multi-panel GUI application using JTabbedPane to organize different views or sections within a single window.
25	Write a Swing application to demonstrate event handling for mouse (e.g., MouseListener) and keyboard (e.g., KeyListener) events.

  
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Course Code	Course Title		L	T	P	Credits								
BT-ECE-272A	Microprocessors Based System Design Lab		0	0	2	1								
			CIE	SEE		Total								
			50	50		100								
Course Outcomes														
CO1	Implement Fundamental Arithmetic and Logical Operations in Assembly Language													
CO2	Apply Memory Manipulation Techniques in Assembly Language													
CO3	Implement String and Data Processing Operations in Assembly Language													
CO4	Develop Algorithmic Solutions for Problem Solving in Assembly Language													
Course Outcomes (CO) to Programme Outcomes (PO) mapping (Scale 1: Low, 2: Medium, 3: High)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	2	2	1	-	-	3	-
CO2	3	3	3	2	-	-	-	2	2	1	-	2	3	2
CO3	3	3	3	2	-	-	-	2	2	1	-	2	3	2
CO4	3	3	3	-	-	-	-	2	2	1	-	-	3	2
Avg	3	3	3	2	-	-	-	2	2	1	-	-	3	2

#### List of Experiments:

- Write an assembly language program to add/sub two 8-bit, 16-bit and 32-bit numbers.
- Write an assembly language program to multiply two 16 bit unsigned/signed numbers.
- Write an assembly language program to divide two unsigned/signed numbers (32/16, 16/8, 16/16, 8/8).
- Write an assembly language program to find 1's and 2's complement of a number.
- Write an assembly language program to evaluate the following equation:

$$x = \frac{(6 \times 8) + 9 - 7}{5}$$

- Write an assembly Language program to multiply 2, 8-bit numbers using repetitive addition. Assume the multiplicand is saved at location DS:0050 and the multiplier is available at location DS:0060.
- Write an assembly language program to save 55H on 10 memory locations starting from DS:200H onwards.
- Write an ALP to copy a chunk of 5 bytes of data starting from memory location DS:0100H to memory location DS:0110H
- Write an ALP to exchange two chunks of data, 8 bytes each. First data begins from memory location DS:0100H and the second data begins from memory location DS:0120H.
- Write an assembly language program to add 10 Byte of data available in the memory from location DS:0050H onwards and save the result in memory location DS:0020H.
- Write an assembly language program to convert the following two unpacked BCD numbers into a packed BCD number:
  - 05H
  - 08H
- Write an assembly language program to search the presence of a given byte in a list of 20 byte available in the memory starting from the memory location DS:0100H.
- Write an assembly language program to count the number of 1's in a given byte. Save the count in DL register.
- Write an assembly language program to check the parity of a given byte. If the parity is odd save 0FH in DL register. If the parity is even save 0F0H in the DL register.
- Write an assembly language program to find smallest /largest number from array of n numbers.
- Write an assembly language program to arrange numbers in array in ascending / descending

order.

17. Write an assembly language program to convert Hex to Decimal, Decimal to Hex.
18. Write an assembly language program to compare two strings using string instructions / without using string instructions.
19. Write an assembly language program to display string in reverse order, string length, concatenation of two strings.
20. Write an assembly language program to find factorial of a number.
21. Write an assembly language program to transfer the data between 8086 Microprocessor and Peripheral Device Using 8255 Programmable Peripheral Interface.

**Note: Students have to perform at least 15 experiments from the given list of practical.**

**NOTE:**

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2. The students will be allowed to use non-programmable scientific calculator. However, sharing / exchange of calculator or any other items are prohibited in the examinations. No programmable calculators, mobile phones or other electrical.



Course Code	Course Title	L	T	P	Credits									
BT-CE-102A	Environmental Studies	3	-	-	-									
		CIE	SEE		Total									
		40	60	100										
<b>Course Outcomes</b>														
CO1	Develop concepts of basic environmental factors.													
CO2	Introduce to the students the basic understanding of ecosystem and its structural and functional aspects and vast biodiversity.													
CO3	Outline aspects of environmental issues.													
CO4	Understand the knowledge of energy resources and their environmental implications.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	2	3	-	-	-	-	-	2	3
CO2	2	-	-	-	-	-	3	-	-	-	-	-	2	3
CO3	2	-	-	-	-	3	3	2	-	-	-	-	1	3
CO4	3	-	-	-	-	2	3	-	-	-	-	2	2	3

## COURSE CURRICULAM

### Course Outline

<b>Unit: I</b>	<b>The multidisciplinary nature of environmental studies</b>	<b>Contact Hours:10</b>
Introduction to Environment: Definition, Scope, and importance of environmental studies; need for public awareness. Environmental Pollution: Definition, Cause and effects of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Role of an individual in prevention of pollution, Pollution case studies		
<b>Unit: II</b>	<b>Natural Resources</b>	<b>Contact Hours:10</b>
Water resources: over-utilization, floods, drought, dams-benefits and problems; Mineral resources: Use and exploitation, environmental effects; Food resources: changes caused by modern agriculture, fertilizer-pesticide problems, water logging, Energy resources: Growing energy needs, renewable and non-renewable energy sources; Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.		
<b>Unit: III</b>	<b>Ecosystems and Biodiversity</b>	<b>Contact Hours:10</b>
Concept of an ecosystem, Structure and function, Energy flow, Ecological succession, ecological pyramids. Concept of Biodiversity, definition and types, Hot-spots of biodiversity; Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity.		
<b>Unit: IV</b>	<b>Social Issues and the Environment</b>	<b>Contact Hours:8</b>
Water conservation, rain water harvesting, Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, public awareness. Population growth, variation among nations, Family Welfare Programme. Human Population and the Environment - Population growth, Population explosion, Women and Child Welfare.		

**Field Work** - Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc. (Field work equal to 5 lecture hours)

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### **Text Book**

- Environmental Studies- Deswal and Deswal. Dhanpat Rai & Co.
- Environmental Science & Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India

### **Reference Books**

- Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
- Environmental Science- Botkin and Keller. 2012. Wiley, India.
- A Textbook of Environmental Studies by Asthana D.K. and Asthana Meera
- Fundamental Concepts in Environmental Studies by Mishra D.D.
- Environmental Studies by S.C Sharma M.P Poonia
- Textbook of Environmental Studies for Undergraduate by Erach Bharucha
- Environmental Studies: Third Edition by R. Rajagopalan

### **Online Learning Resources/URLs:**

1. <https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf>

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# Honours Course

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-252A	Business Analytics with Excel & Power BI	3	-	2	4									
		CIE	SEE	Total										
		40	60	100										
<b>Course Outcomes</b>														
CO1	Understand and use advanced ideas in Business Analytics to solve real and complex business problems using different kinds of data.													
CO2	Learn about advanced data manipulation, statistical analysis, and professional visualization techniques using Microsoft Excel for in-depth business intelligence.													
CO3	Develop expertise in Power BI for sophisticated data acquisition, transformation, and complex data modeling, including advanced DAX pattern implementation.													
CO4	Design and develop Power BI solutions, providing strategic insights and driving impactful decision-making.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	-	2	3	3
CO2	3	3	3	2	3	-	-	-	-	-	-	2	3	3
CO3	2	2	3	-	3	2	-	-	-	3	-	2	3	2
CO4	2	2	2	-	3	3	-	2	2	3	2	3	3	3

## COURSE CURRICULAM

### Course Outline

Unit: I	Introduction to Business Analytics Fundamentals	Contact Hours: 06
<p>Strategic Role of Business Analytics: Evolution of analytics, competitive advantage through data, organizational readiness.</p> <p>Advanced Analytical Techniques Overview: Introduction to Regression Analysis (Multiple, Logistic), Time Series Forecasting fundamentals, basics of Optimization and Simulation.</p> <p>Analytics Project Lifecycle: In-depth study of methodologies like CRISP-DM, agile analytics approaches, project scoping and stakeholder management.</p> <p>Data Governance and Quality Management: Principles of data governance, data quality dimensions, data lineage, master data management concepts.</p>		
Unit: II	Data Analysis & Modeling with Microsoft Excel	Contact Hours: 08
<p>Excel Functions and Formulas: Array formulas, user-defined functions (UDFs) via LAMBDA (conceptual), complex nested functions (e.g., XLOOKUP, TEXTJOIN, UNIQUE).</p> <p>Power Query in Excel for Advanced ETL: Deep dive into Power Query Editor in Excel, M-language fundamentals, custom functions, query folding optimization, handling large datasets.</p> <p>Power Pivot for Data Modeling in Excel: Creating robust data models within Excel, establishing intricate relationships, understanding DAX basics within Power Pivot for calculated fields.</p> <p>Dynamic and Advanced Charting Techniques: Creating interactive and dynamic charts, sparklines, advanced conditional formatting for visual alerts and trends.</p>		
Unit: III	Data Analysis and Visualization with Microsoft Excel	Contact Hours: 10
<p>Excel Interface and Basic Operations: Navigating the ribbon, worksheets, cells, ranges; basic formulas and functions (SUM, AVERAGE, COUNT, MAX, MIN).</p> <p>Data Manipulation and Cleaning in Excel: Sorting, Filtering, Advanced Filter, Conditional Formatting, Text-to-Columns, Remove Duplicates.</p> <p>Lookup and Reference Functions: VLOOKUP, HLOOKUP, INDEX-MATCH for retrieving data.</p> <p>Conditional and Statistical Functions: SUMIFS, COUNTIFS, AVERAGEIFS, RANK, LARGE, SMALL.</p> <p>PivotTables and PivotCharts: Creating and customizing PivotTables for data summarization and analysis,</p>		

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generating dynamic PivotCharts.

Chart Creation and Enhancement: Creating various chart types (Bar, Line, Pie, Scatter, Combo Charts), formatting charts for clarity and impact.

Introduction to Basic Excel Dashboards: Principles of dashboard design using Excel features.

**Unit: IV**

**Power BI for Business Intelligence & Visualization**

Contact Hours: 10

Power BI Ecosystem & Basics: Overview of Power BI Desktop and Service, key features, capabilities, and typical use cases.

Data Connection & Transformation: Connecting to various data sources (Excel, CSV, databases, web); comprehensive data cleaning and transformations using Power Query Editor (e.g., merging, appending, pivoting, error handling).

Data Modeling & DAX: Principles of data modeling including relationships (cardinality, cross-filter direction) and schema design (Star vs. Snowflake). Introduction to DAX for creating calculated columns and measures, covering essential functions (aggregates, logical, text, date/time intelligence).

Visualization & Report Design: Exploring diverse visualization types (charts, KPIs, maps); implementing report interactivity (slicers, bookmarks, drill-through); applying dashboard design principles (formatting, themes, custom visuals).

**Textbooks:**

1. James R Evans, "Business Analytics," Global Edition, Pearson Education
2. U Dinesh Kumar, "Business Analytics," Wiley India Pvt. Ltd., New Delhi
3. Ger Koole, "An Introduction to Business Analytics," Lulu.com, 2019

**Reference Books:**

1. J. D. Camm, J. J. Cochran, M. J. Fry, J. W. Ohlmann, D. R. Anderson, D. J. Sweeney, T. A. Williams, "Essentials of Business Analytics," 2e; Cengage Learning.
2. Vipin Kumar, "Introduction to Data Mining," Pang-Ning Tan, Michael Steinbach, Pearson Education India
3. Bhimasankaram Pochiraju, Sridhar Seshadri, "Essentials of Business Analytics: An Introduction to the Methodology and its Application," Springer

**Online Learning Resources/URLs:**

1. NPTEL (National Programme on Technology Enhanced Learning): NPTEL website: <https://onlinecourses.nptel.ac.in/>

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Course Code	Course Title	L	T	P	Credits
BT-AIDS-252A	Business Analytics with Excel & Power BI Lab	3	-	2	4
		CIE	SEE		Total
		40	60		100

### Course Outcomes

CO1	Apply fundamental and advanced business analytics concepts to formulate, analyze, and interpret solutions for complex data-driven problems.
CO2	Demonstrate practical expertise in advanced data manipulation, statistical analysis, and professional visualization techniques using Microsoft Excel.
CO3	Master the practical aspects of data acquisition, transformation, and complex data modeling in Power BI, including implementing advanced DAX patterns.
CO4	Develop, deploy, and optimize interactive Power BI dashboards and reports to effectively communicate strategic business insights and support decision-making.

### Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	-	2	2	3
CO2	3	3	3	2	2	-	-	-	-	-	-	2	3	3
CO3	2	2	3	-	3	2	-	-	-	3	-	2	3	2
CO4	2	2	2	-	2	3	-	2	2	3	2	3	3	3

Sr. No.	Name of Experiments
1	Analyze a business problem, formulate analytical questions, and propose data sources.
2	Identify data quality issues in a raw dataset and outline a data governance plan.
3	Apply basic descriptive statistics (mean, median, std dev) to a dataset in Excel.
4	Implement advanced array formulas and LAMBDA functions (conceptual) in Excel.
5	Use Power Query in Excel to connect to multiple sources and perform complex merges.
6	Build a data model in Excel's Power Pivot, define relationships, and create basic DAX.
7	Design dynamic charts in Excel that respond to user input or data filters.
8	Apply advanced conditional formatting rules for visual alerts and trends in Excel.
9	Perform comprehensive data cleaning (duplicates, text-to-columns) in Excel.
10	Master VLOOKUP/INDEX-MATCH and advanced logical/conditional Excel functions.
11	Create complex PivotTables and Pivot Charts for multi-dimensional data analysis.
12	Develop an interactive dashboard in Excel using various features (slicers, forms).
13	Connect Power BI Desktop to diverse data sources (database, cloud service, API).
14	Perform advanced data transformations and custom columns using Power Query M language.
15	Construct a robust Star Schema data model in Power BI with complex relationships.
16	Create advanced DAX measures including Time Intelligence functions and iterators.
17	Design and develop a multi-page interactive Power BI report with diverse visualizations.
18	Implement report interactivity features like bookmarks, drill-through, and custom navigation.
19	Publish a Power BI report to Service, create an App, and configure Row-Level Security (RLS).
20	Analyze Power BI report performance and apply optimization techniques for efficiency.

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# **After 4th Semester Exit Course**

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-301A	Data Analytics & Visualization	3	-	-	2									
		CIE	SEE		Total									
		40	60	100										
<b>Course Outcomes</b>														
CO1	Understand the comprehensive lifecycle phases of Data Analytics, from initial discovery and planning to model building and effective communication of results.													
CO2	Comprehend and apply various advanced Data Analysis Techniques for different analytical problems and data types.													
CO3	Implement methods for mining and processing data from diverse streams, including real-time analytics applications.													
CO4	Analyze frequent item sets, apply various clustering techniques, and effectively visualize data to extract meaningful patterns and communicate insights.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	-	-	1	2	2	3	3	3
CO2	2	2	3	2	3	-	-	-	1	2	2	2	2	3
CO3	2	3	3	2	3	-	-	-	2	3	2	3	3	3
CO4	3	3	3	3	3	-	-	-	2	2	2	3	3	2

## COURSE CURRICULAM

### Course Outline

Unit: I	Introduction to Data Analytics Fundamentals	Contact Hours:10
<p>Introduction to Data Analytics: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data. Introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics.</p> <p>Data Analytics Lifecycle: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization.</p>		
Unit: II	Advanced Data Analysis Techniques	Contact Hours:10
<p>Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis &amp; nonlinear dynamics.</p> <p>Rule induction, neural networks: learning and generalization, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.</p>		
Unit: III	Mining Data Streams	Contact Hours:10
<p>Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window.</p> <p>Real-Time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions.</p>		
Unit: IV	Frequent Item sets, Clustering & Visualization	Contact Hours:10
<p>Mining frequent item sets, market-based modelling. Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent item sets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProClus, frequent pattern-based clustering methods, clustering in non-Euclidean space, clustering for streams and parallelism.</p>		

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Introduction to Visualization and Stages – Computational Support - Issues - Different Types of Tasks - Data representation – Limitation: Display Space- Rendering Time – Navigation Links.  
Human Vision – Space Limitation - Time Limitations - Design - Exploration of Complex Information Space - Figure Caption in Visual Interface - Visual Objects and Data Objects - Space Perception and Data in Space - Images, Narrative and Gestures for Explanation.

**Textbook/s:**

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.
3. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.

**Reference Books:**

1. Claus O. Wilke, “Fundamentals of Data Visualization”, O’Reilly Media, Sebastopol, 2019
2. Alexander Loth, “Visual Analytics with Tableau”, Wiley, Hoboken, 2019
3. Joshua N. Milligan, “Learning Tableau 2022”, Packt Publishing, Birmingham, 2021

**Online Learning Resources/URLs:**

1. Coursera – Courses like “Data Visualization with Tableau” by University of California, Davis and “Data Analysis with Python” by IBM
2. Website: <https://www.coursera.org>
3. edX – Courses such as “Data Science: Visualization” by Harvard University  
Website: <https://www.edx.org>
4. Udemy – Courses like “Tableau 2023 A-Z: Hands-On Tableau Training for Data Science” and “Microsoft Power BI Desktop for Business Intelligence”
5. Website: <https://www.udemy.com>
6. Kaggle – Hands-on learning through real datasets, notebooks, and competitions Website: <https://www.kaggle.com/learn>

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Course Code	Course Title	L	T	P	Credits									
BT-AIDS-303A	Design & Analysis of Algorithms	3	-	-	2									
		CIE	SEE	Total										
		40	60	100										
<b>Course Outcomes</b>														
CO1	Analyze the time and space complexity of algorithms and apply divide-and-conquer strategies to basic sorting and recurrence problems.													
CO2	Apply dynamic programming, greedy, backtracking, and branch & bound techniques to solve optimization problems.													
CO3	Implement and analyze graph algorithms for traversal, shortest paths, and minimum spanning trees.													
CO4	Understand flow and sorting networks and evaluate algorithmic problems in terms of computational complexity classes.													
<b>Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)</b>														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	2

## COURSE CURRICULUM

### Course Outline

<b>Unit: I</b>	Introduction	Contact Hours: 9 hrs.
Review: Elementary Data Structures (Arrays, Linked Lists, Stacks, Queues, Trees, Hash Tables, Heaps), Algorithms and its complexity (Time and Space), Analyzing Algorithms, Asymptotic Notations (Big-O, Big-Ω, Big-Θ), Sorting Algorithms: Priority Queue, Quick Sort, Heap Sort, Merge Sort Recurrence relation: Methods for solving recurrence (Substitution Method, Recursion Tree Method, Master Theorem), Divide and Conquer Algorithms: General Strategy, Example – Strassen’s Matrix Multiplication.		
<b>Unit: II</b>	Advanced Design and Analysis Techniques	Contact Hours: 10 hrs.
Dynamic programming: Elements, Matrix-chain multiplication, longest common subsequence, 0/1 Knapsack Problem, Optimal Binary Search Trees. Greedy algorithms: Elements, Activity- Selection problem, Huffman codes, Task scheduling problem, Travelling Salesman Problem. Backtracking and Branch & Bound: Basic Concepts, N-Queens Problem, Subset Sum Problem, Travelling Salesman Problem using Branch & Bound Advanced Data Structures: Binomial Heaps, Fibonacci Heaps, Splay Trees, Red-Black Trees		
<b>Unit: III</b>	Graph Algorithms	Contact Hours: 10 hrs.
Graph Traversal Methods: Traversal Methods (Depth first and Breadth first search), Topological sort, strongly connected components: Kosaraju’s Algorithm Minimum spanning trees- Kruskal’s Algorithm, Prim’s Algorithm Single source shortest paths, Relaxation, Dijkstra’s Algorithm, Bellman- Ford algorithm, Single source shortest paths for directed acyclic graphs All pairs shortest paths- shortest paths and matrix multiplication, Floyd-Warshall algorithm.		
<b>Unit: IV</b>	Network and Advanced Topics	Contact Hours: 7 hrs.
Flow Networks: Basics, Ford- Fulkerson method, Maximum Bipartite matching Sorting Networks: Basics, Comparison Networks, Zero-One Principle, Bitonic Sorting Networks, Merging Networks Computational Complexity: Basic Concepts, Polynomial Vs Non-Polynomial Complexity, NP-hard and NP-complete classes.		

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**Textbook/s:**

1. Corman, Leiserson and Rivest: Introduction to Algorithms, 2/e, PHI.
2. Das Gupta: Algorithms, TMH.
3. Horowitz, Ellis and Sahni, Sartaj: Fundamentals of Computer Algorithms. Galgotia Publications.
4. Aho, Hopcroft and Ullman: The Design and Analyses of Computer Algorithms. Addison Wesley.
5. R. B. Patel: Expert Data Structures with C, Khanna Publications, Delhi, India, 2nd Edition 2004, ISBN 81-87325-07-0.
6. R. B. Patel and M.M.S Rauthan: Expert Data Structures with C++, Khana Publications, Delhi, India, 2<sup>nd</sup> Edition 2004, ISBN 87522-03-8.

**Reference Books:**

1. Parag H. Dave and Himanshu B. Dave: *Design and Analysis of Algorithms*, Pearson Education, India, 2nd Edition, 2008, ISBN 978-8131705117.
2. Sara Baase and Allen Van Gelder: *Computer Algorithms: Introduction to Design and Analysis*, Pearson Education, India, 3rd Edition, 2000, ISBN 978-0201612448.

**Online Learning Resources/URLs:**

1. <https://www.geeksforgeeks.org/fundamentals-of-algorithms/>
2. <https://brilliant.org/courses/algorithm-fundamentals/>

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Course Code	Course Title	L	T	P	Credits
BT-AIDS-373 A	Data Analytics & Visualization Lab	0	0	2	2
		CIE	SEE		Total
		50	50		100

#### Course Outcomes

CO1	Perform fundamental data handling and numerical operations in R, including data import/export and matrix manipulations.
CO2	Apply statistical analysis and data preprocessing techniques, such as handling missing data, normalization, and dimensionality reduction, using R.
CO3	Implement common machine learning algorithms like linear regression and clustering, and conduct specialized analyses such as association rules and time-series modeling in R.
CO4	Collect data from diverse sources using web-scraping/APIs, perform text mining, and create various advanced visualizations, including cartographic representations, in R.

#### Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	-	-	-	1	3	2	3	3	3
CO2	2	2	3	2	3	-	-	-	2	2	3	2	2	3
CO3	2	3	3	2	3	-	-	-	2	3	2	3	3	3
CO4	3	3	3	3	3	-	-	-	2	2	2	3	3	2

Sr. No.	Name of Experiments
1	To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R
2	To perform data import/export (.CSV, .XLS, .TXT) operations using data frames in R.
3	To get the input matrix from user and perform Matrix addition, subtraction, multiplication, inverse transpose and division operations using vector concept in R.
4	To perform statistical operations (Mean, Median, Mode and Standard deviation) using R.
5	To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization
6	To perform dimensionality reduction operation using PCA for Houses Data Set
7	To perform Simple Linear Regression with R.
8	To perform K-Means clustering operation and visualize for iris data set
9	Learn how to collect data via web-scraping, APIs and data connectors from suitable sources as specified by the instructor.
10	Perform association analysis on a given dataset and evaluate its accuracy.
11	Build a recommendation system on a given dataset and evaluate its accuracy.
12	Build a time-series model on a given dataset and evaluate its accuracy.
13	Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
14	Perform text mining on a set of documents and visualize the most important words in a visualization such as word cloud.
15	Perform text classification (e.g., sentiment analysis) on a given text dataset using a basic machine learning model in R.

  
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Course Code	Course Title	L	T	P	Credits
BT-AIDS-375A	Design & Analysis of Algorithms Lab	0	0	2	2
		CIE	SEE	Total	
		50	50	100	

### Course Outcomes


CO1	Implement and analyze sorting and searching algorithms, including Quick Sort and Binary Search, measuring performance across varying input sizes.
CO2	Apply dynamic programming to solve the 0/1 Knapsack Problem and implement Topological Sorting on Directed Acyclic Graphs (DAGs).
CO3	Develop graph algorithms by implementing Kruskal's and Prim's Algorithms for Minimum Spanning Tree (MST), and Dijkstra's Algorithm for shortest paths in weighted graphs.
CO4	Implement optimization algorithms like Backtracking (e.g., N-Queens and Subset Sum) and analyze their performance. Parallelize the Floyd-Warshall Algorithm for all-pairs shortest paths and evaluate its efficiency.

### Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	1	1	1	2	2	3
CO2	3	3	3	2	2	-	-	-	1	1	1	2	2	3
CO3	3	3	3	3	2	-	-	-	1	1	1	2	3	3
CO4	3	3	3	3	3	-	-	-	1	1	1	3	3	3

Sr. No.	Name of Experiments
1	Write a program to sort a list of elements using the Quick Sort algorithm. Measure the time taken for different input sizes and plot a graph of time taken versus number of elements. Input can be generated randomly or read from a file.
2	Implement the Binary Search algorithm using a recursive divide and conquer approach and test it on sorted arrays.
3	Write a program to perform Topological Sorting on a Directed Acyclic Graph (DAG).
4	Implement the 0/1 Knapsack problem using dynamic programming to determine the maximum value that can be accommodated in a knapsack of a given capacity.
5	Write a program to compute the shortest path from a given source vertex to all other vertices in a weighted graph using Dijkstra's Algorithm.
6	Implement Kruskal's Algorithm to find the Minimum Spanning Tree (MST) of a graph.
7	Implement Prim's Algorithm to find the Minimum Spanning Tree (MST) of a graph.
8	Perform Breadth First Search (BFS) to print all nodes reachable from a given starting node in a directed graph.
9	Use Depth First Search (DFS) to check whether a graph is connected.
10	Write a program to find all subsets of a given set of positive integers that sum up to a specified value using the backtracking approach. Display a message if no such subset exists.
11	Implement an exact solution for the TSP using dynamic programming or branch and bound.
12	Develop a program to find the Minimum Cost Spanning Tree of a graph using Prim's algorithm.
13	Implement the Floyd-Warshall algorithm for computing the shortest paths between all pairs of vertices. Parallelize the implementation using OpenMP and compare the speedup achieved.
14	Write a program to solve the N-Queens problem using backtracking and display all possible solutions for a given value of N.
15	Write a program to sort a list of integers using the Bitonic Sort Algorithm.

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