

As Per NEP 2020

**ANJUMAN-I-ISLAM'S
KALSEKAR TECHNICAL CAMPUS
SCHOOL OF ENGINEERING & TECHNOLOGY**
(AN AUTONOMOUS INSTITUTE AFFILIATED TO UNIVERSITY OF MUMBAI)



**Syllabus for Major
Vertical – 1, 4 & 6**

Name of the Programme – B.Tech. (Computer Science & Engineering (Data Science))

Faculty of Engineering

Board of Studies in Computer Science & Engineering (Data Science)

**U.G. Second Year
Programme**

Exit Degree

**Two Year U.G. Diploma in Computer
Science & Engineering (Data
Science).**

Semester

III & IV

From the Academic Year

2025-26



(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B.Tech. (<u>Computer Science & Engineering (Data Science)</u>)
2	Exit Degree	Two Year U.G. Diploma in <u>Computer Science & Engineering (Data Science)</u>.
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R: _____	Attached herewith
6	Semesters	Sem. III & IV
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-

Dr. Tabassum Maktum
BoS-Chairman – CSE(DS)
SoET-AIKTC

Sd/-

Dr. Rajendra Magar
Principal, SoET-AIKTC

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Dr. Ramjan Khatik
Director, AIKTC

Preamble

In alignment with the **National Education Policy (NEP) 2020**, the Department of Computer Science & Engineering (Data Science) is committed to ensuring academic excellence through a structured and outcome-based approach to teaching and learning. Accreditation remains the key mechanism for assuring quality in higher education, with a primary focus on evaluating program outcomes. Reflecting this philosophy, the **Faculty of Science and Technology, University of Mumbai**, has pioneered the integration of NEP 2020 principles into curriculum design and implementation.

The **Second-Year Engineering Program** serves as a foundation for developing scientific reasoning, analytical thinking, and problem-solving skills among learners. Students are offered a flexible choice of subjects from **Program Core Courses, Multidisciplinary Minors, and Vocational Skill-Enhanced Courses**, ensuring holistic development. In line with NEP 2020, the curriculum emphasizes the essential knowledge and skills required in modern engineering, while also providing exposure to emerging technologies and industry practices.

To support a **stress-free and learner-centric pedagogy**, a **choice-based subject pool** has been introduced for the 3rd and 4th semesters. These include **Core Courses, Open Electives, and Multidisciplinary Minors**, designed to nurture creativity and align with current industry trends. Vocational and skill-enhancement modules further provide hands-on experience in contemporary industrial practices, ensuring learners acquire both academic knowledge and practical expertise.

The program structure ensures learners have the **freedom to pursue courses of their interest**, enabling a personalized and interdisciplinary learning experience. Alongside core engineering courses, emphasis is placed on **Design Thinking** introduced in the First Semester to encourage innovation and transition learners from rote learning to becoming creative professionals. Additionally, the NEP 2020 framework provides for **multiple exit options** with Certificates and Diplomas, supported by vocational skill pools aligned with industry demands.

The faculty has resolved that **clear Course Objectives and Course Outcomes** be defined for every subject to ensure consistency and depth across affiliated institutes. The **NEP 2020 grading system** brings a paradigm shift from teacher-centric to learner-centric education, focusing on time invested in learning rather than teaching. It emphasizes **continuous internal assessment**, integrating revision sessions, tutorials, guest lectures, and advanced content delivery within the 15-week teaching framework (12–13 weeks for teaching and 2–3 weeks for reinforcement).

Importantly, the second-year syllabus is designed to be **balanced and stress-free**, ensuring that learners can smoothly transition into college life and build strong bonds with faculty mentors. The revised curriculum will be implemented for the **First Year and Second Year of Engineering from the academic year 2025–26**, followed by Third Year in 2026–27 and Final Year in 2027–28.

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Two Year Under Graduate Diploma in Engineering- Computer Science & Engineering (Data Science).

Credit Structure (Sem. III & IV)

		R: _____ C									
Level	Semester	Major		Minor	OE	BSEC	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives								
5.0	III	PCC301:2 PCC302:2 PCC303:2 PCL301: 2 PCL302:1 PCL303:1 PCL304:1	--	MDM:2	--	BSEC:5	--	AEC: 2 ED: 2	--	22	Two Year UG Diploma 86
		R: _____ D									
	IV	PCC401:2 PCC402:2 PCC403:2 PCL401:1 PCL402:1 PCL403:1 PCL404:1	--	MDM: 4	OE:2	BSEC:4	--	--	CEP:2	22	
	Cum Cr.	21	--	6	2	9		4	2	44	
Exit option: Award of Two Year UG Diploma in Major with 86 credits and additional 8 credits, out of which 4 credits in work based vocational courses or internship/apprenticeship during summer vacation and 4 credits from skill-based courses to be earned during third and/or fourth semester.											

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, BSEC- Basic Science & Engineering Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Letter Grades and Grade Points:

U.G and P.G Program				
Sr. No.	Letter Grade	Percentage of Marks	Grade Points	Performance
1	O	80 and above	10	Outstanding
2	A	75:00 – 79.99	9	Excellent
3	B	70:00 – 74.99	8	Very Good
4	C	60:00 – 69.99	7	Good
5	D	50:00 – 59.99	6	Fair
6	E	45:00 – 45.99	5	Average
7	P	40:00 – 44.99	4	Pass
8	F	< 40.00	0	Fail

Semester - III									
Course Code	Course Name	Course Abbr	Teaching Contact Hours			Credits			
			Theory	Tutorial	Practical	Theory	Tutorial	Practical	Total
25CDSSEC301	Statistical Maths	SM	3	-	-	3	-	-	3
25CDSPCC301	Data Structures	DS	2	-	-	2	-	-	2
25CDSPCC302	Database Management System	DBMS	2	-	-	2	-	-	2
25CDSPCC303	Fundamentals of Data Science	FDS	2	-	-	2	-	-	2
25CDSSEC302	Problem Solving and Aptitude Building - I	PSAB-I	2	-	-	2	-	-	2
25CDSMDC301	Multidisciplinary Minor Course I	MDC-I	2	-	-	2	-	-	2
25AE302X	Modern Language	ML	2	-	-	2	-	-	2
25AE303	Entrepreneurship Development	ED	2	-	-	2	-	-	2
25CDSPCL301	Data Structures Lab	DS-L	-	-	4	-	-	2	2
25CDSPCL302	Database Management System Lab	DBMS-L	-	-	2	-	-	1	1
25CDSPCC303	Fundamentals of Data Science Lab	FDS-L	-	-	2	-	-	1	1
25CDSPCL304	Modern Programming Lab	MPL-L	-	-	2	-	-	1	1
TOTAL			27 hrs			22 Credits			

Semester - III							
Course Code	Course Name	Course Abbr	Internal Assessment		External Assessment		TOTAL
			CIA	MSE	ESE	Prac / Pres / Oral	
25CDSPCC301	Data Structures	DS	20	20	40	-	80
25CDSPCC302	Database Management System	DBMS	20	20	40	-	80
25CDSPCC303	Fundamentals of Data Science	FDS	20	20	40	-	80
25CDSSEC301	Statistical Maths	SM	20	30	50	-	100
25CDSSEC302	Problem Solving & Aptitude Building I	PSAB-I	50		-		50
25CDSMDC301	Multidisciplinary Course I	MDC-I	20	20	40	-	80
25AE302X	Modern Language	ML	50				50
25AE303	Entrepreneurship Development	ED	50				50
25CDSPCL301	Data Structures Lab	DS-L	50			25	75
25CDSPCL302	Database Management System Lab	DBMS-L	25			25	50
25CDSPCL303	Fundamentals of Data Science Lab	FDS-L	25			25	50
25CDSPCL304	Modern Programming Language Lab	MPL-L	25			25	50
TOTAL			485		310		795

Data Structures

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCC301	Data Structures	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: C Programming	
Course Objectives:	Understand the significance of data structures in the field of computer science and their role in efficient problem-solving.
	Explore various linear and nonlinear data structures and searching techniques.
	Select appropriate data structures based on the nature of a given real-world problem.
Course Outcomes (COs): At the end of the course students will be able to	
CO1	Differentiate between linear and non-linear data structures and apply basic operations such as searching, insertion, deletion, and traversal on stacks and queues. (BL3)
CO2	Perform various operations like searching, insertion, deletion and traversals on Linked List. (BL3)
CO3	Apply tree data structure to solve hierarchical and real-world problems. (BL4)
CO4	Utilize the graph data structure to solve problems in various domains. (BL3)
CO5	Select and apply suitable searching techniques to solve computational problems. (BL4)

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Title	Introduction, Stack and Queues	CO1	BL3	9
	1.1	Introduction to Data Structures, Concept of ADT, Classification of Data Structures, Array Revision, Recursion			
	1.2	Stack: ADT, Representation, Operations, Applications of Stack: Infix to postfix conversion, postfix expression evaluation, balanced parentheses			
	1.3	Queue: ADT, Representation, Operations on Queue, Circular Queue, Priority Queue, Double Ended Queue, Applications of Queue			
	1.4	Self Learning: Need of data structure for AI and ML, Infix to prefix conversion			

2	Title	Linked List	CO2	BL3	6
	2.1	ADT, Representation, Array vs Linked list, Types of Linked list			
	2.2	Singly linked list: Representation, Operations			
	2.3	Doubly linked list: Representation, Operations			
	2.4	Circular linked list: Representation, Operations			
	2.5	Stack using linked list, Queue using linked list, Applications of Linked list			
	2.6	Self Learning: Real-World Applications			
3	Title	Trees	CO3	BL4	10
	3.1	ADT, Tree Terminology, Binary Tree, Traversal of Binary Tree			
	3.2	Binary Search Tree, Operations: Insertion, Deletion, Traversal			
	3.3	Self-balancing trees: AVL trees, Operations: Rotations, Insertion			
	3.4	Applications: Expression Tree, Huffman Encoding			
	3.5	B/B+ Tree, B tree- Insertion, Deletion			
	3.6	Self Learning: Splay Tree, Tries, K-D tree, Applications in data science			
4	Title	Graph	CO4	BL3	4
	4.1	ADT, Graph Terminologies, Representation of Graph			
	4.2	Graph Traversal Technique: BFS, DFS			
	4.3	Applications: Topological Sorting			
	4.4	Self Learning: Real-World Applications Social networks, Road maps and GPS, Web page ranking (Google PageRank), Network security and packet routing,			

		Knowledge graphs in AI			
5	Title	Searching	CO5	BL4	4
	5.1	Linear Search, Binary Search			
	5.2	Hashing – Hash Tables, Hash Functions. Collision Resolution Techniques: Linear Probing, Quadratic Probing, Double Hashing			
	5.3	Self Learning: Significance of Searching Techniques in Real world applications			
				Total	28+5

Text Books :	
1	Data Structures using C, ReemaThareja, Oxford, June 2014
2	Data Structures using C, ISRD Group
3	Data Structures Using C, Aaron M Tenenbaum, Yedidiah Langsam, Moshe J Augenstein, Pearson
4	Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2ndEdition, CENGAGE Learning.
Reference Books :	
1	Data Structure Using C, E. Balagurusamy, Tata McGraw-Hill Education India.
2	Data Structures and Program Design in C, Robert Kruse, C. L. Tondo, Bruce Leung, Pearson Edition

Database Management System

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCC302	Database Management System	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Programming Fundamentals

Course Objectives:

1	Understand the need for databases and how DBMS solves data-related problems.
2	Study the architecture of DBMS and its key components.
3	Model real-world systems using Entity-Relationship diagrams.
4	Perform operations using relational algebra and SQL.
5	Apply normalization to reduce redundancy and improve consistency.

Course Outcomes (COs): At the End of the course students will be able to	
CO1	Define DBMS concepts, architecture, and the role of a DBA. (BL2)
CO2	Model data using ER diagrams and relational schemas. (BL3)
CO3	Apply relational algebra and SQL for querying databases. (BL3, BL4)
CO4	Write complex SQL queries for data manipulation. (BL3, BL4)
CO5	Apply normalization and manage transactions for database consistency. (BL4)

Module No.	Detailed Contents		CO Map ped	BL	Hrs
1	Title	Introduction to DBMS	CO1	BL2	3
	1.1	Differences between DBMS and File Systems, Advantages and disadvantages			
	1.2	DBMS architecture (1-tier to 3-tier), Data abstraction: physical, logical, and view levels, Role of DBA			
	1.3	Self-Learning: Explore real-world applications of DBMS in industries like banking, healthcare, and education.			
2	Title	Entity-Relationship (ER) Model	CO2	BL3	5
	2.1	Entities, attributes, relationships, Entity types: strong & weak			
	2.2	Primary keys, composite & derived attributes, Generalization, specialization, aggregation			
	2.3	ER to Relational mapping			
	2.4	Self-Learning: Design an ER diagram for a small company's database system and convert it into a relational schema.			
3	Title	Relational Model & Relational Algebra	CO3	BL4	7
	3.1	Concepts: relation, schema, instance, Relational constraints: keys, integrity			
	3.2	Relational algebra: select, project, rename, union, intersection, set difference, Cartesian product, join			
	3.3	Algebraic query examples in AI/ML, Basics of query optimization			

	3.4	Self-Learning:Solve advanced relational algebra problems and optimize queries for performance.			
4	Title	Structured Query Language (SQL)	CO4	BL3	6
	4.1	SQL basics: SELECT, INSERT, UPDATE, DELETE, Clauses: WHERE, ORDER BY, GROUP BY, HAVING			
	4.2	Advanced SQL: Joins (INNER, OUTER), Nested Queries, Views and Subqueries			
	4.3	SQL use in AI/ML (data preprocessing)			
	4.4	Self-Learning:Write SQL queries for a database with multiple relations, focusing on joins and subqueries.			
5	Title	Relational Database Design & Transactions	CO5	BL4	8
	5.1	Functional dependencies and their significance, 1NF, 2NF, 3NF, BCNF, Schema refinement and anomalies			
	5.2	Avoiding redundancy and inconsistency for ML-ready data			
	5.3	Transaction states and properties (ACID), Schedule types: serial, serializable, Concurrency control: locking, timestamp ordering			
	5.4	Self-Learning:Apply normalization techniques to a given unnormalized database and explore best practices for transaction management.			
				Total	28 +5

Text Books :	
1	Silberschatz, Korth & Sudarshan, <i>Database System Concepts</i> , 7th Edition, McGraw Hill
2	Elmasri & Navathe, <i>Fundamentals of Database Systems</i> , 7th Edition, Pearson
3	Ramakrishnan & Gehrke, <i>Database Management Systems</i> , 3rd Edition, McGraw Hill
Reference Books :	
1	Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, <i>Database Systems: The Complete Book</i> , 1st Edition, Prentice Hall
2	C. J. Date, <i>An Introduction to Database Systems</i> , 8th Edition, Addison-Wesley
3	C. J. Date, <i>SQL and Relational Theory: How to Write Accurate SQL Code</i> , 1st Edition, O'Reilly Media

Fundamentals of Data Science

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCC303	Fundamentals of Data Science	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using Imperative Programming

Course Objectives: The course will enable students to:

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions
3	Apply linear regression and logistic regression on the given dataset.

Course Outcomes (COs): At the end of the course, students will be able to:

CO1	Analyze the importance of Data Science and its Applications in Engineering. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basic statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Title	Introduction to Data Science	CO1	BL3	6
	1.1	Overview of the course			
	1.2	Importance of data science in engineering			
	1.3	Real-world examples of data-driven engineering solutions			
	1.4	Self-Learning: Philosophy of Exploratory Data Analysis, Data Science process and Data Scientist's role in this process			
2	Title	Data Collection and Preprocessing	CO2	BL4	6
	2.1	Data types and sources, Data collection methods, Data cleaning and preprocessing techniques			
	2.2	Exploratory Data Analysis and Data Visualization			
	2.3	Descriptive statistics, Data visualization techniques using tools: in Python			
	2.4	Self-Learning: Basic tools of EDA			
3	Title	Statistical Analysis for Data Science	CO3	BL3	8
	3.1	Introduction to Statistical Analysis,			
	3.2	Overview of statistical concepts and terms, Probability distributions			
	3.3	Hypothesis testing and significance, Statistical Inference			
	3.4	Estimation and confidence intervals, Parametric and non-parametric			

		tests,			
	3.5	Self-Learning: Describing Data with Averages - Describing Variability			
4	Title	Machine Learning Algorithms	CO4	BL3	7
	4.1	Introduction to Machine Learning, Basic concepts and types of machine learning algorithms, Supervised vs. unsupervised learning			
	4.2	Regression and Classification: Linear regression, Simple and Multiple Linear Regression, Logistic regression			
	4.3	Correlation vs. Regression, Precision, Recall, ML Models Score and Error			
	4.4	Self-Learning: KNN, K-means			
5	Title	Case Studies & Applications	CO5	BL3	6
	5.1	Real-world case studies demonstrating the use of data science in engineering			
	5.2	Discussion of ethical challenges and considerations in these case studies.			
	5.3	Self-Learning: Case-Study on any available recommendation system.			
Total					28+5

Textbooks:	
1	Fundamentals of data science, Dr. Aijaz Ali, Khan, Anita Rani Mehta, Vandana Ahuja, Rivers Publication, 2023
2	U. Dinesh Kumar, "Data Science: Theory and Practice," Wiley India
3	V.K. Jain, "Data Science and Analytics."
Reference Books:	
1	Python for Data Analysis-by WMc Kinney, OREILLY Publication.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning," Springer.

Statistical Mathematics

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSSEC301	Statistical Mathematics	3	-	-	3	-	-	3
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	30		50		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Engineering Mathematics I & II

Course Objectives: To build a strong mathematics foundation to support advanced engineering studies

Course Outcomes (COs): At the end of the course, students will be able to

1	Apply the concept of eigen values and eigen vectors to solve engineering problems.
2	Apply the concept of Correlation and Regression to solve engineering problems.
3	Apply the concepts of Probability and expectations for getting the spread of the data and use standard distribution functions.

4	Apply the concept of hypothesis testing and parametric and non parametric test to solve engineering problems
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Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	1.1	Linear Algebra: Matrix Theory Characteristic equation, Eigenvalues and Eigen vectors	CO1	BL 3	07
	1.2	Example based on properties of Eigen values (Without Proof).			
	1.3	Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix.			
	1.4	Diagonalization of matrices. Self-learning Topics: Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices. (1hr)			
2	2.1	Statistical Techniques Karl Pearson's Coefficient of correlation (r)	CO2	BL 3	07
	2.2	Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks			
	2.3	Lines of regression.			
	2.4	Fitting of first and second degree curve Self-learning Topics: Covariance, fitting of exponential curve.			
3	3.1	Probability Definition and basics of probability	CO3	BL3	07
	3.2	Discrete and continuous random variable with probability distribution and Probability density function			
	3.3	Expectation, Variance			
	3.4	Moment generating function, Raw and central moments up to 4th order. Self-learning Topics: Conditional probability, Baye's theorem			

4	4.1	Probability distributions Introduction	CO3	BL3	07
	4.2	Binomial distribution			
	4.3	Poisson distribution			
	4.4	Normal distribution Self-learning Topic: Applications of Probability Distributions in Engineering			
5	5.1	Sampling Theory I Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degrees of freedom. Errors in testing of hypothesis	CO4	BL3	08
	5.2	Large Sample: Testing the hypothesis that the population mean is μ			
	5.3	Small sample test: Students' t-distribution			
	5.4	Test the significance for the difference between means of two samples Self-learning topics: Test significance of difference between the means for Large samples, Estimate parameters of a population			
6	6.1	Chi square test: Test of goodness of fit and independence of attributes.	CO4	BL3	06
	6.2	Contingency table			
	6.3	Analysis of Variance(F-Test): One way Classification Self-learning topic: Yate's Correction			
Total					42

Text Book:	
1	Dr B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publications, 4 nd Edition
Reference Books:	
1	H. K. Das, “Advanced Engineering Mathematics”, S. Chand, 28 th Edition
2	Erwin Kreysizg, “Advanced Engineering Mathematics”, John Wiley & Sons, 10 th Edition.
3	Matrices, Shanti Narayan, S. Chand publication
4	T. Veerarajan, “Probability, Statistics and Random Processes”, McGraw-Hill Education.

Problem Solving and Aptitude Building -I

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSSEC302	Problem Solving and Aptitude Building-I	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
30	10	10	50	-		-		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (30)

Minimum Two (02) of the above mentioned activities each of 30 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (10)

Minimum Two (02) of the above mentioned tests each of 10 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (10)

As per the rubric provided by the Attendance committee.

Prerequisite: Basic knowledge of arithmetic and logical thinking.

Course Objectives:

1	To develop fundamental quantitative aptitude and problem-solving skills.
2	To strengthen logical reasoning and data interpretation abilities.
3	To prepare students for competitive exams and placement aptitude tests.

Course Outcomes (COs): At the End of the course students will be able to	
1	Apply arithmetic concepts for solving real-life and placement problems.
2	Solve questions related to ratios, percentages, and time-based problems.
3	Apply algebraic concepts to solve equations and inequalities.
4	Demonstrate logical reasoning ability in pattern-based problems.
5	Analyze and interpret basic reasoning scenarios with structured techniques.

Module No.	Detailed Contents		CO Map ped	BL	Hrs
1	1.1	Module 1: Number Systems & Arithmetic Basics: Divisibility, LCM/HCF	CO1	BL2	05
	1.2	Remainders, Simplifications			
	1.3	Fractions and Decimals			
2	2.1	Module 2: Percentages, Profit & Loss: Percentage Calculations and Applications, Profit, Loss, and Discount	CO2	BL2	05
	2.2	Simple and Compound Interest, Ratio and Proportion			
	2.3	Mixtures and Alligations			
3	3.1	Module 3: Time & Work, Speed & Distance: Averages and Weighted Averages, Time, Speed, and Distance	CO2	BL3	06
	3.2	Relative Speed and Trains, Boats and Streams			
	3.3	Time and Work, Pipes and Cisterns			
4	4.1	Module 4: Algebra and Linear Equations: Basic Algebraic Identities, Linear and Quadratic Equations	CO3	BL3	06
	4.2	Inequalities Problems on Ages			
	4.3	Surds and Indices, Simplification Using Algebra			
5	5.1	Module 5: Introduction to Logical Reasoning: Number and Letter Series, Coding-Decoding	CO4, CO5	BL2, BL3	06

	5.2	Blood Relations, Direction Sense			
	5.3	Ranking and Order, Syllogisms and Venn Diagrams			
Total					33

Text Book:	
1	Quantitative Aptitude for Competitive Examinations, R.S. Aggarwal, S. Chand
2	A Modern Approach to Verbal and Non-Verbal Reasoning, R.S. Aggarwal, S. Chand
3	Quantitative Aptitude Quantum CAT, Sarvesh K. Verma, Arihant Publications
4	Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publications
Reference Books:	
1	How to Prepare for Quantitative Aptitude for CAT, Arun Sharma, McGraw Hill
2	Logical Reasoning and Data Interpretation for the CAT, Nishit K. Sinha, Pearson Education
3	Analytical Reasoning, M.K. Pandey, BSC Publishing
4	Arihant's Master Resource Book – Logical Reasoning & Data Interpretation, Ajay Singh, Arihant Publications

Design Thinking

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSMDC301	Design Thinking	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40 -		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Nil

Course Objectives:

CO1	Introduces the fundamental principles and process of design thinking.
CO2	Explore human-centered problem-solving approaches.
CO3	Understand the stages of empathy, ideation, prototyping, and testing

CO4	Analyze design thinking frameworks and real-world applications
CO5	Examine visualization and storytelling as tools for innovation.
Course Outcomes (COs): At the End of the course students will be able to	
CO 1	Explain the philosophy, mindset, and stages of design thinking. (BL2)
CO 2	Describe frameworks used for customer empathy and defining problems. (BL2)
CO 3	Use ideation tools and creativity methods for generating solutions. (BL4)
CO 4	Evaluate different approaches to prototyping and solution testing. (BL5)
CO 5	Analyze how storytelling and visualization aid design thinking. (BL4)

Module No.	Detailed Contents		CO Map ped	BL	Hrs
1	Introduction to Design Thinking		CO 1	2	6
	1.1	Definition and origin of design thinking			
	1.2	Design thinking vs Traditional problem-solving approaches			
	1.3	Importance of design thinking in modern innovation			
	1.4	Design thinking mindsets: empathy, experimentation, optimism			
	1.5	Overview of models: Stanford d.school 5-step process, Double Diamond model			
	1.6	Principles of human-centered design			
	Case Studies: IDEO, Apple, Airbnb Activities: ❖ Group exercise: Identify real-world challenges				

	❖ Comparative discussion: Engineering Design vs. Design Thinking				
2	Empathy and Problem Framing		CO 2	2	6
	2.1	User empathy in design thinking			
	2.2	Techniques: Observation, interviews, shadowing			
	2.3	Empathy tools: Empathy maps, journey maps			
	2.4	Framing problems: POV statements, HMW questions			
	2.5	Design thinking for social impact			
	Theoretical Focus: Cognitive bias, User perspective, Systems thinking Activities: ❖ Field Observation (Virtual/Physical) ❖ Create Empathy Map and User Persona ❖ Develop a Problem Statement				
3	Ideation and Creative Thinking		CO 3	4	6
	3.1	The psychology of creativity in problem solving			
	3.2	Ideation methods: Brainstorming, Mind Mapping, SCAMPER, Lateral Thinking			
	3.3	Innovation heuristics and analogies			
	3.4	Overcoming fixed mindsets and cognitive blocks			
	3.5	Convergent vs divergent thinking			

	3.6	Idea selection: Feasibility vs impact			
	Case Analysis: Creative ideation at Google, IDEO Activities: ❖ Ideation Sprint in Teams ❖ Affinity Diagramming ❖ Concept Selection				
4	Prototyping and Testing Strategies		CO 4	5	6
	4.1	Concept of prototyping and its purpose in design thinking			
	4.2	Types of prototypes: Low fidelity, high fidelity, MVP (theory only)			
	4.3	Prototyping strategies for products and services			
	4.4	Testing concepts: A/B testing, feedback loops, usability testing			
	4.5	Role of experimentation and failure			
	4.6	Metrics: Desirability, viability, feasibility			
	Discussion: Design validation through user feedback / Experimentation and learning from failure Activities: ❖ Build Low-Fi Prototypes (Paper, LEGO, Sketch) ❖ Test with Peers and Refine Based on Feedback				
5	Visualization, Storytelling and Application		CO 5	4	6
	5.1	Role of storytelling in communicating ideas			

	5.2	Storytelling structures: Pixar framework, Hero’s journey			
	5.3	Visualization tools: Mind maps, affinity diagrams, journey maps			
	5.4	Scenario planning and role-based narratives			
	5.5	Strategic application of design thinking in business, education, and healthcare			
	5.6	Challenges and limitations of design thinking			
	Readings: Industry application cases from IBM, SAP, and educational settings Activities: ❖ Prepare Final Storyboard and Pitch ❖ Present Team Prototypes + Roadmap ❖ Reflective Group Discussion				
	Total			30	

Text Books :	
1	Tim Brown – Change by Design: How Design Thinking Creates New Alternatives for Business and Society, Harper Business
2	Idris Mootee – Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, John Wiley & Sons
3	Jeanne Liedtka, Andrew King, Kevin Bennett – Solving Problems with Design Thinking, Columbia Business School Publishing
Reference Books :	
1	Roger Martin – The Design of Business: Why Design Thinking is the Next Competitive Advantage, Harvard Business Review Press
2	Tom Kelley & David Kelley – Creative Confidence: Unleashing the Creative Potential Within Us All, Crown Publishing

3	Tom Kelley – The Art of Innovation, Currency
4	Maurício Vianna et al. – Design Thinking: Business Innovation, MJV Press
5	L.T.M. Blessing & A. Chakrabarti – DRM, A Design Research Methodology, Springer
6	Karl T. Ulrich, Design: Creation of Artifacts in Society, University of Pennsylvania
7	Pavan Soni, Design Your Thinking, Penguin India, 2020

Entrepreneurship Development

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25AE303	Entrepreneurship Development	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
30	10	10	50	-		-		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (30)

Minimum Two (02) of the above mentioned activities each of 30 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (10)

Minimum Two (02) of the above mentioned tests each of 10 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (10)

As per the rubric provided by the Attendance committee.

Prerequisite: Basic understanding of business, innovation, and management principles.

Course Objectives:

1	To equip students with the skills to identify problems, generate innovative solutions, and develop viable prototypes using structured ideation and innovation management tools
2	To develop the mindset and skills necessary for entrepreneurial thinking and venture creation.
3	To introduce students to entrepreneurial processes including opportunity identification,

	business model development, and resource mobilization.
4	To enhance analytical and decision-making abilities in real-world entrepreneurial scenarios.
Course Outcomes (COs):	
CO1	Apply entrepreneurial traits, ideation tools, and opportunity evaluation methods.
CO2	Analyze market needs and define a customer-focused value proposition.
CO3	Analyze startup financing, team building, and lean strategies.
CO4	Apply business model canvas and assess venture feasibility
CO5	Evaluate and pitch entrepreneurial ideas effectively.

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Entrepreneurship Fundamentals		CO1	BL3	4
	1.1	Characteristics of Entrepreneurs			
	1.2	Types of Startups			
	1.3	Entrepreneurial Mindset			
2	Opportunity Discovery and Ideation		CO1,C O2	BL3 ,BL 4	6
	2.1	Problem Identification			
	2.2	Opportunity Evaluation			
	2.3	Creativity and Innovation Tools (SCAMPER, Brainstorming)			
3	Business Model & Customer Discovery		CO2,C O4	BL3 ,BL 4	6
	3.1	Business Model Canvas			
	3.2	Value Proposition Design			
	3.3	Lean Startup Methodology			
4	Startup Planning and Resources		CO3	BL4	6
	4.1	Building a Team and Co-founders			

	4.2	Startup Financing Basics			
	4.3	Bootstrapping and Funding Options			
5	Pitching and Launch Readiness		CO5	BL4	8
	5.1	Investor Pitch Preparation			
	5.2	Pitching Frameworks and Techniques			
	5.3	Legal and Regulatory Aspects (MSME, Startup India)			
Total			30		

Text Books :	
1	Entrepreneurship – Rajeev Roy
2	The Startup Owner’s Manual – Steve Blank
3	Innovation and Entrepreneurship – Peter F. Drucker
Reference Books :	
1	The Lean Startup – Eric Ries
2	Disciplined Entrepreneurship – Bill Aulet
3	Zero to One – Peter Thiel

Data Structures Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL301	Data Structures Lab	-	-	4	-	-	2	2
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
30	10	05		05	50		25	

IPE: Internal Practical Evaluation (30)

Three (03) internal practical exams of 30 marks each as per below syllabus. 15 marks for Program execution, 05 marks for Program documentation and 10 marks for viva. The average of 03 exams marks would be considered as IPE.

Exp: Experiments (10)

Program(s) Execution & Problem(s) Solving: 06; On Time: 02; Viva: 02

Activity: [Assignment/Model/Mini Project] (05)

Minimum Two (02) of the above assessment tools each of 05 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using C Programming

Course Objectives: The course will enable students to:

1	To implement basic data structures such as arrays, linked lists, stacks and queues.
2	Solve problems involving stacks, queues and linked lists.
3	To develop applications using data structure algorithms.
4	Solve problems involving graphs, and trees.

Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	Implement various operations like insertion, deletion, and traversing on arrays, stack and queues.[BL3]
CO2	Implement various operations like insertion, deletion and traversing on linked list.[BL3].
CO3	Choose appropriate data structure and apply it to solve various problems. [BL3]
CO4	Implement various operations like insertion, deletion and traversing on non linear data structures.[BL3].
CO5	Select appropriate searching technique to solve a given problem.[BL3]

Week No.	Detailed Contents	CO Mapped	BL	Hrs
1	1. Introduction to Arrays and Basic Operations Concepts: Static vs. Dynamic Arrays, contiguous memory allocation, indexing. Programs: 1. Implement a menu-driven program for array operations: creation, display, insertion at a given position, deletion from a given position, searching (linear and binary search). 2. Implement menu driven program for matrix operations: addition, multiplication, transpose. Problems: 1. Contains Duplicate (Id 217, leetcode.com/problems) 2. Two Sum using Brute force (Id 1, leetcode.com/problems)	CO1	BL3	4
2	2. Implementation of Stack Concepts: LIFO principle, Push, Pop, Peek, isEmpty, isFull Programs: 1. Implement a Stack using arrays. 2. Implement Infix to Postfix conversion. Problem: 1. Valid Parentheses (Id 20, leetcode.com/problems)	CO1	BL3	4
3	3. Implementation of Queue Concepts: FIFO principle, Enqueue, Dequeue, Front, Rear, isEmpty, isFull Programs:	CO1	BL3	4

	1. Implement a Queue using arrays. 2. Implement a Circular Queue using arrays. Problems: 1. Generate Binary Numbers from 1 to N (geeksforgeeks.org) 2. Reverse First K elements of Queue (geeksforgeeks.org)			
4	ASSESSMENT & SUBMISSION			4
5	4. Implementation of Linked Lists Concepts: Singly, Doubly (previous and next pointers), and circular linked lists. Programs: 1. Implement a menu-driven program for a Singly Linked List. 2. Implement a menu-driven program for a Doubly Linked List Problem: 1. Reverse Singly Linked List (Id 206, leetcode.com/problems)	CO2	BL3	4
6	5. Implementation of Trees Concepts: Recursive function calls, base cases, recursion vs. iteration. Binary Tree definitions (root, node, child, parent, leaf). Programs: 1. Implement basic Binary Tree creation and basic traversals (In-order, Pre-order, Post-order) Problems: 1. Level Order Traversal (Id 102, leetcode.com/problems) OR 2. Maximum Depth of Binary Tree (Id 104, leetcode.com/problems)	CO4	BL3	4
7	6. Implementation of Binary Search Trees (BST) Concepts: BST properties (left child < parent < right child), searching, insertion, deletion. Programs: 1. Implement a menu-driven program for a Binary Search Tree: insertion, deletion, searching, finding min/max element, traversals. Problem: 3. Validate BST (Id 98, leetcode.com/problems)	CO4	BL3	4
8	ASSESSMENT & SUBMISSION			4
9	7. Stack and Queue using Linked List	CO1	BL3	4

	Concepts: Dynamic memory for stack and queue. Programs: 1. Implement stack using linked list. 2. Implement a queue using a linked list. Problem: 1. Palindrome Linked List (Id 234, leetcode.com/problems)	CO2		
10	8. Graph Representation and Traversals Concepts: Graphs (vertices, edges), Adjacency Matrix, Adjacency List, BFS, DFS. Programs: 1. Implement Breadth-First Search (BFS) for a given graph 2. Implement Depth-First Search (DFS) for a given graph. Problem: 1. Shortest Path in Binary Matrix (Id 1091, leetcode.com/problems) OR 2. Number of Islands (Id 200, leetcode.com/problems)	CO4	BL3	4
11	9. Implementation of Hashing Concepts: Hash functions, collisions, collision resolution techniques (chaining, linear probing, quadratic probing). Programs: 1. Implement a Hash Table with a chosen hash function and collision resolution technique. Problem: 1. Two Sum using Hashing (Id 1, leetcode.com/problems)	CO5	BL3	4
12	10. Implementation of Heaps (CBS-Optional) Concepts: Heap properties (min-heap, max-heap), Heapify. Programs: 1. Implement a Max-Heap (or Min-Heap) using arrays. 2. Implement Heap Sort Problem: 1. Kth largest element in an array (Id 215, leetcode.com/problems)	CO3	BL3	4
13	ASSESSMENT & SUBMISSION			4
14	Assignments: Solve any two 1. Remove Nth Node from End of Singly Linked List. (N = sum of last 2 digits of your Roll No) (Leetcode #19)	CO3	BL4	4

	2. Lowest Common Ancestor of a Binary Tree. (Total No of Nodes = sum of last 2 digits of your Roll No + 3) (Leetcode #236) 3. Course Schedule (Leetcode #207)			
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Textbooks:	
1	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”
2	Robert Lafore, “Data Structures and Program Design in C++”
3	Michael T Goodrich, “Data Structures and Algorithms in C++ (or Python/Java equivalent)”
Websites:	
1	Leetcode (leetcode.com)
2	GeeksforGeeks (geeksforgeeks.org)
3	Codeforces (codeforces.com)
4	HackerRank (hackerrank.com)

Database Management System Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL302	Database Management System Lab	-	-	2	-	-	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Python Programming

Lab Objectives:

1	To create ER diagrams and convert them into normalized schemas.
2	To install and work with relational database systems.
3	To apply SQL commands for data manipulation, including complex queries.

4	To implement transaction control, triggers, stored procedures, and integrate SQL queries with basic AI/ML datasets.
Lab Outcomes (LOs): At the End of the course students will be able to	
CO1	Design and implement ER models into normalized relational schemas. (BL3)
CO2	Execute SQL commands for creating and manipulating relational databases. (BL3)
CO3	Perform complex SQL queries using joins, subqueries, and aggregates. (BL3, BL4)
CO4	Implement transactions, stored procedures, and triggers for business logic automation. (BL3, BL4)

Wee k No.	Exp No.	Title of Experiment	CO Mappe d	Bloo m's Level	Hrs
1	1	ER/EER Modeling A startup food delivery company wants to launch a platform where customers can browse restaurants, place food orders, and track deliveries. To design a robust backend, the company seeks to model the entire data system capturing customers, restaurants, food menus, orders, delivery agents, and payment details. Design an Entity-Relationship (ER) or Extended ER (EER) model to represent all necessary entities, relationships, attributes, and constraints to support the functioning of the online food delivery platform.	CO1	BL3	2
2	2	ER to Relational Mapping A hospital management system is being planned to centralize patient, doctor, appointment, and billing records. Based on the ER model of this system, map all entities such as Patients, Doctors, Departments, Appointments, and Payments into relational tables. Identify suitable primary and foreign keys, and define how one-to-many and many-to-many relationships are handled in the schema.	CO1	BL3	2
3	3	DDL and Integrity Constraints A university wants to build a student information system to manage student registrations, subjects, faculty assignments, and exam results. Create the relational database using SQL DDL commands. Define integrity constraints such as primary	CO2	BL3	2

		keys for Students and Subjects, foreign keys for course registrations, and CHECK constraints for validating exam scores.			
4	4	DML Operations A car rental company is setting up a database to manage customers, vehicles, rental bookings, and payment status. Insert realistic sample data using SQL DML commands to simulate customer bookings, car availability updates, rental record modifications, and booking cancellations. Use a variety of INSERT, UPDATE, and DELETE commands to reflect day-to-day operations.	CO2	BL3	2
5	5	Basic SQL & Aggregations A fitness center chain wants to analyze customer attendance, membership types, and class popularity across its branches. Write SQL queries to find monthly attendance trends, total number of members by membership type, average class occupancy, and maximum usage of equipment. Use aggregate functions, string formatting, and grouping to support business analysis.	CO3	BL3, BL4	2
6	Internal Assessment -I & Submission				
7	6	Join Operations An airline booking system needs to display complete travel histories of customers, flights, and bookings. Implement various JOIN operations to display passenger names with their flight details, list flights that have not been booked, and show routes with their associated airlines. Demonstrate INNER JOIN, LEFT JOIN, and FULL OUTER JOIN in different data retrieval scenarios.	CO3	BL3	2
8	7	Nested and Complex Queries A retail chain is analyzing customer purchases to personalize marketing strategies. Write nested and complex SQL queries to identify high-value customers who have spent above a threshold, products that were never bought in a specific region, and brands with declining sales trends. Use subqueries, EXISTS, NOT IN, and aggregation filtering to generate actionable insights.	CO3	BL3, BL4	2

9	8	DCL and TCL Commands A university IT department needs to control access to its academic database. Implement DCL commands to assign permissions to roles such as Admin, Teacher, and Student for operations like result updates, course creation, and student record viewing. Demonstrate the use of TCL commands such as COMMIT, ROLLBACK, and SAVEPOINT during batch updates of internal assessments.	CO4	BL3	2
10	9	Procedures and Functions An e-commerce warehouse system needs automation for packing and shipping processes. Create a stored procedure that assigns packing staff to new orders based on availability. Develop a user-defined function that calculates shipping charges based on weight and distance. These functions should help streamline backend operations and minimize processing time.	CO4	BL3, BL4	2
11	10	Views and Triggers A healthcare clinic wants to track sensitive changes to patient information and provide simplified reporting views to staff. Implement views to show today's appointments, pending payments, and top consulted doctors. Create triggers to log changes in patient medical history and notify doctors when new test results are added for their patients.	CO4	BL3, BL4	2
12	11	Transactions & Concurrency Control Simulate concurrent transactions in a banking system with locking and rollback/commit to ensure consistency.	CO4	BL4	2
13	Internal Assessment -II & SUBMISSION				

14	Assignment A university plans to develop an online course registration system to manage students, faculty, courses, and enrollments. You are hired to design and implement the backend database for this system. The system must handle the following: • Students can register for courses. • Each course is taught by one faculty member. • A faculty member can teach multiple courses. • A student can enroll in multiple courses. • Only active courses and eligible students should be allowed to enroll. • The system should track registration dates and auto-calculate total course credits for each student.	CO1 CO2 CO3 CO4	BL3, BL4	2
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Text Books :

1	Silberschatz, Korth & Sudarshan, <i>Database System Concepts</i> , 7th Edition, McGraw Hill
2	Elmasri & Navathe, <i>Fundamentals of Database Systems</i> , 7th Edition, Pearson
3	Ramakrishnan & Gehrke, <i>Database Management Systems</i> , 3rd Edition, McGraw Hill

Reference Books :

1	Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, <i>Database Systems: The Complete Book</i> , 1st Edition, Prentice Hall
2	C. J. Date, <i>An Introduction to Database Systems</i> , 8th Edition, Addison-Wesley
3	C. J. Date, <i>SQL and Relational Theory: How to Write Accurate SQL Code</i> , 1st Edition, O'Reilly Media

Fundamentals of Data Science Lab

Lab Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL303	Fundamentals of Data Science Lab	-	-	2	-	-	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Basics of Python

Lab Objectives:

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions.
3	Apply linear regression and logistic regression on the given dataset

Course Outcomes (COs): At the End of the course students will be able to:	
CO1	Apply the Data Analysis tools on different databases for summarization and interpretation. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basic statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Week No.	Suggested Experiment	CO Mapped	BL	Hrs
1	Apply pivot table of Excel to perform data analysis	CO1, CO2	BL3	2
2	Apply descriptive statistical techniques on the given dataset using Python to summarize and interpret the data.	CO1, CO2	BL3	2
3	Generate and interpret histogram plots using Python to identify distribution patterns in the dataset.	CO3	BL3	2
4	Apply simple linear regression using Python and analyze the regression output to interpret relationships between variables.	CO3, CO4	BL3, BL4	2
5	Perform multiple linear regression using Python and evaluate the regression table to identify significant predictors and understand model accuracy.	CO3, CO4	BL4	2
6	SUBMISSION & ASSESSMENT			2
7	Apply logistic regression on the given dataset and analyze the regression output to interpret classification results.	CO3, CO4	BL3, BL4	2
8	Install and explore Tableau to identify and understand the user interface components such as Dimensions, Measures, Pages, Filters, Marks, and Show Me. Connect datasets and create basic visualizations .	CO2, CO5	BL3	2

9	Apply various chart types in Tableau, integrate maps and geolocation data, and develop an interactive dashboard. Publish the dashboard to Tableau Public.	CO5	BL3, BL4	2
10	Construct scatter plots, apply data highlighters, and use Pages, Cards, and Annotations. Design a story and publish it on Tableau Public.	CO5	BL3	2
11	Case study: Apply interactive data visualization techniques using Tableau to explore and represent datasets effectively.	CO5	BL3, BL4	2
12	Case Study: Use Power BI to visualize and analyze customer segmentation data from a case study, and evaluate visualization effectiveness.	CO5	BL3, BL4	2
13	SUBMISSION AND ASSESSMENT			
Assign ment	Choose any open dataset. Perform the tasks mentioned below. Submit a detailed report with screenshots and code snippet. 1. Dataset understanding 2. Data Cleaning and Preprocessing 3. Descriptive statistics 4. Basic Analysis 5. Report Writing.	ALL	BL3	2

Text Books :	
1	Fundamentals of data science, Dr. Aijaz Ali, Khan, Anita Rani Mehta, Vandana Ahuja, Rivers Publication, 2023
2	U. Dinesh Kumar, "Data Science: Theory and Practice," Wiley India
3	V.K. Jain, "Data Science and Analytics."
Reference Books :	
1	Python for Data Analysis-by WMc Kinney, OREILLY Publication.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, " <i>The Elements of Statistical Learning</i> ," Springer.

Modern Programming Lab

(Applicable: A.Y. 2025–2026 Onwards)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL304	Modern Programming Lab	-	-	2	-	-	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: C Programming

Course Objectives:

1	To learn core OOP concepts such as classes, objects, inheritance and polymorphism.
2	To develop proficiency in concepts such as multithreading, exception handling, and the use of user-defined packages.

3	To familiarize with the fundamental components and structures involved in building Graphical User Interface (GUI) applications.
Course Outcomes (COs): At the End of the course students will be able to	
CO1	To apply fundamental programming constructs. (BL3)
CO2	To illustrate the concept of packages, classes and objects. (BL3)
CO3	To elaborate the concept of strings, arrays to solve problems involving data manipulation. (BL3)
CO4	To implement the concept of inheritance and interfaces. (BL3)
CO5	To implement the concept of exception handling and multithreading. (BL3)
CO6	Design interactive GUI applications. (BL3)

Week No.	Detailed Contents		CO Map ped	BL	Hrs
1	OOP concepts: Objects, class, Encapsulation, Abstraction, Inheritance, Polymorphism, message passing, JVM, JDK, JRE Basic programming constructs: Input and output functions in Java: scanner class, variables, data types, Operators, I/O,		CO1	BL3	2
	1.1	Write a Java program to input the name, roll number, and CGPA of a student using the Scanner class.			
	1.2	Write a Java program that takes the following details such as Employee ID (String or Integer), Name and Monthly Basic Salary for employee and perform the following operations: Calculate the Annual Basic Salary (12 * monthly basic). Compute the following based on the monthly basic salary : ● HRA (House Rent Allowance) = 20% of basic salary ● DA (Dearness Allowance) = 10% of basic salary ● PF (Provident Fund deduction) = 12% of basic salary ● Gross Monthly Salary = Basic + HRA + DA ● Net Monthly Salary = Gross Salary – PF ● Annual Net Salary = Net Monthly Salary × 12			
	1.3	Developing Conversion Utilities: Develop any converter, such as Rupees to dollars, temperature converter, inch to feet, etc.			

2	Control Structures, Branching and Loops if-else, if-else if, switch, loops (for, while and do-while), Branching Statements - Break, Continue, return		CO1	BL3	2
	2.1	Given an integer, , perform the following conditional actions: • If is odd, print Weird • If is even and in the inclusive range of to , print Not Weird • If is even and in the inclusive range of to , print Weird • If is even and greater than , print Not Weird (https://www.hackerrank.com/challenges/java-if-else/problem)			
	2.2	Write a Java program that accepts the student's name , roll number , and marks in five subjects , each out of 100. The program should validate that all entered marks are between 0 and 100. Calculate total marks (sum of all subjects), Average marks and Percentage . Assign an appropriate grade based on the average marks and add a remark based on the grade.			
	2.3	Print number pattern using loops. Use nested loops to generate a triangle number pattern, applying conditional checks.			
	2.4	Test your Learning: Java Loops: Read integer N (2–20) and print its first ten multiples. (https://www.hackerrank.com/challenges/java-loops-i/problem)			
3	Classes & Objects: Class, object, data members, member functions		CO2	BL3	2
	3.1	Write a Java program to create a Bank Account Simulator with BankAccount class with the attributes: account_number and balance. The program should: Create an object of BankAccount, Set account number and initial balance using setter methods or direct assignment. Accept a series of operations (deposit or withdraw) and apply them and Display the final balance after all operations.			
4	Constructors– Types of Constructors, Constructor Overloading static members and functions, Method Overloading				

CO2 BL3 2

	4.1	Write a Java program that calculates the area of 2D shapes and the volume of 3D shapes using method overloading . The program should include the 2D Shapes like Circle, Rectangle, Square, Triangle, 3D Shapes like Sphere, Cylinder, Cuboid, Cube			
	4.2	Create a Student class to demonstrate constructor overloading by allowing the creation of student objects using different initialization formats . The program should include Student Class Fields like rollNumber, name, department.			
	4.3	Write a program that demonstrates use of Static member and static functions.			
5	Array, Strings, String Buffer		CO3	BL3	2
	5.1	Write a program that demonstrates the use of various methods available in String class.			
	5.2	Write a program that demonstrates the use of various methods available in StringBuffer class.			
	5.3	Write a program to find the Maximum Element in an Integer Array			
6	Internal Assessment -I & Submission				
7	Inheritance:Types, Method overriding , super and final keyword		CO4	BL3	2
	6.1	Create a Java program to demonstrate inheritance by designing an Employee superclass and a Manager subclass. The program should include the appropriate methods to demonstrate the inheritance hierarchy.			
	6.2	Write a Java program to create a Vehicle class with a method showSpeed() that displays the default speed of a generic vehicle. Create a Car subclass that overrides this method to show specific speed. Then, extend Car with a SportsCar class that further overrides showSpeed() and uses the super keyword to invoke both the Car and Vehicle implementations of showSpeed().			
8	Abstract Classes & Interfaces– Abstract class and methods and Interfaces		CO4	BL3	2
	7.1	Write a program that declares an abstract class Shape that implements the Drawable method and also includes a field String color and an abstract method calculateArea().			

		Implements two subclasses: Circle → stores radius, overrides both methods Rectangle → stores length and breadth, overrides both methods In the main() method: Use polymorphism to refer to Shape references and call overridden methods			
	7.2	Write a Java program that defines a Payment interface with: void processPayment(double amount) - Implements 'this' interface in two classes: - CreditCardPayment with additional fields: cardNumber, cardHolderName, cvv - UPIPayment with additional fields: upiId, mobileNumber - Use validation where necessary (e.g., CVV must be 3 digits, UPI ID must contain '@') - In main() method: Accept details from user Display confirmation messages			
9	Packages in java : User defined packages, Access specifiers				
	8.1	Write a Java program that demonstrates the concept of user-defined packages and the use of all four access specifiers (private, default, protected, public) through appropriate class and method structures.	CO2	BL3	2
10	Exception Handling – Types of Exception, built-in Exceptions, try-catch, custom exception (throw and throws), finally				
	9.1	Write a Java program to perform the division of two numbers. The program should: - Use try-catch to handle ArithmeticException (divide by zero) - Use a try-catch to handle invalid inputs (InputMismatchException) - Use a finally block to print a message that runs regardless of exception - Loop until the user provides valid input and a successful division occurs	CO5	BL3	2
	9.2	Write a Java program that: - Defines a custom checked exception class InvalidAgeException - Throws InvalidAgeException if the age is less than 18 - Catches the exception and displays an appropriate error message - Uses a loop to retry input until valid age is entered			

		Displays a success message on valid age entry			
11	Thread lifecycle, thread class methods, creating threads		CO5	BL3	2
	10.1	Write a Java program to demonstrate the concept of multithreading using both approaches: 1. Extending the Thread class, 2. Implementing the Runnable interface. The program should show how multiple threads can run concurrently and independently, and how to control their execution using thread methods.			
12	GUI Programming – JavaFX basics, layout managers, Event handling, JDBC connectivity		CO6	BL3	2
	11.1	Write a JavaFX program to build a basic calculator GUI that performs simple arithmetic operations: Addition, Subtraction, Multiplication, and Division. Use ActionListener to detect button clicks and perform calculations. Handle invalid input (e.g., non-numeric entries) using try-catch and display appropriate error messages. For division, include zero-check to avoid divide-by-zero errors			
	11.2	Write a Java program using JavaFX to create a login form with Backend connectivity using JDBC			
13	Internal Assessment -II & Submission				
14		Assignment Building a Database-Driven GUI (JavaFX + JDBC) (https://www.codeproject.com/Articles/1197811/JavaFX-JDBC-Application) Build a complete GUI-based application integrating OOP, file handling, and event handling and database connectivity.	CO6	BL5	2

Text Books :	
1	Herbert Schildt, Java: The Complete Reference, McGraw Hill
2	E. Balagurusamy, Programming with Java, McGraw Hill
3	Cay S. Horstmann, Core Java Volume I – Fundamentals, Pearson
4	Kathy Sierra & Bert Bates, Head First Java, O'Reilly
Reference Books :	
1	Oracle Java Documentation – https://docs.oracle.com/javase/
2	JavaTpoint Java Tutorial – https://www.javatpoint.com/java-tutorial
3	GeeksforGeeks Java Guide – https://www.geeksforgeeks.org/java/
4	W3Schools Java Tutorial – https://www.w3schools.com/java/

Modern Programming Lab

(Revised: A.Y. 2026–2027 Onwards)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL304	Modern Programming Lab	-	-	2	-	-	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using Imperative Programming

Course Objectives: The course will enable students to:

1

Understand fundamental Python programming constructs and manipulate data structures.

2	Develop problem-solving skills to write reusable and modular code using functions, manage runtime errors using exception handling, and apply regular expressions for effective text processing and validation.
3	Gain knowledge of object-oriented programming (OOP) in Python.
4	Build competence in developing interactive applications by designing and implementing graphical user interfaces (GUIs) for enhancing user experience and application usability.
5	Familiarize with Python libraries and tools such as NumPy, Pandas, and Matplotlib for efficient data handling, analysis, and visualization.
Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	Apply core Python programming concepts by creating and manipulating data structures.
CO2	Create functions, apply exception handling, and use regular expressions in Python to develop solutions for real-life programming problems efficiently and logically.
CO3	Apply the concept of object-oriented programming to solve problems.
CO4	Design and develop graphical user interface (GUI) applications to create user-friendly applications.
CO5	Apply Python libraries to perform efficient data handling, analysis, and manipulation tasks for the given problem.

Week No.	Detailed Contents		CO Map ped	BL	Hrs
1	Introduction to Python: Basic Syntax and Data Types—Variables, data types, operators, and Input-Output.		CO1	BL3	2
	1.1	Personalized Greeting Generator: Write a Python code to generate a Personalized Greeting.			
	1.2	Calculating Areas of Geometric Figures: Write a Python program to calculate the areas of any geometric figures like circle, rectangle, and triangle.			
	1.3	Developing Conversion Utilities: Develop any converter, such as Rupees to dollars, temperature converter, inch to feet, etc.			
	1.4	Calculating EMI: Develop a Python program to calculate the Monthly EMI (Equated Monthly Installment) for a loan based on user input.			
2	Control Flow and Functions: Conditional Statements: if, else, elif				

	Loops: for and while loops.				
	2.1	Fibonacci Sequence Generator: Develop a Python program to print the Fibonacci sequence using a while loop.			
	2.2	Factorial Generator: Design a Python program to compute the factorial of a given integer N.			
	2.3	Multiplication Table Generator: Write a Python program to take a numerical input from the user and generate its multiplication table using loops.			
	2.4	Automate Payroll System: A company wants to automate its payroll system. The program should accept employee details (ID, Name, Basic Salary), calculate Gross Salary (DA = 80% of Basic, HRA = 40% of Basic), deduct PF = 12% of Basic, and Tax = 5% if salary > 50,000, and display the Net Salary after deductions.			
3	Data Type: Lists, Strings, Tuples, Sets, and Dictionaries, and operations on them.		CO1	BL3	4
	3.1	Average speed of Runners: A marathon event has 10 runners. A runner qualifies if their speed is more than 1.5 times the average speed of all runners. The program should accept speed values for 10 runners in a list, calculate the average speed, and print the qualified runners.			
	3.2	Secure Transaction Records in a Banking System: A bank needs to maintain immutable transaction records for security and auditing purposes. Since transaction details should not be modified once recorded, use an appropriate data type to store transaction logs.			
	3.3	Check if a String is a Palindrome: Ask the user for a string and print out whether this string is a palindrome or not.			
	3.4	Library Book Management System: A local library wants to manage its collection of books. Each book has a unique ID, a title, an author, and the number of available copies. The library staff should be able to add new books, update book information, search for a book by ID, and display all books. Use a Python dictionary to manage and manipulate book records.			
	3.5	Check if Two Sets Have No Elements in Common: Write a Python program to check if two given sets have no elements in common.			

4	Functions: Defining functions, parameters, and return values; scope and lifetime of variables.		CO2	BL3	2
	4.1	Prime Number Analyzer: Using a function, write a Python program to analyze if the input number is prime or not.			
	4.2	Developing Conversion Utilities: Develop any converter, such as Rupees to dollars, temperature converter, inch to feet, etc.			
	4.3	Convert inches to centimeters: (Use the Map function to perform the conversion). Implement a function that takes a list of measurements in inches and returns a list of the corresponding measurements in centimeters. For example, if the input is [5, 10, 15], the output should be [12.7, 25.4, 38.1].			
	4.4	Sum of digits of a number: (Use the reduce() function to perform the calculation.). Implement a function that calculates the sum of the digits of a given number using the reduce() function from the functools module in Python. For example, if the input number is 12345, the function should return 15 (1 + 2 + 3 + 4 + 5 = 15).			
Problem Statement: Create a nested dictionary of three employees, each with keys for name, age, and salary. Write a function to give each employee a 10% raise and print the updated dictionary. https://www.codechef.com/blogs/dictionary-in-python?utm_source					
5	4. Exceptional Handling: To enable learners to proficiently handle and manage exceptions		CO2	BL3	2
	5.1	Basic Exception Handling: To implement and demonstrate at least five different types of exception handling mechanisms in Python to ensure error-free execution and improve the robustness of programs.			
	5.2	Custom Exceptions: Develop a Python program that simulates a banking system with a function to withdraw money. Raise custom exceptions for scenarios such as insufficient funds and invalid account numbers.			
Problem Statement: (https://www.codechef.com/learn/course/oops-concepts-in-python/CP OPPY12/problems/ADVPPY110?utm_source)					
6	ASSESSMENT-I & SUBMISSION				
7	Introduction to OOP: Creating Classes and Objects Class attributes and methods ,Constructor and destructor, Type of Inheritance: Single, multiple, and multilevel inheritance.		CO3	BL3	2

	7.1	Online Shopping System: Develop classes for products, customers, and shopping carts. Include methods for adding items to the cart, calculating total costs, processing orders, and managing inventory.			
	7.2	Vehicle Rental System: Design a system using classes for vehicles, rental agencies, and rental transactions. Implemented methods to handle vehicle availability, rental periods, pricing, and customer bookings.			
	7.3	Area of Triangle: Write a Python class named polygon with two methods: input sides and display sides. Inherit a Class Triangle from the polygon and calculate the area of a triangle.			
8	Introduction to OOP: Encapsulation and Polymorphism		CO3	BL3	2
	8.1	Online Course Management System: Consider an Online Course Management system with a base class named Student, which includes essential attributes such as name, age, and course to represent a student's basic details. From this base class, two specialized classes are derived: UndergraduateStudent and PostgraduateStudent. The UndergraduateStudent class extends the functionality of the base class by adding a semester attribute, representing the current semester of study. Similarly, the PostgraduateStudent class introduces a thesis_topic attribute, which stores the research focus of the student. Each of these subclasses overrides the display_info() method to include their additional attributes while still utilizing the base class's functionality.			
9	Regular Expressions, Pattern matching, Regex functions in Python		CO3	BL3	2
	9.1	Write a Python program to extract all valid email addresses and phone numbers from a given text file using pattern-matching techniques with regular expressions.			
	9.2	Write a Python program to handle the following cases using the 're' module functionalities: - Retrieve all the lines that contain "This" in the beginning of the line. - Repeat Q1 but retrieve both upper- and lower-case letters. - Retrieve all lines that contain consecutive te's - Retrieve lines that contain a word of any length starting with s & ending with e. - Retrieve all lines with a date in the form of 1 or 2 digits, a dot, 1 or 2 digits, a dot, and two digits.			

10	GUI Development using any Python GUI framework		CO4	BL3	2
	10.1	GUI for Developing Conversion Utilities: Develop a Python GUI application that performs various unit conversions such as currency (Rupees to Dollars), temperature (Celsius to Fahrenheit), and length (Inches to Feet). The application should include input fields for the values, dropdown menus or buttons to select the type of conversion, and labels to display the results.			
	10.2	College Admission Registration Form: The college admission registration form collects essential personal, educational, and contact information from prospective students.			
11	8.1 Introduction to Popular Libraries: NumPy and Pandas for data manipulation, and Matplotlib for data visualization		CO5	BL3	2
	11.1	A meteorological department records temperature data in different cities. You need to store and analyze this data efficiently using NumPy arrays. Create 1D, 2D, and 3D NumPy arrays to store temperature data. Perform reshaping, slicing, and indexing operations on the arrays. Consider a 1D array that represents daily temperature readings 2D array stores temperature readings for multiple cities, and a 3D array represents data for different weeks.			
	11.2	Problem Statement: Develop a program in Python to create a calendar as an array of 7 elements to represent 7 days of the week. • Each Element of the array is a structure having three fields. • The first field is the name of the Day (A string) • The second field is the date of the Day (An integer) • The third field is the description of the activity for a particular day https://www.codechef.com/learn/course/college-data-structures-python/CPDSPY01/problems/CPDSAPY10			
12	Introduction to Popular Libraries: Pandas for data manipulation, Matplotlib for data visualization		CO5	BL3	2
	12.1	Using the Iris Data (https://www.kaggle.com/datasets/saurabh00007/iris.csv), perform the following tasks: - Read the first 8 rows of the dataset. - Display the column names of the Iris dataset. - Fill any missing data with the mean value of the respective column. - Remove rows that contain any missing values. - Group the data by the species of the flower. - Calculate and display the mean, minimum, and maximum			

		values of the Sepal length column.			
13	ASSESSMENT- II & SUBMISSION				
Assignment 1	Student Marks Management System Using Python Educational institutions often need a basic system to manage and analyze student performance data. Manual handling of marks for multiple students and subjects is error-prone and inefficient. Design a Python program that can: ● Accept student details (Name, Roll Number) ● Accept marks in 3 or more subjects ● Calculate: ○ Total marks ○ Percentage ○ Grade based on percentage ● Display the result in a formatted report card ● Allow multiple student entries Step 1: Define a function to input student details. Create a function named after yourself (e.g., input_details_by_rahul()) Step 2: Collect marks for 3+ subjects Step 3: Calculate total, percentage, and grade Step 4: Store student data in a dictionary or list Step 5: Allow the user to view report cards Step 6: Save all student reports to a file				
Assignment 2	Write the output of the following code: 1) <pre> x = 5 while x > 0: if x % 2 == 0: print(x, end=' ') x -= 1 </pre> 2) <pre> Li = ['Harsh', 'Pratik', 'Bob', 'Dhruv'] print (Li[1][-1]) </pre> 3) <pre> def my_func(): x = 10 print("Inside function:", x) x = 20 my_func() print("Outside function:", x) </pre> 4) <pre> for char in 'hello': </pre>				

	<pre> if char == 'l': break print(char, end=' ') 5) items = ['pen', 'pencil', 'eraser'] items.remove('pencil') print(items) items.pop() print(items) 6) for char in 'PYTHON STRING': if char == ' ': break print(char, end="") if char == 'O': continue </pre>
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Textbooks:	
1	Dr. R. Nageswara Rao, “Core Python Programming,” Dreamtech Press.
2	Andrew NG, “Introduction to Python Programming.”
3	E. Balagurusamy, “Introduction to computing and problem-solving using Python,” McGraw-Hill Education.
Reference Books:	
1	Charles Dierbach, “Introduction to Computer Science using Python.”
2	David Beazley, “ <i>Python Cookbook</i> ” .
3	Luciano Ramalho, “ <i>Fluent Python</i> ”.

Semester – IV									
Course Code	Course Name	Course Abbr	Teaching Contact Hours			Credits			
			Theory	Tutorial	Practical	Theory	Tutorial	Practical	Total
25CDSPCC401	Analysis of Algorithms	AoA	2	-	-	2	-	-	2
25CDSPCC402	Intelligent System	IS	2	-	-	2	-	-	2
25CDSPCC403	Machine Learning	ML	2						2
25CDSMDC402	Multidisciplinary Minor II	MDM-II	3	-	-	3	-	-	3
25OE401X	Open Elective I	OE-I	2	-	-	2	-	-	2
25CDSSEC401	Communication & Personality Dev II	CPD-II	2	-	-	2	-	-	2
25CDSSEC402	Problem Solving & Aptitude Building II	PSAB-II	2	-	-	2	-	-	2
25CDSPCL401	Analysis of Algorithms Lab	AoA-L	-	-	2	-	-	1	1
25CDSPCL402	Intelligent System Lab	IS-L	-	-	2	-	-	1	1
25CDSPCL403	Machine Learning Lab	ML-L	-	-	2	-	-	1	1
25CDSPCL404	Data Visualization Lab	DV-L	-	-	2	-	-	1	1
25CDSMDL402	Multidisciplinary Minor II Lab	MDM-II-L	-	-	2	-	-	1	1
25CDSCEP301	Community Engagement Project	CEP	-	-	4	-	-	2	2
TOTAL			29 hrs			22 Credits			

Semester – IV							
Course Code	Course Name	Course Abbr	Internal Assessment		External Assessment		TOTAL
			CIA	MSE	ESE	Prac / Pres / Oral	
25CDSPCC401	Analysis of Algorithms	AoA	20	20	40	-	80
25CDSPCC402	Intelligent System	IS	20	20	40	-	80
25CDSPCC403	Machine Learning	ML	20	20	40	-	80
25CDSMDC402	Multidisciplinary Minor II	MDC-II	20	30	50	-	100
25OE401X	Open Elective I	OE-I	20	20	40	-	80
25CDSSEC401	Communication & Personality Dev II	CPD-II	25			25	50
25CDSSEC402	Problem Solving & Aptitude Building II	PSAB-II	50		-		50
25CDSPCL401	Analysis of Algorithms Lab	AoA-L	25		-	25	50
25CDSPCL402	Intelligent System Lab	IS-L	25		-	25	50
25CDSPCCL403	Machine Learning Lab	ML-L	25		-	25	50
25CDSPCL404	Data Visualization Lab	DV-L	25		-	25	50
25CDSMDL402	Multidisciplinary Minor II Lab	MDM-II-L	25		-	25	50
25CDSCEP301	Community Engagement Project	CEP	50	-	-	25	75
TOTAL			460		385		845

Analysis of Algorithms

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCC401	Analysis of Algorithms	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Data structure concepts, Discrete structures

Course Objectives:

1	To provide mathematical approaches for Analysis of Algorithms.
2	To understand and solve problems using various algorithmic approaches.
3	To analyze algorithms using various methods.

Course Outcomes (COs): At the end of the course students will be able to

CO1	Explore the fundamentals of complexity analysis and analyze the performance of different algorithms in terms of time and space complexity. (L3)
CO2	Illustrate the concept of divide and conquer and greedy strategies and analyze the complexity of relevant algorithms.(L3)
CO3	Apply dynamic programming techniques to solve computational problems and evaluate the time and space complexity of the corresponding algorithms. (L3)
CO4	Utilize backtracking and branch and bound techniques to solve computational problems and to solve complex problems and assess their computational efficiency. (L3)
CO5	Explore various string matching techniques and their applicability to different problem types. (L3)

Module No.	Detailed Contents		CO Map ped	BL	Hrs
1	Title	Introduction to Algorithm	CO1	BL3	5
	1.1	Performance analysis: space, and time complexity			
	1.2	Asymptotic Notations: O, Θ , Ω notations, Recurrences: Substitution Method, Master Theorem			
	1.3	Bubble Sort, Selection Sort, insertion sort and their Complexity Analysis			
	1.4	Self Learning: Complexity class: Definition of P, NP, NP-Hard, NP-Complete			
	Title	Divide and Conquer Approach and Greedy Approach	CO2	BL3	10
2	2.1	Divide and Conquer Approach: General Method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search			
	2.2	Greedy Approach: General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Minimum cost spanning trees: Kruskal and Prim's algorithms, Job sequencing with deadlines			

	2.3	Self Learning: Applications in Recommended System and Clustering			
3	Title	Dynamic Programming	CO3	BL3	07
	3.1	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm, All pair shortest path: Floyd Warshall Algorithm			
	3.2	0/1 knapsack Problem, Longest common subsequence, Travelling Salesperson problem			
	3.3	Self-Learning: Assembly-line scheduling			
4	Title	Backtracking and Branch and bound	CO4	BL3	06
	4.1	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring			
	4.2	Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem			
	4.3	Self-Learning: Hamiltonian Cycle			
5	Title	String Matching Algorithms	CO5	BL3	05
	5.1	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm			
	5.2	Self-Learning: Applications in Search Engines and Information Retrieval			
Total					28+5

Text Books :	
1	Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. “Fundamentals of computer algorithms” University Press.
2	T. H. Cormen, C.E. Leiserson,R.L. Rivest, and C. Stein, “Introduction to algorithms”, 2nd Edition, PHI Publication 2005.
3	Harsh Bhasin.”Design and Analysis of Algorithms” Oxford University Press
Reference Books :	
1	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw-Hill Edition.
2	S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI

Intelligent System

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCC402	Intelligent System	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: C Programming

Course Objectives:

1	Describe the fundamental characteristics of intelligent environments and compare various agent architectures
2	Understand different search algorithms to solve problems
3	Discuss knowledge representation techniques and reasoning methods to evaluate and solve problems.
4	Analyze and evaluate different decision-making approaches used in uncertain situations.
5	Explain and differentiate between various machine learning techniques

Course Outcomes (COs): At the End of the course students will be able to	
CO1	Understand the characteristics of the environment and differentiate between various agent architectures. (BL2)
CO2	Apply and analyze search algorithms to solve problems using various search techniques (BL3,BL4)
CO3	Use knowledge and reasoning to analyze problems and evaluate through uncertain situations. (BL3, BL5)
CO4	Comprehend the knowledge of intelligent planning and ontological engineering. (BL2, BL3)

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Title	Introduction to Artificial Intelligence	CO1	BL2	03
	1.1	Artificial Intelligence (AI): History of AI, Applications of AI, The present state of AI			
	1.2	Intelligent Agents and Environment the structure of an agent, Types of Agents, Environments and Its Properties, PEAS Representation for an Agent, Learning Agent			
	1.3	Self Learning: Applications of AI			
2	Title	Problem-Solving using Searching	CO2	BL3 , BL4	08
	2.1	Solving Problems by Searching: Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality			
	2.2	Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bidirectional Search			
	2.3	Informed Search: Heuristic Function, Admissible Heuristic, Greedy Best First Search, A* Search, Local Search: Hill Climbing Search, Simulated Annealing Search			
	2.4	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning			
	2.5	Self Learning: Solving Problems by Searching			

		Techniques			
3	Title	Knowledge and Reasoning	CO3	BL2 BL3 BL4	09
	3.1	Definition of Knowledge, Knowledge Representation Systems, Issues in Knowledge Representation, Propositional Logic (PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula,			
	3.2	Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL			
	3.3	Forward Chaining, Backward Chaining and Resolution in FOPL			
	3.4	Uncertain Knowledge and Reasoning: Random Variable, Prior and Posterior Probability, Bayes’s Rule and its use, Bayesian Belief Networks			
	3.5	Self Learning: Case study on Knowledge and Reasoning in			
4	Title	Logical Foundations of Ontological System and Planning in AI	CO4	BL2 BL3	08
	4.1	Definition, and importance of ontologies in AI, Components of ontologies: classes, properties, individuals			
	4.2	Ontology development methodologies (e.g. Protégé), Ontology languages (e.g. OWL, RDF)			
	4.3	The planning problem, Partial order planning, total order planning			
	4.4	Expert Systems, Components of Expert System: Knowledge base, Inference engine, user interface, working memory, Development of Expert Systems			
	4.5	Self Learning: Applications of Ontologies in AI (e.g Semantic web)			
Total					28+4

Text Books :	
1	Stuart J. Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach —Second Edition" Pearson Education.
2	Elaine Rich and Kevin Knight —Artificial Intelligence‡ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3	George F Luger —Artificial Intelligence‡ Low Price Edition, Pearson Education., Fourth edition.
Reference Books :	
1	Ivan Bratko —PROLOG Programming for Artificial Intelligence‡, Pearson Education, Third Edition
2	D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall
3	Saroj Kaushik —Artificial Intelligence‡, Cengage Learning.

Machine Learning

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCC403	Machine Learning	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	20		40		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Data Structures, Basic Probability and Statistics, Algorithms

Course Objectives:

1	Understand and articulate the fundamental concepts of Machine Learning
2	apply essential mathematical concepts such as linear algebra, calculus, probability, and optimization to understand, implement, and analyze machine learning algorithms
3	Evaluate and compare appropriate machine learning models
4	Understand the machine learning model types
5	Apply dimensionality reduction techniques to simplify data, enhance model performance, and facilitate data visualization.

Course Outcomes (COs): At the End of the course students will be able to	
CO1	Discuss the basic concepts of Machine Learning
CO2	Use mathematical foundation for machine learning
CO3	Select suitable Machine learning models
CO4	Identify the appropriate model types for classification, regression, and clustering tasks.
CO5	Apply Dimensionality Reduction techniques

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Title	Introduction to Machine Learning	CO1	BL1	05
	1.1	Introduction and Applications: Definition of ML, ML vs AI, Applications in domains, Types of ML (Supervised, Unsupervised, Reinforcement)			
	1.2	Workflow & Concepts: ML process, datasets, overfitting/underfitting			
	1.3	Performance Metrics: Confusion Matrix, Accuracy, Precision, Recall, F1 Score, RMSE			
	1.4	Self Learning: AI vs ML			
2	Title	Supervised Learning	CO2	BL2 BL3	08
	2.1	Regression Techniques: Linear Regression, Multiple linear Regression, Cost Function, Gradient Descent			
	2.2	Classification Algorithms: Logistic Regression, k-Nearest Neighbors (kNN)			
	2.3	Model Evaluation: Cross-validation, Bias-variance trade-off, confusion matrix revisit			
	2.4	Self Learning: Apply regression/ classification on real-world data			
3	Title	Unsupervised Learning	CO3	BL2	06
	3.1	Clustering: k-Means algorithm, Applications,			

		Evaluation techniques (Elbow method, Silhouette score)			
	3.2	Dimensionality Reduction: PCA concepts, use cases, data visualization			
	3.3	Hierarchical Clustering : Agglomerative approach, dendrograms			
	3.4	Self Learning: Practice clustering and PCA on real datasets			
4	Title	Model Optimization & Deployment	CO4	BL1 BL2	07
	4.1	Regularization: L1 and L2 regularization, avoiding overfitting			
	4.2	Scaling and Pipelines: Feature scaling methods, Building ML pipelines in Scikit-learn			
	4.3	Hyperparameter Tuning: Train/test split, GridSearchCV, Random search			
	4.4	Self Learning: AutoML and model versioning concepts			
5	Title	Specialized Models & Emerging Trends	CO5	BL1 BL2 BL3	07
	5.1	Tree-Based Models: Decision Trees and Random Forests, feature importance			
	5.2	SVM & Neural Networks: Concept of SVM, kernel trick (overview), Neural Network basics			
	5.3	Applications in NLP, Healthcare, Finance, Recommendation Systems			
	5.4	Self Learning: Case Study on Customer Churn Prediction			
Total				28+5	

Text Books :	
1	Nathalie Japkowicz & Mohak Shah, —Evaluating Learning Algorithms: A Classification Perspective, Cambridge.
2	Marc Peter Deisenroth, Aldo Faisal, Cheng Soon Ong, —Mathematics for machine learning
3	Ethem Alpaydın, —Introduction to Machine Learning, MIT Press McGraw-Hill Higher Education
Reference Books :	
1	Tom M. Mitchell, —Machine Learning, McGraw Hill
2	Kevin P. Murphy, —Machine Learning — A Probabilistic Perspective, MIT Press
3	Shai Shalev-Shwartz, Shai Ben-David, —Understanding Machine Learning, Cambridge University Press

Foundation of Data Science

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSMDC402	Foundation of Data Science	3	-	-	3	-	-	3
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
10	05	05	20	30		50		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (10)

Minimum Two (02) of the above mentioned activities each of 10 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using Imperative Programming

Course Objectives: The course will enable students to:

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions
3	Apply linear regression and logistic regression on the given dataset.

Course Outcomes (COs): At the end of the course, students will be able to:	
CO1	Analyze the importance of Data Science and its Applications in Engineering. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basics statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Introduction to Data Science		CO1	BL3	07
	1.1	Overview of the course			
	1.2	Importance of data science in engineering			
	1.3	Real-world examples of data-driven engineering solutions			
	1.4	Self-Learning: Philosophy of Exploratory Data Analysis, Data Science process and Data Scientist's role in this process			
2	Data Collection and Preprocessing		CO2	BL4	09
	2.1	Data types and sources, Data collection methods, Data cleaning and preprocessing techniques			
	2.2	Exploratory Data Analysis and Data Visualization			
	2.3	Descriptive statistics, Data visualization techniques using tools: in Python			
	2.4	Self-Learning: Basic tools of EDA			
3	Statistical Analysis for Data Science		CO3	BL3	10
	3.1	Introduction to Statistical Analysis			
	3.2	Overview of statistical concepts and terms, Probability distributions			
	3.3	Hypothesis testing and significance, Statistical Inference			

	3.4	Estimation and confidence intervals, Parametric and non-parametric tests,			
	3.5	Self-Learning: Describing Data with Averages - Describing Variability			
4	Machine Learning Algorithms		CO4	BL3	10
	4.1	Introduction to Machine Learning, Basic concepts and types of machine learning algorithms, Supervised vs. unsupervised learning			
	4.2	Regression and Classification: Linear regression, Simple and Multiple Linear Regression, Logistic regression			
	4.3	Correlation vs. Regression, Precision, Recall, ML Models Score and Error			
	4.4	Self-Learning: KNN, K-means			
5	Case Studies & Applications		CO5	BL3	07
	5.1	Real-world case studies demonstrating the use of data science in engineering			
	5.2	Discussion of ethical challenges and considerations in these case studies.			
	5.3	Self-Learning: Case-Study on any available recommendation system.			
Total				42	

Textbooks:	
1	Fundamentals of data science, Dr. Aijaz Ali, Khan, Anita Rani Mehta, Vandana Ahuja, Rivers Publication, 2023
2	U. Dinesh Kumar, "Data Science: Theory and Practice," Wiley India
3	V.K. Jain, "Data Science and Analytics."
Reference Books:	
1	Python for Data Analysis-by WMc Kinney, OREILLY Publication.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, " <i>The Elements of Statistical Learning</i> ," Springer.

Communication & Personality Development-II-(CPD-II)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSSEC401	Communication & Personality Development -II (CPD-II)	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		Prese. / Oral 50		
Activity	Test	Att	Total					
15	05	05	25	-		25		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (15)

Minimum Two (02) of the above mentioned activities each of 15 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (05)

Minimum Two (02) of the above mentioned tests each of 05 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (05)

As per the rubric provided by the Attendance committee.

Prerequisite: Basic English language fluency

Course Objectives: Analyse personal traits, interests, values, aptitudes and skills.

1	Critically analyse technical documents and other literature for understanding and development of thoughts.
2	Listen and understand the dynamics of professional communication in the form of group discussions, presentations, etc. required for career enhancement.
3	Analyse personal traits, interests, values, aptitudes and skills.
4	Understand the importance of integrity and develop a personal code of ethics.

Course Outcomes (COs): At the End of the course, students will be able to	
1	Comprehend various technical literature to develop the competency of formal communication
2	Develop student's ability to actively listen, participate effectively in GD and deliver clear, engaging presentations.
3	Understand the role of communication in personal and professional success.
4	Demonstrate effective individual professional ethics at the workplace.

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	1.1	READING AND WRITING SKILLS: Critical Reading: Understanding the concept of critical reading	CO1	BL1 BL2 BL3	06
	1.2	Applying critical reading skills to analyse a given text.			
	1.3	Read and Summarise a Research paper (Environment, Sustainability and Social aspects)			
	1.4	Read a book (fiction / non-fiction) and prepare a review on it.			
2	2.1	LISTENING & SPEAKING SKILLS: Listening Comprehension (Motivational Talks or TED TALKS): Pronunciation, intonation, Stress and Rhythm	CO2	BL1 BL2 BL3	10
	2.2	Group Discussion: Principles of Group Discussion, Do's and Don'ts of Group Discussion			
	2.3	Giving Presentations: Dealing with Stage Fear, Planning, Structuring and Delivering Presentation			
3	3.1	PERSONAL DEVELOPMENT PLANNING: Self- Assessment strategies (SWOT Analysis)	CO3	BL1 BL2 BL3	05
	3.2	Digital Footprints-Maintaining a Professional Persona			

	3.3	Goal Setting: (Defining goals, Types of goals, Establishing SMART goals, Steps in setting goals, Goal setting activity)			
4	4.1	PROFESSIONAL ETHICS: Body language	CO4	BL1 BL2 BL3	07
	4.2	Assertive Behaviour & Conflict Resolution			
	4.3	Decision-making Skills			
	4.4	Leadership and Qualities of a successful leader			
	4.5	Character-building			
	4.6	Work Ethics and Etiquette.			
Total				28	

LIST OF ASSIGNMENTS: (In the form of Short Notes, Questionnaire / MCQ Test, Role Play, Case Study, Quiz, etc.)	
Sr. No.	Assignment Questions
1	Literature Review of Research Papers
2	Summary of a (fiction / non-fiction) Book
3	Summary of a TED talk / Motivational Video
4	Based on SWOT analysis, create a plan that leverages strengths, minimizes weakness, capitalizes on opportunities and mitigates threats.
5	Write a personal essay reflecting your experiences, values & aspirations.
6	How to use body language effectively?
6	Describe your favourite leader highlighting his key skills.
7	Write in detail about a personal set of values that determines how an employee behaves in the workplace.
Note:	
1	The group size for the presentation and group discussion should not be less than 5 students or exceed 7 students.
2	There will be an end-semester presentation on any technical topic.

Textbooks:	
1	Communication Skills by Sanjay Kumar & Pushp Lata
2	Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
Reference Books:	
1	Arms, V. M. (2005). <i>Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition</i> . Boston, MA: McGraw-Hill.
2	Bovée, C. L., & Thill, J. V. (2021). <i>Business communication today</i> . Upper Saddle River, NJ: Pearson.
3	Butterfield, J. (2017). <i>Verbal communication: Soft skills for a digital workplace</i> . Boston, MA: Cengage Learning.
4	Masters, L. A., Wallace, H. R., & Harwood, L. (2011). <i>Personal development for life and work</i> . Mason: South-Western Cengage Learning
5	Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). <i>Organizational behaviour</i> . Harlow, England: Pearson.
6	Meenakshi Raman, Sangeeta Sharma (2004) <i>Technical Communication, Principles and Practice</i> . Oxford University Press
7	Archana Ram (2018) <i>Place Mentor, Tests of Aptitude for Placement Readiness</i> . Oxford University Press

Problem Solving and Aptitude Building-II

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSSEC402	Problem Solving and Aptitude Building Part-II	2	-	-	2	-	-	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		End Semester Examination		
Activity	Test	Att	Total					
30	10	10	50	-		-		

Activity: [Presentation/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (30)

Minimum Two (02) of the above mentioned activities each of 30 marks have to be conducted. The average marks would be considered.

Test [Open Book Test/Class Test/Multiple Choice Questions] (10)

Minimum Two (02) of the above mentioned tests each of 10 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (10)

As per the rubric provided by the Attendance committee.

Prerequisite: Completion of Part-1 or equivalent problem-solving foundation	
Course Objectives: The course will enable students to	
1	To enhance understanding of complex aptitude and reasoning patterns
2	To develop analytical thinking through data interpretation and puzzles.
3	To prepare for aptitude-based recruitment assessments and competitive exams.

Course Outcomes (COs): At the End of the course students will be able to	
CO1	Analyze data using arithmetic and tabular methods.
CO2	Apply mensuration and geometry concepts in real-life contexts.
CO3	Solve problems involving counting principles and probability.
CO4	Use structured logic to solve puzzles and reasoning problems.
CO5	Apply critical thinking to abstract reasoning and decision-making problems.

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Module 1: Advanced Arithmetic & Data Interpretation:		CO1	BL3	05
	1.1	Advanced Percentage and Interest Calculations			
	1.2	Partnerships and Investments			
	1.3	Data Interpretation Basics (Tables, Pie Charts, Bar Graphs) Caselet DI			
2	Module 2: Geometry and Mensuration:		CO2	BL3	05
	2.1	Basic Geometric Shapes and Properties Triangles, Circles, Quadrilaterals			
	2.2	Mensuration Formulas (2D and 3D) Area, Volume, Surface Area Problems			
	2.3	Coordinate Geometry Basics			
3	Module 3: Permutations, Combinations & Probability:		CO3	BL3	06
	3.1	Fundamental Counting Principle, Permutations and Combinations			
	3.2	Factorials and Arrangements Basic Probability and Conditional Probability			
	3.3	Problem Solving Techniques			
	Module 4: Advanced Logical Reasoning:		CO4	BL3	06

4	4.1	Puzzles and Seating Arrangements (Linear and Circular)			
	4.2	Input-Output, Logical Deductions			
	4.3	Statements & Assumptions, Statements & Conclusions			
	Module 5: Analytical and Abstract Reasoning:		CO5	BL3	06
5	5.1	Module 5: Analytical and Abstract Reasoning: Analytical Decision Making, Pattern Recognition			
	5.2	Cube and Dice Problems, Clocks and Calendars			
	5.3	Cause and Effect, Critical Thinking and Problem-Solving Techniques			
Total					28

Text Books :

1	Quantitative Aptitude for Competitive Examinations,R.S. Aggarwal,S. Chand.
2	A Modern Approach to Verbal and Non-Verbal Reasoning,R.S. Aggarwal,S. Chand
3	Quantitative Aptitude Quantum CAT,Sarvesh K. Verma,Arihant Publications
4	Fast Track Objective Arithmetic,Rajesh Verma,Arihant Publications

Reference Books:

1	How to Prepare for Quantitative Aptitude for CAT, Arun Sharma, McGraw Hill
2	Logical Reasoning and Data Interpretation for the CAT, Nishit K. Sinha, Pearson Education
3	Analytical Reasoning, M.K. Pandey, BSC Publishing
4	Arihant's Master Resource Book – Logical Reasoning & Data Interpretation, Ajay Singh, Arihant Publications

Analysis of Algorithms Lab

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL401	Analysis of Algorithms Lab	-	-	2	-	-	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Basic knowledge of programming and data structure

Course Objectives: The course will enable students to

1	To implement and analyze fundamental algorithmic techniques with a focus on understanding their structural design, and practical applications.
2	To develop the ability to compare algorithms based on time and space complexity and to select appropriate algorithms for solving computational problems efficiently.

3	To cultivate problem-solving skills by applying algorithmic strategies to real-world and case-based problems, while reinforcing principles of algorithm design, optimization, and correctness.
Course Outcomes (COs): At the End of the course students will be able to	
CO1	Implement and analyze basic sorting algorithms based on input characteristics and performance. (L4)
CO2	Develop and execute divide and conquer algorithms to solve different computational problems and analyze their complexity. (L3)
CO3	Implement greedy algorithms to solve various optimization problems and evaluate their performance. (L3)
CO4	Implement dynamic programming solutions for various computational problems and evaluate their efficiency. (L4)
CO5	Implement backtracking and branch and bound methods for solving different computational problems. (L3)
CO6	Implement efficient string matching algorithms to accurately solve pattern searching problems in text processing and related computational tasks.(L3)

Week No.	Exp No.	Detailed Contents	CO Mapped	BL	Hrs
1	1.1	A recruitment software module needs to sort job candidates based on years of experience. Implement Selection Sort to order a list of candidate profiles by years of experience.	CO1	BL3	2
	1.2	Implement a program to sort a given array of integers in ascending order using the Insertion Sort algorithm.			
2	2.1	A university admission system maintains a sorted list of student roll numbers who have successfully enrolled in a course. When a student wants to check their enrollment status, the system performs a search in the list. Apply the Binary Search algorithm to quickly find the student's roll number.	CO1	BL3	2
3	3.1	A university examination department needs to sort student records based on their total marks obtained in a semester. The department wants to quickly generate a merit list. Implement the Quick Sort algorithm to sort the students in descending order of	CO2	BL3	2

		their total marks.			
4	3.2	An e-commerce platform wants to show sorted results based on the price of an item. Implement Merge Sort to sort product listings.			
5	4.1	Implement Dijkstra's algorithm to find the shortest paths in a city map. The roads are represented as unweighted edges, and the goal is to find the shortest distance from the starting location to all other locations. https://ds2-iiith.vlabs.ac.in/exp/dijkstra-algorithm/index.html	CO3	BL3	2
6	Internal Assessment -I & Submission				
7	5.1	A government agency plans to develop an eco-friendly road network within a large national park to connect all major observation points . Implement a system that helps the government identify the most cost-effective set of roads to be built, using Kruskal's algorithm to compute the Minimum Spanning Tree of the given network.	CO3	BL3	2
8	7.1	Cost-Optimized Delivery Routing using Bellman-Ford Algorithm: Develop a system to calculate the minimum delivery cost from a central warehouse to all destinations in a transport network, considering both positive and negative route costs.	CO4	BL3	2
9	9.1	Implement 0/1 Knapsack algorithm : In a post-disaster relief operation, a truck is being loaded with emergency supplies to be transported to an affected area. Each supply item has a weight (in kilograms) and a value, which reflects its importance or utility in saving lives or providing aid. The truck has a maximum weight capacity (W) due to road safety regulations and fuel limitations. Each item is indivisible — you either take the entire item or leave it. Select the optimal set of supplies to load into the truck so that the total importance (value) is maximized without exceeding the truck's weight limit.	CO4	BL3	2

	9.2	Fractional Knapsack Using Greedy Approach You are given N items, each with a weight w[i] and a value v[i], and a knapsack with a maximum weight capacity W. Your task is to determine the maximum total value that can be accommodated in the knapsack by taking fractions of items if necessary.	CO3	BL3	2
10	10.1	In academic institutions, detecting textual similarity between student assignments is critical to identify potential plagiarism. Given two assignment submissions as sequences of words, develop a program to compute the Longest Common Subsequence (LCS) using Dynamic Programming .	CO4	BL3	2
11	11.1	Implement a program to solve the N-Queens problem using the Backtracking algorithm . The objective of the N-Queens problem is to place N chess queens on an N×N chessboard so that no two queens threaten each other. This means that no two queens should be placed in the same row, column, or diagonal.	CO5	BL3	2
12	12.1	Implement a Naive string matching algorithm to locate occurrences of a keyword or phrase (pattern) within a larger body of text .	CO6	BL3	2
	12.2	Implement the KMP string matching algorithm to search for a user-provided query string (pattern) within a large product description database (text) for an e-commerce platform stores			
13	Internal Assessment -II & SUBMISSION				
14		Problem Solving Assignment on ● Dynamic Programming Approach ● Backtracking Approach ● String Matching Algorithms	CO4,C O5,CO 6	BL3	2

Text Books :	
1	Ellis Horowitz, Sartaj Sahni, S. Rajsekar. "Fundamentals of computer algorithms" University Press.
2	T. H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.

Reference Books :	
1	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw- Hill Edition.
2	S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI
Online Resources:	
1	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
2	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
3	LeetCode - LeetCode is an online platform for coding interview preparation. The platform provides coding and algorithmic problems intended for users to practice coding.
4	CodeChef - Learn and Practice Coding with Problems

Intelligent System Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL402	Intelligent System Lab	0	0	2	0	0	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Python Programming

Course Objectives: The course will enable students to

1	Design an appropriate agent architecture tailored to solve a real-world AI problem.
2	Implement knowledge representation and reasoning techniques using an AI programming language.
3	Develop a problem-solving agent capable of addressing specific tasks effectively.

4	Incorporate methods of reasoning under uncertainty to enhance the decision-making capabilities of an AI agent.
Course Outcomes (COs): At the End of the course students will be able to	
CO1	Identify suitable Agent Architecture for a given real world AI problem. (L2) Also Implement simple programs using Prologs. (L3)
CO2	Implement various search techniques for a Problem-Solving Agent. (L3)
CO3	Construct a Bayesian Belief Network for a given problem and draw probabilistic inferences from it. (L3)
CO4	Implement knowledge base using intelligent planning to solve real world problem(L3)

Week No.	Exp. No.	Detailed Contents	CO Mapped	Bloom's Level	Hrs
1	1	Case study on AI applications published in IEEE/ACM/Springer or any prominent journal.	CO1	BL2	2
2	2	Provide the PEAS description and TASK Environment for a given AI problem.	CO1	BL2	2
3	3	Write simple programs using PROLOG as an AI programming Language.	CO1	BL3	2
4	4	Write a program using PROLOG for first order logic.	CO1	BL3	2
5	5	Implement any one of the Uninformed search techniques.	CO2	BL3	2
6	Internal Assessment -I & Submission				
7	7	Implement a hill climbing algorithm to solve 8 puzzle problems.	CO2	BL3	2
8	8	Implement any 2 player game using game playing algorithms.	CO2	BL3	2
9	9	Implement adversarial search using min-max algorithm.	CO2	BL3	2
10	10	Implement BFS and DFS search problems using Python.	CO2	BL3	2

11	11	Create a Bayesian Network for the given Problem Statement and draw inferences from it.	CO3	BL3	2
12	12	Develop a Knowledge base using OWS	CO1, CO4	BL3, BL3	2
13	Internal Assessment -II & Submission				
14	14	Case Study of any Rule Based System using SWRL	CO1, CO4	BL3, BL3	2

Text Books :	
1	Stuart J. Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach Second Edition" Pearson Education.
2	Elaine Rich and Kevin Knight —Artificial Intelligence Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3	George F Luger —Artificial Intelligence Low Price Edition, Pearson Education., Fourth edition.
Reference Books :	
1	Ivan Bratko —PROLOG Programming for Artificial Intelligence, Pearson Education, Third Edition
2	D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall
3	Saroj Kaushik —Artificial Intelligence, Cengage Learning.

Machine Learning Lab

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCCL403	Machine Learning Lab	0	0	1	0	0	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: C Programming, Python Programming

Lab Objectives: The course will enable students to

1	Understand machine learning models for real-world problems.
2	Implement various Regression techniques
3	Implement Clustering and classification techniques

4	Assess and select the most appropriate algorithm based on problem requirements
5	Develop skills to implement and fine-tune machine learning models using programming tools.
Lab Outcomes (LOs): At the End of the course students will be able to	
CO1	Apply, analyze, evaluate, and create machine learning models for real-world problems.
CO2	Apply and evaluate regression techniques for prediction tasks.
CO3	Analyze clustering techniques to group data effectively.
CO4	Compare different algorithms to select the most suitable one for a given problem.
CO5	Build and optimize machine learning models using appropriate programming tools

Week No.	Exp No.	Title of Experiment	CO Mapped	BL	Hrs
1	1	Exploring Machine Learning Libraries and Tools You are tasked with setting up an ML development environment for a new data science team. Explore and compare tools like Scikit-learn, TensorFlow, and Keras. Document the installation, key functions, and basic usage through simple examples.	CO1	BL2	2
2	2	Sentiment Analysis of Movie Reviews Using Naive Bayes A film streaming service wants to automate feedback analysis. Build a classifier using Naive Bayes to predict whether a user review is positive or negative. Train the model on labeled review data and evaluate using accuracy and F1-score.	CO1	BL3	2
3	3	Predicting House Prices Using Linear Regression A real estate agency wants to predict house prices based on features like area, number of rooms, and location rating. Build and train a linear regression model on housing datasets and evaluate its RMSE and R ² score.	CO2	BL3	2
4	4	Email Spam Classification Using Logistic Regression A company wants to classify emails as spam or not. Use logistic regression to build a binary classifier using email metadata and	CO2	BL3	2

		content keywords. Evaluate the model with a confusion matrix and F1-score.			
5	5	Student Pass/Fail Prediction Using KNN A college wants to predict whether students will pass based on their attendance and test scores. Implement a k-Nearest Neighbors classifier and evaluate using cross-validation. Serialize the trained model using Pickle.	CO2	BL4	2
6	Internal Assessment -I & Submission				
7	6	Clustering Customer Locations Using DBSCAN A food delivery service wants to identify dense customer zones. Apply DBSCAN clustering on customer location coordinates to discover potential zones for opening new hubs. Visualize clusters using matplotlib.	CO3	BL4	2
8	7	Customer Segmentation Using K-Means Clustering A retail chain wants to segment customers based on annual income and spending score. Apply K-Means clustering and determine optimal clusters using the Elbow method.	CO3	BL3	2
9	8	Mumbai House Price Prediction Using Decision Tree Regression Analyze the Mumbai housing dataset to predict median house value using decision trees. Compare model depth and features used for splitting. Visualize the tree and report on performance metrics.	CO4	BL4	2
10	9	Algorithm Selection Case Study: Random Forest vs. Gradient Boosting You are asked to improve a classification task's accuracy. Implement and compare Random Forest and Gradient Boosting classifiers on the same dataset (e.g., loan default prediction). Compare accuracy and F1-score.	CO4	BL4	2
11	10	SVM for Classification of Handwritten Digits Use the MNIST dataset to train an SVM classifier for handwritten digit recognition. Experiment with linear and RBF kernels. Evaluate precision, recall, and confusion matrix.	CO4	BL3	2
12	11	Building a Scikit-learn Pipeline and Scaling Features A startup needs a clean ML pipeline for deployment. Build a	CO5	BL4	2

		pipeline that includes preprocessing (scaling, encoding), model training, and prediction for a small dataset (e.g., titanic survival).			
13	Internal Assessment -II & SUBMISSION				
14		Hyperparameter Tuning with GridSearchCV Optimize the performance of a classifier (e.g., SVM or Random Forest) using GridSearchCV. Tune parameters such as kernel type, number of estimators, or depth. Use cross-validation to compare results.	CO5	BL4	2

Text Books :	
1	“Pattern Recognition and Machine Learning” by Christopher M. Bishop
2	“The Elements of Statistical Learning” by Hastie, Tibshirani, Friedman
3	“Applied Predictive Modeling” by Kuhn & Johnson
Reference Books :	
1	Pattern Classification, Richard O. Duda, Peter E. Hart, David G. Stork
2	"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
3	"Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy

Data Visualization Lab

Lab Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSPCL403	Data Visualization Lab	-	-	2	-	-	1	1
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Discrete mathematics, Database Management Systems, Programming in Python

Lab Objectives:

1	To understand the process of data analytics from raw data to actionable insights.
2	To implement regression, time series, and text analytics using Python and R.
3	To apply effective data visualization techniques using Matplotlib, Seaborn, and ggplot2.

4	To analyze data and interpret results for informed decision-making.
Lab Outcomes (LOs): At the End of the course students will be able to:	
CO1	Understand the data analytics lifecycle and tools used in each phase.
CO2	Apply regression and classification techniques to model real-world data.
CO3	Implement time series and forecasting methods.
CO4	Perform basic NLP tasks and visualize text data.
CO5	Create clear, interactive, and insightful visualizations using Python/R.
CO6	Integrate visualizations into dashboards and interpret insights effectively.

Sr.No.	Suggested Experiment	CO Mapped	BL	Hrs
1	Apply the analytics lifecycle to an e-commerce dataset to uncover sales patterns and user behavior. "We are given a raw dataset containing information about online shopping transactions (e.g., customer ID, purchase amount, product category, and date). Describe the steps you would take to convert this raw data into a meaningful visual summary that helps a business manager understand customer buying trends."	CO1	BL3	2
2	Predict salary based on years of experience using linear regression. You are given a dataset containing salaries of employees along with their years of experience. Using Python or R, build a simple linear regression model to predict salary based on years of experience. How would you check the accuracy of your predictions? Mention the libraries or functions you would use.	CO2	BL3	2
3	Analyze housing prices based on area, bedrooms, and locality using multiple regression.	CO2	BL4	

	You are provided with a dataset containing housing information based on this you are supposed to create a Linear Regression Model using Python to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). The Boston Housing dataset contains information about various houses in Boston through different parameters. There are 506 samples and 14 feature variables in this dataset. The objective is to predict the value of prices of the house using the given features.			2
4	You are given a dataset containing student attendance (%) and internal test scores. The dataset also includes whether each student passed or failed the course. Using Python , how would you build a model to predict whether a student will pass or fail?	CO2	BL3	2
5	You are provided with social network advertising datasets over . Using Python or R, perform 1. Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset. 2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.	CO3	BL4	2
6	Internal Assessment -I & Submission			
7	From a list of given students from Data Science class you are supposed to create an “Academic performance” dataset of students and perform the following operations using Python. 1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them. 3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution.	CO3	BL5	2

8	Clean and tokenize Text data to prepare for vectorized feature dataset classification. You are supposed to extract Sample document and apply following document preprocessing methods: 1. Tokenization, POS Tagging, stop words removal, Stemming and Lemmatization. 2. Create representation of document by calculating Term Frequency and Inverse Document Frequency.	CO4	BL3	2
9	You are given a dataset for a flower having data as iris.csv dataset Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of 'Iris-setosa', 'Iris-versicolor' and 'Iris-versicolor' of iris.csv dataset. 1. Implement Simple Naïve Bayes classification algorithm using Python/R on iris.csv dataset. 2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.	CO4	BL6	2
10	You are given dataset 'Titanic' ship. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. 1. Use the Seaborn library to see if we can find any patterns in the data. 2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram. 3. Use the above dataset 'Titanic' as used in the above problem. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names : 'sex' and 'age') 4. Write observations on the inference from the above statistics.	CO3, CO4	BL5	2
11	Build an interactive dashboard to monitor sales or healthcare data using Tableau	CO5, CO6	BL6	

	You are given a dataset containing either sales records or healthcare data (such as patient visits, treatments, or medication usage). Using Tableau, create an interactive dashboard that allows users to explore key trends and metrics. What types of visual elements (charts, filters, maps) would you include and why? How would you make the dashboard user-friendly and interactive? How can such a dashboard help in data-driven decision-making for businesses or healthcare providers?			2
12	Perform the following data visualization operations using Tableau on Adult and Iris datasets. 1D (Linear) Data visualization 2D (Planar) Data Visualization 3D (Volumetric) Data Visualization Temporal Data Visualization Multidimensional Data Visualization Tree/ Hierarchical Data visualization Network Data visualization	CO5, CO6	BL3, BL4	2
13	Internal Assessment –II & Submission			
14	Mini Projects/ Case Study – PYTHON/R Develop a movie recommendation model using the scikit-learn library in python. Refer dataset https://github.com/rashida048/Some-NLP-Projects/blob/master/movie_dataset.csv	CO6	BL6	2

Text Books :	
1	Colin Ware .“Visual Thinking for Design of information visualization and cognitive design” , Morgan Kaufmann (Elsevier) publisher(2008), ISBN: 978-0123708960
2	Alberto Cairo ,“ The Functional Art: An Introduction to Information Graphics and Visualization" Publisher New Riders (2012) , ISBN: 978-0321834737
3	Scott Murray “Interactive Data Visualization for the Web: An Introduction to Designing with D3”, Publisher O’Reilly Media, First Edition: 2013 Updated Edition: 2017 (2nd Edition),ISBN: 978-1491921289
4	Edward R. Tufte “The Visual Display of Quantitative Information”, Publisher: Graphics Press, First Published: 1983 Second Edition: 2001 ISBN: 978-0961392147
Reference Books :	
1	Claus O. Wilke, “Fundamentals of Data Visualization”, O’Reilly Media Press,(2018). ISBN: 9781492031086
2	Kieran Healy ,“ Data Visualization: A Practical Introduction (R and ggplot2 for academic data)”, Published by: Princeton University Press (2018) ISBN: 978-0691181622

Foundation of Data Science Lab

Lab Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSMDL402	Foundation of Data Science	-	-	2	-	-	1	2
Examination Scheme								
Continuous Internal Assessment (CIA)							External	
IPE	Exp	Activity		Att	Total		Prac & Oral	
15	05	03		02	25		25	

IPE: Internal Practical Evaluation (15)

Two (02) internal practical exams of 15 marks each as per below syllabus. 10 marks for Program execution, 02 marks for Program documentation and 03 marks for viva. The average of 02 exams marks would be considered as IPE.

Exp: Experiments (05)

Program(s) Execution & Problem(s) Solving: 03; On Time: 01; Viva: 01

Activity: [Assignment/Model/Mini Project] (03)

Minimum Two (02) of the above assessment tools each of 03 marks have to be conducted, covering the course outcomes. The average marks would be considered.

Att: Attendance (02)

As per the rubric provided by the Attendance committee.

Prerequisite: Basics of Python

Lab Objectives: The course will enable students to

1	Apply necessary skills to leverage data for problem-solving in various engineering disciplines.
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2	Apply to collect, analyze, and interpret data to gain valuable insights and make data-driven decisions.
3	Apply linear regression and logistic regression on the given dataset
Course Outcomes (COs): At the End of the course students will be able to:	
CO1	Apply the Data Analysis tools on different databases for summarization and interpretation. (BL3)
CO2	Analyze Data Collection and Preprocessing tasks. (BL3)
CO3	Analyze basic statistics concepts required for Data Science. (BL3)
CO4	Apply machine learning algorithms for prediction and classification tasks. (BL3)
CO5	Apply these understandings on Real-world problems and challenges. (BL3)

Week No.	Suggested Experiment	CO Mapped	BL	Hrs
1	Apply pivot table of Excel to perform data analysis	CO1, CO2	BL3	2
2	Apply descriptive statistical techniques on the given dataset using Python to summarize and interpret the data.	CO1, CO2	BL3	2
3	Generate and interpret histogram plots using Python to identify distribution patterns in the dataset.	CO3	BL3	2
4	Apply simple linear regression using Python and analyze the regression output to interpret relationships between variables.	CO3, CO4	BL3, BL4	2
5	Perform multiple linear regression using Python and evaluate the regression table to identify significant predictors and understand model accuracy.	CO3, CO4	BL4	2
6	SUBMISSION & ASSESSMENT			2
7	Apply logistic regression on the given dataset and analyze the regression output to interpret classification results.	CO3, CO4	BL3, BL4	2

8	Install and explore Tableau to identify and understand the user interface components such as Dimensions, Measures, Pages, Filters, Marks, and Show Me. Connect datasets and create basic visualizations .	CO2, CO5	BL3	2
9	Apply various chart types in Tableau, integrate maps and geolocation data, and develop an interactive dashboard. Publish the dashboard to Tableau Public.	CO5	BL3, BL4	2
10	Construct scatter plots, apply data highlighters, and use Pages, Cards, and Annotations. Design a story and publish it on Tableau Public.	CO5	BL3	2
11	Case study: Apply interactive data visualization techniques using Tableau to explore and represent datasets effectively.	CO5	BL3, BL4	2
12	Case Study: Use Power BI to visualize and analyze customer segmentation data from a case study, and evaluate visualization effectiveness.	CO5	BL3, BL4	2
13	SUBMISSION AND ASSESSMENT			2
Assign ment	Choose any open dataset. Perform the tasks mentioned below. Submit a detailed report with screenshots and code snippet. Dataset understanding Data Cleaning and Preprocessing Descriptive statistics Basic Analysis Report Writing.	All	BL3	2

Text Books :	
1	Fundamentals of data science, Dr. Aijaz Ali, Khan, Anita Rani Mehta, Vandana Ahuja, Rivers Publication, 2023
2	U. Dinesh Kumar, “Data Science: Theory and Practice,” Wiley India
3	V.K. Jain, “Data Science and Analytics.”

Reference Books :	
1	Python for Data Analysis-by WMc Kinney, OREILLY Publication.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, " <i>The Elements of Statistical Learning</i> ," Springer.

Community Engagement Project

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25CDSCEP401	Community Engagement Project	-	-	4	-	-	2	2
Evaluation Scheme								
Continuous Internal Assessment (CIA)				Mid Semester Examination		External		
Activity	Test	Att	Total			Prese. & Oral		
30	10	10	50	-		25		

Activity: [Community Engagement & Fieldwork/Solution Design & Prototyping/Mindmap/Case Study/Poster/Numerical Assignment/Group Discussion/Field Visit/ GATE Questions] (30)

Minimum Two (02) of the above mentioned activities each of 30 marks have to be conducted. The average marks would be considered.

Test [Presentation/Technical Documentation/Open Book Test/Class Test/Multiple Choice Questions/Prototype Design/] (10)

Minimum Two (02) of the above mentioned tests each of 10 marks have to be conducted to ensure coverage of all Course Outcomes. The average marks would be considered.

Att: Attendance (10)

As per the rubric provided by the Attendance committee.

Prerequisite: Problem Solving using Imperative Programming

Course Objectives:

1	Expose students to societal, economic, and environmental challenges in underserved communities
2	Apply computational thinking, AI, data analytics, and software engineering principles to real-world problems.

3	Encourage teamwork, empathy, and stakeholder collaboration.
4	Build technical prototypes with measurable social impact
Course Outcomes (COs): At the End of the course students will be able to	
CO1	Identify and define real-world problems in community settings using a data-driven approach.
CO2	Design solutions leveraging computing principles (AI, ML, software, or analytics).
CO3	Collaborate effectively with peers and engage with community stakeholders.
CO4	Document the development process and evaluate the social impact of the solution.

Module No.	Detailed Contents		CO Mapped	BL	Hrs
1	Preparation & Problem Discovery		CO1	BL3 & BL4	10
	1.1	Orientation on community engagement & social innovation			
	1.2	Review of tech-enabled social interventions			
	1.3	Community visits / problem identification			
2	Data Collection & Solution Development		CO2 CO3	BL5	36
	2.1	Field interaction, user interviews, surveys			
	2.2	Data cleaning, EDA / software architecture.			
	2.3	AI/ML modelling or software/app design. Prototype building and testing			
3	Documentation & Social Impact		CO4	BL5	10
	3.1	Technical report			
	3.2	Presentation to stakeholders			
	3.3	Reflective assessment			

Sample Project Titles

For CSE (Computer Engineering):

- Mobile app for nearby medicine/oxygen supply tracking during emergencies
- Complaint redressal system for urban/rural infrastructure issues
- Public grievance chatbot with NLP integration

For AIML:

- AI model to predict student dropout risk in rural schools
- ML-based waste classification system for smart bins
- Sentiment analysis of citizen feedback to local governance portals

For Data Science:

- Data-driven water consumption analysis for housing societies
- Mapping digital divide in rural regions using publicly available data
- Predictive analytics for crop yield based on community farm data

Healthcare and Well-being

- AI Chatbot for Primary Health Advice in Local Languages
- Predictive Model for Early Detection of Malnutrition in Children
- Disease Outbreak Predictor Using Public Health Data
- Appointment Scheduler and Reminder App for Rural Clinics
- Mobile Application for Tracking Medicine Availability in PHCs

Education and Digital Literacy

- AI-Based Personalized Learning Platform for Underserved Schools
- OCR App to Convert Printed Marathi/Urdu Text into Audio for Visually Impaired
- Student Performance Predictor Using Past Academic and Attendance Data
- Gamified App for Teaching Digital Literacy in Rural Schools
- Adaptive Quiz Generator for School Students Using Bloom's Taxonomy

Environment and Sustainability

- Smart Waste Segregation System Using Image Classification
- Rainwater Harvesting Monitor Using IoT and Data Dashboard
- Air Quality Data Collection and Visualization in Local Areas
- Forest Fire Alert System Using Satellite Data and ML Models
- Energy Consumption Optimizer for Small Shops Using Predictive Analytics

Infrastructure and Utilities

- Real-Time Water Supply Monitoring System with SMS Alerts
- App for Reporting Potholes and Broken Street Lights with Geo-tagging
- Crowd-sourced Mapping of Public Toilets and Cleanliness Score
- Smart Attendance System for Anganwadi Workers Using Face Recognition
- Solar Panel Efficiency Tracker with IoT Sensors and Dashboards

Agriculture and Rural Livelihood

- AI Model for Crop Disease Identification from Leaf Images
- Chatbot for Farmer Queries Using Regional Language NLP
- Market Price Predictor for Local Produce Using Time Series Analysis
- Weather-Adaptive Irrigation Recommendation System
- ML-Powered Seed Selection App Based on Soil and Season

Civic Engagement & Governance

- Sentiment Analysis on Social Media Feedback to Local Authorities
- AI-Based Fake News Detection for WhatsApp Forwards
- Transparent Beneficiary Tracking System for Govt Schemes
- Survey Analytics Tool for Panchayat-Level Decision Making
- Suggestion Box App for Ward-Level Public Feedback with Ranking System

Accessibility and Inclusion

- Sign Language Translator App Using Deep Learning
- Smart Navigation App for Visually Impaired in Public Spaces
- AI Tool to Convert Speech to Regional Text for Hearing Impaired
- Local Language Reader with Text Summarization for Elderly
- Emotion Detection App for Children with Autism