TAKSHASHILA UNIVERSITY

(Tamil Nadu State Private University)

ONGUR, TINDIVANAM TK, VILLUPURAM DT

FACULTY OF ENGINEERING AND TECHNOLOGY

SCHOOL OF COMPUTATIONAL ENGINEERING

Department of Artificial Intelligence and Data Science
(IBM)

REGULATION – R25 NEP

CURRICULUM & SYLLABI

III Semester

VISION AND MISSION OF UNIVERSITY

VISION:

To create change makers and world leaders similar to the ancient Takshashila University

MISSION:

The brightest minds and the best resources are used to nurture and develop the leaders of tomorrow, where they are encouraged to be eternally curious and ethically sound.

DEPARTMENT VISION AND MISSION

VISION:

To be a center of excellence in Artificial Intelligence and Data Science by fostering transformative education, interdisciplinary research and innovation to develop intelligent, ethical, and sustainable solutions that address global challenges and contribute to societal progress

MISSION:

M1: Academic Excellence	Deliver a contemporary, outcome-based curriculum that equips students with strong foundations in Artificial Intelligence, Data Science and computational thinking to solve complex real-world problems.
M2: Research and Innovation	Promote interdisciplinary research, innovation, and the adoption of emerging AI and data-driven technologies to develop impactful solutions for industrial and societal needs.
M3: Industry Readiness and Entrepreneurship	Strengthen employability and entrepreneurial capabilities through industry collaborations, experiential learning, internships, professional certifications and start-up incubation.
M4: Ethics and Lifelong Learning	In still ethical values, responsible AI practices, professional integrity, and a commitment to lifelong learning to develop socially responsible leaders capable of driving sustainable technological advancement.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge
Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis
Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions
Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems
Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage
Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society
Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability
Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8: Ethics
Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work
Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication
Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance
Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning
Recognize the need for, and have the preparation and ability to engage in continuous learning in the face of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Competitive Platform

To create a competitive platform for solving critical problems in a wide variety of fields.

PEO2: Exploration

Enthusiastic participation in learning, understanding, designing and applying new innovative research ideas as the field evolves.

PEO3: Career

Applying cutting-edge technology that improves knowledge and to commit students for life-long learning to reach the leading positions in the career.

PEO4: Professional Values

Simulate the graduates to hold the responsibilities in the context of technology, ethics, society and humanity.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: AI and Data Analytics Competency

Apply the principles of Artificial Intelligence and Data Science to develop intelligent, data-driven solutions for complex real-world problems.

PSO2: Research and Innovation

Design and implement AI-based and data-centric solutions using modern tools, emerging technologies and research methodologies to address industrial and societal challenges.

PSO3: Professional Competence

Demonstrate professional ethics, entrepreneurial mind-set and lifelong learning to excel in careers, higher education, research, and innovation in Artificial Intelligence and Data Science.

TAKSHASHILA UNIVERSITY
(Established Under Tamil Nadu State Private Universities Act 2019 & Recognized by UGC u/s 2(f) of the UGC Act,1956

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FACULTY OF ENGINEERING AND TECHNOLOGY
B.TECH. IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (IBM)
(REGULATION – R25 NEP)
SEMESTER – III

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Hrs.	Max. Marks								
				L	T	P			CAT Theory (Best of two)	ASS	MCQ	ATT	SEM	P	CAM	ESM	Total
1	U25MA07T	Probability and Statistics for Data Science	BS	3	1	0	4	60	20	5	5	5	5	-	40	60	100
2	U25CE04B	Data Structures	PC	1	0	4	3	75	20	5	5	5	5	10	50	50	100
3	U25AD83B	DevOps and Agile	PC	3	0	2	4	75	20	5	5	5	5	10	50	50	100
4	U25EC08B	Digital Principles and System Design	ES	3	0	2	4	75	20	5	5	5	5	10	50	50	100
5	U25AD01T	Fundamentals of Data Science	PC	3	1	0	4	60	20	5	5	5	5	-	40	60	100
6	U25BA10T	Total Quality Management	HS	2	0	0	2	30	20	5	5	5	5	-	40	60	100
			Total:				21	360									
7	U25VA06T	Constitution of India	VAC	1	0	0	0	15	-	40	40	5	15	-	100	-	100
8	U25SE02P	Skill Enhancement Course - II	SEC	0	0	1	0	15	-	-	-	-	-	-	100	-	100
9	U25AE01P	Ability Enhancement Course - I	AEC	0	0	1	0	15	-	-	-	-	-	-	100	-	100
			Total:				0	45									
			Semester Total:				**21**	**405**							**570**	**330**	**900**

Note:

L – Lecture
T – Tutorial
P – Practical
CAT – Continuous Assessment Test
ESM – End Semester Exam Marks

ASS – Assignment
ATT – Attendance
CAM – Continuous Assessment Marks
SEM – Seminar
PW – Project Work

BoS Chairman

U25MA07T	Probability and Statistics for Data Science	L	T	P	C	Total
		3	1	0	4	60

COURSE OBJECTIVES:

• To introduce the basic concepts of probability and random variables
• To understand and apply discrete and continuous probability distributions to solve problems.
• To acquaint the knowledge of descriptive statistics
• To introduce the basic concepts of test of sampling in non-parametric Test
• To gain the knowledge of statistical quality control.

COURSEOUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
CO2:	Select the appropriate probability distribution for a given problem.
CO3:	Understand and execute the sampling techniques.
CO4:	Apply the basic concepts of testing of sampling through various methods of tests.
CO5:	Apply the statistical quality control through various measurements.

UNIT I: PROBABILITY CONCEPTS AND RANDOM VARIABLE	**12 Hrs.**
Probability Space - Events - Axiomatic approach to Probability - Conditional Probability - Independent Events - Baye's Theorem - Single Random Variables.	

UNIT II: PROBABILITY DISTRIBUTION	**12 Hrs.**
Discrete Distributions: Binomial, Poisson and Geometric - Continuous Distributions: Uniform, Exponential and Normal (Problems Only).	

UNIT III: DESCRIPTIVE STATISTICS	**12 Hrs.**

Sampling Techniques - Data Classification - Tabulation - Frequency and graphic Representation - Measures of Central Tendency - Measures of Variation - Quartiles and Percentiles.

UNIT IV: NON-PARAMETRIC TESTS	**12 Hrs.**
Introduction - Sign test - Tests based on Runs - Test of randomness - U test - H test - Kolmogorov Tests.	

UNIT V: STATISTICAL QUALITY CONTROL	**12 Hrs.**
Control charts for measurements ($\bar{X}$ and R charts) - Control charts for attributes (p, c and np charts) - Tolerance limits - Acceptance sampling.	

Total Hours: 60.

TEXTBOOKS:	
1.	Johnson. R. A., Miller. I. R and Freund. J. E, Miller and Freund's "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2023.
2.	John E. Freund, "Mathematical Statistics", Prentice Hall, 8th Edition, 2021.

REFERENCE BOOKS:	
1.	Gupta. S. C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2.	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Academic Press (Elsevier), 2023.
3.	Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 10th Edition, Cengage Learning, 2024.
4.	P. Mohana Shankar, Probability, Random Variables, and Data Analytics with Engineering Applications, Springer Nature, 1st Edition, 2021.
5.	Gerald Keller, *Statistics for Management and Economics*, Cengage Learning, 12th Edition, 2023.

WEB REFERENCES:	
1.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ma43
2.	https://online.stat.psu.edu/stat500/

3.	https://projects.iq.harvard.edu/stat110
4.	https://www.cpp.edu/videotutorials/ime/probability-and-statistics.shtml
5.	https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg31

COs/POs/PSOs Mapping :

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	-	2	1	-	-	-	-	-	-	1	3	1	2
2	3	3	-	2	1	-	-	-	-	-	-	1	3	1	2
3	3	3	-	2	1	-	-	-	-	-	-	1	3	2	3
4	3	3	1	2	1	-	-	-	-	-	-	1	3	2	3
5	2	3	1	2	2	-	-	-	-	-	-	1	3	3	3

CorrelationLevel:1-Low,2-Medium,3-High, '-' - no correlation

BoS Chairman

U25CE04B	Data Structures	L	T	P	C	Total
		1	0	4	3	75

COURSE OBJECTIVES:

• To impart the basic concepts of data structures and its terminologies
• To understand concepts about stack and queue operations
• To understand basic concepts about linked list and its various operations
• To understand concepts about Tree and its applications
• To understand basic concepts about Sorting, Hashing and Graph.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Compute time and space complexity for given problems
CO2:	Demonstrate the implementation and applications of stack and queue data structures.
CO3:	Illustrate the various operations of linked list.
CO4:	Analyze and apply different tree data structures.
CO5:	Compare and apply appropriate sorting, hashing, and graph traversal techniques.

UNIT I: BASIC TERMINOLOGIES OF DATA STRUCTURES	**3 Hrs.**
Introduction: Basic Terminologies – Elementary Data Organizations. Data Structure Operations: Insertion – Deletion – Traversal. Analysis of an Algorithm. Asymptotic Notations. Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques – Complexity analysis.	

UNIT II: STACK AND QUEUE OPERATIONS	**3 Hrs.**
Stack and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queues: Simple Queue – Circular Queue – Priority Queue – Dequeue.	

UNIT III: LINKED LIST OPERATIONS	3 Hrs.
Linked lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.	

UNIT IV: TREES	3 Hrs.
Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree. Introduction to B-Tree and B+ Tree.	

UNIT V: SORTING, HASHING AND GRAPHS	3 Hrs.
Sorting**:** Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table – Hash Function and its characteristics. Graph: Basic Terminologies and Representations – Graph traversal algorithms.	

Total Hours: 15

LIST OF EXERCISES:

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT.
3. Write a C program to implement list ADT to perform following operations a) Insert an element into a list.a) Delete an element from list c) Search for a key element in list d) count number of nodes in list.
4. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
5. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked listand an array.
6. Write a C program to perform the following operations:
1. Insert an element into a binary search tree.
2. Delete an element from a binary search tree.
3. Search for a key element in a binary search tree.

7.	Write a C program that use recursive functions to traverse the given binary tree in
	a) Pre-order b) In-order and c) Post-order.
8.	Write a C program to perform the AVL tree operations.
9.	Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
10.	Write a C program to implement Graph Traversal Techniques.

Total Hours: 60

TEXT BOOKS:	
1.	Reema Thareja, Data Structures Using C, 3rd Edition, Oxford University Press, 2024.
2.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, 4th Edition, MIT Press, 2022.

REFERENCE BOOKS:	
1.	Narasimha Karumanchi, Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, 6th Edition, Career Monk Publications, 2024.
2.	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2023.
3.	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, Reprint 2023.
4.	Seymour Lipschutz and Vijayalakshmi Pai G., Schaum's Outline of Data Structures with C, 2nd Edition, McGraw-Hill Education, 2022.

WEB REFERENCES:	
1	https://nptel.ac.in/courses/106106130
2	https://www.geeksforgeeks.org/dsa/dsa-tutorial-learn-data-structures-and-algorithms/
3	https://cp-algorithms.com/
4	https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-fall-2011/
5	https://docs.google.com/presentation/d/1jjivjdvD4mx6qb4bd4rUKB6FDZbYtveJ5NKeyVeA1lk/edit

COs/POs/PSOs Mapping:															
COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	2	1	-	-	-	-	-	3	-	2	2	1
2	3	2	3	2	3	-	-	1	1	-	2	-	3	2	1
3	3	3	3	2	2	-	-	1	1	-	2	-	3	2	1
4	3	3	3	3	2	-	-	1	1	-	2	-	3	3	1
5	3	3	3	2	3	-	-	1	1	1	3	-	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

BoS Chairman

U25AD83B	DevOps and Agile	L	T	P	C	Total
		3	0	2	4	75

COURSE OBJECTIVES:

• To understand the principles and applications of Design Thinking for innovative problem solving
• To learn DevOps concepts, tools, and practices for modern software development
• To develop skills in DevOps automation, cloud computing, containerization, and DevSecOps
• To understand Agile and Scrum methodologies for effective project management
• To apply Agile testing, quality assurance, and collaboration tools for software delivery.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the concepts and stages of the Design Thinking process.
CO2:	Conduct user research and develop innovative design solutions.
CO3:	Apply prototyping and user feedback techniques for product improvement.
CO4:	Demonstrate basic DevOps practices using Cloud and Docker technologies.
CO5:	Apply Agile, Scrum, and Agile Marketing principles in project environments.

UNIT I: INTRODUCTION TO DESIGN THINKING	**9 Hrs.**
Introduction to Design Thinking: Concepts, principles, mindset, human-centered design approach, innovation, and applications across various domains - Design Thinking Process: Empathize, Define, Ideate, Prototype, and Test stages for solving real-world problems - User Research and Empathy: User interviews, observations, empathy mapping, persona development, customer journey mapping, and stakeholder analysis - Idea Generation: Brainstorming, SCAMPER, mind mapping, brainwriting, "How Might We" (HMW) questions, and creative thinking techniques - Prototyping: Low-fidelity and high-fidelity prototyping, paper prototypes, storyboards, wireframes, and digital prototyping tools - Testing and Validation: Usability testing, user feedback collection, solution validation, iterative	

improvements, and performance evaluation - Design Thinking Applications: Case studies in business, healthcare, education, technology, entrepreneurship, and social innovation - Collaboration and Innovation: Teamwork, communication, ethical considerations, innovation culture, and multidisciplinary problem-solving.

UNIT II: INTRODUCTION TO DEVOPS	**9 Hrs.**
Introduction to DevOps: Concepts, principles, DevOps culture, software development life cycle (SDLC), continuous improvement, collaboration between development and operations teams, and business benefits of DevOps - Version Control Systems: Git fundamentals, repository management, branching strategies, merging, pull requests, conflict resolution, and collaboration using GitHub or GitLab - Continuous Delivery and Continuous Deployment (CD): CD concepts, release automation, deployment strategies, rollback mechanisms, and deployment pipeline management – Configuration Management: Infrastructure as Code (IaC), configuration management concepts, and automation using tools such as Ansible - Containerization: Docker architecture, Docker images, containers, Docker file creation, container lifecycle management, Docker Compose, and container best practices.	

UNIT III: DEVOPS SECURITY AND BEST PRACTICES	**9 Hrs.**
Container Orchestration: Kubernetes architecture, pods, deployments, services, namespaces, scaling, load balancing, and application orchestration - Cloud and Infrastructure: Fundamentals of cloud computing, virtual machines, cloud services, infrastructure provisioning, and deployment on public cloud platforms - Monitoring and Logging: Infrastructure and application monitoring, log management, performance monitoring, alerting, troubleshooting, and tools such as Prometheus and Grafana - DevOps Security and Best Practices: DevSecOps fundamentals, security automation, CI/CD security, compliance, collaboration, agile practices, and industry case studies.	

UNIT IV: AGILE & SCRUM METHODOLOGIES	**9 Hrs.**
Introduction to Agile - Agile Methodologies – Benefits of Agile in Project Workflows. Project Execution Methodologies – Overview of Project Execution Methodologies (Waterfall vs Agile). Agile Deep Dive – Principles and Practices – Roles and Responsibilities in Agile Teams. Scrum Deep Dive – Scrum – Scrum Artifacts – Scrum Ceremonies – Planning and Execution. Scrum Metrics and Additional Insights – Scrum Metrics (Velocity, Burndown, etc.) – Common Challenges – Additional Tools and Resources for Agile Teams.	

UNIT V: AGILE TESTING AND QUALITY ASSURANCE	**9 Hrs.**

Agile Planning and Estimation: User stories, epics, acceptance criteria, story mapping, estimation techniques, planning poker, sprint planning, and release planning - Agile Project Execution: Sprint execution, task management, collaboration, communication, continuous feedback, and iterative development - Agile Metrics and Tracking: Velocity, burndown charts, burnup charts, cumulative flow diagrams, lead time, cycle time, and performance measurement - Agile Testing and Quality Assurance: Test-driven development (TDD), behavior-driven development (BDD), continuous testing, quality assurance, defect management, and Agile testing practices - Agile Tools and Collaboration: Agile project management tools such as Jira, Trello, Azure DevOps, backlog management, workflow tracking, and team collaboration.

Total Hours: 45

LIST OF EXERCISES:

1.	Create a ‘Customer’ Mindmap with Sub-topics by using Miro.
2.	Create a ‘Virtual Learning Login’ Jounery Map by using Miro.
3.	Create a ‘Science’ Concept Map with Sub-topics by using Miro.
4.	Creating a flowchart for the Hiring process using Miro involves outling the sequential steps in recruiting and hiring new employees.
5.	Creating a spaghetti diagram in Miro involves visually mapping out the flow or movement of process in ‘Project Management Process’.
6.	Creating a Business Intelligence (BI) Architecture diagram using Miro involves visually representing the components and flow of data within a BI system.
7.	Creating a Simple Opportunity solution tree in Miro involves identifying opportunities to “Increase the visit to sign-up-ratio” and proposing potential solutions to address the.
8.	Create a Docker Volume in Docker by using the Command prompt.
9.	To Implement various commands to manage networks for your container in Docker by using Command prompt.
10.	To Implement various commands to create image for your container in Docker by using Windows PowerShell.
11.	Creating a basic Agile board in Miro involves setting up columns representing the stages your Agile workflow and adding cards to represent tasks or user stories.
12.	Creating a Agile product Roadmap in Miro involves track team progress and ensure product transparency involves outlining the key milestones, activities, and timelines related to product development.

Total Hours: 30

TEXT BOOKS:	
1.	IBM Design Thinking, DevOps and Agile © Copyright IBM Corporation 2019 IBM Corporation, New Orchard Road Armonk, NY 10504. Produced in the United States of America, October 2024.

REFERENCE BOOKS:	
1.	Kumar, V., 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, John Wiley & Sons, 2012.
2.	Kim, G., Humble, J., Debois, P., & Willis, J., The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, IT Revolution Press, 2016.
3.	Schwaber, K., Agile Project Management with Scrum, Microsoft Press, 2004.

WEB REFERENCES:	
1.	https://www.atlassian.com/agile
2.	https://www.ibm.com/training/enterprise-design-thinking/framework
3.	https://www.redhat.com/en/topics/devops/
4.	https://aws.amazon.com/devops/what-is-devops/
5.	https://agilealliance.org/agile101/

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	–	–	–	–	1	–	2	3	1	1
2	3	3	2	2	3	–	–	–	1	2	–	2	3	2	2
3	2	3	3	2	3	1	–	1	2	3	1	2	3	3	2
4	2	2	3	3	3	–	–	–	1	2	1	2	3	3	2
5	3	3	2	3	3	1	–	1	1	2	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

BoS Chairman

U25EC08B	Digital Principles and System Design	L	T	P	C	Total
		3	0	2	4	75

COURSE OBJECTIVES:

• To understand the fundamentals of number systems, Boolean algebra and logic gate implementations
• To design and analyze combinational digital circuits using arithmetic and logic building blocks
• To analyze synchronous sequential circuits using flip flops, counters and finite state machines
• To study the behaviour and design issues of asynchronous sequential circuits and hazard free systems
• To understand memory organization, programmable logic devices and FPGA architectures used in digital systems.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Apply number systems, Boolean algebra and simplification techniques for digital logic design.
CO2:	Design and analyze combinational circuits using adders, multiplexers, decoders and related components.
CO3:	Analyze and design synchronous sequential circuits using flip flops, counters and finite state machines.
CO4:	Examine asynchronous sequential circuits and design hazard free digital systems.
CO5:	Explain memory devices, FPGA architecture and programmable logic devices used in digital systems.

UNIT I: BASIC DIGITAL SYSTEMS	**9 Hrs.**

Number systems – Binary, Decimal, Octal, Hexadecimal conversions- Boolean algebra and theorems – Signed number representations–Sum of Product and Product of sum simplification- Canonical forms min term and max term – Simplification of Boolean Expression- Karnaugh maps and Quine McCuskey method – Implementation of Boolean expression using Logic gates and Universal gates.

UNIT II: COMBINATIONAL CIRCUIT DESIGN	**9 Hrs.**
Design of combinational circuits – Half adder and full adder – Subtractor – Parallel adder – Carry look ahead adder – BCD adder - Multiplexer and Demultiplexer – Encoder and Decoder – Magnitude comparator – Code converters – Parity Generator/Checker-Seven Segment display decoder.	

UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS	**9 Hrs.**
Latches and Flip flops – SR, JK, D and T flip flops –Shift registers – Ripple counters – Ring Counters - Synchronous counters – Asynchronous counters — Analysis and design of Finite State Machine – Moore and Mealy models - State reduction and assignment.	

UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS	**9 Hrs.**
Stable and Unstable States-Cycles and races-state reduction-race free assignments – Hazards-Essential Hazards-Fundamental and pulse mode sequential circuits - Design of Hazard free Circuits.	

UNIT V: MEMORY AND PROGRAMMABLE LOGIC DEVICES	**9 Hrs.**
Memory organization – RAM, ROM, PROM, EPROM, EEPROM and Flash memory – FPGA architecture –Programmable Logic arrays(PLA) and Programmable Array Logic (PAL).	

.

Total Hours: 45

List of Exercises:

1.	Verification of basic logic gates and universal gates using truth tables.
2.	Design and implementation of Half Adder and Full Adder circuits using logic gates.
3.	Design and implementation of Half Subtractor and Full Subtractor circuits using logic gates.
4.	Design and implementation of Binary to Gray Code and Gray to Binary Code converters.
5.	Design and implementation of BCD to Excess-3 Code and Excess-3 to BCD Code converters.

6.	Design and implementation of Binary to ASCII and ASCII to Binary Code converters.
7.	Implementation and verification of Multiplexer and Demultiplexer circuits.
8.	Design and implementation of Encoder and Decoder circuits.
9.	Design and implementation of SR, JK, D and T Flip Flops using logic gates.
10.	Design and implementation of Shift Registers and Ring Counters.

Total Hours: 30

TEXT BOOKS:	
1.	M. Morris Mano and Michael D. Ciletti, "Digital Design", 6th Edition, Pearson Education, 2024.
2.	Charles H. Roth Jr., Larry L. Kinney and Eugene B. John, "Fundamentals of Logic Design", Enhanced 7th Edition, Cengage Learning, 2021.

REFERENCE BOOKS:	
1.	Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill Education, Reprint Edition, 2017.
2.	Thomas L. Floyd and R. P. Jain, "Digital Fundamentals", 11th Edition, Pearson Education, 2015.
3.	John F. Wakerly, "Digital Design: Principles and Practices", 5th Edition, Pearson Education, 2018.
4.	Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 4th Edition, McGraw Hill Education, 2014.

WEB REFERENCES:	
1.	https://nptel.ac.in/courses/117105080
2.	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials
3.	https://www.tutorialspoint.com/digital_circuits/index.htm

COs/POs/PSOs Mapping:															
COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	1	-	-	-	-	-	2	-	3	2	1
2	3	3	3	2	2	-	-	-	1	-	2	-	3	2	1
3	3	3	3	2	3	-	-	1	1	-	2	-	3	3	1
4	3	3	3	3	2	-	-	-	1	-	2	-	3	3	1
5	2	2	2	1	3	-	-	-	1	-	3	-	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

BoS Chairman

U25AD01T	Fundamentals of Data Science	L	T	P	C	Total
		3	1	0	4	60

COURSE OBJECTIVES:

• To understand the fundamentals of Data Science, its applications, processes, and the role of databases in data-driven decision making
• To learn data analytics methodologies and lifecycle phases for solving real-world business problems
• To acquire knowledge of text analytics, text mining, and Natural Language processing techniques for extracting insights from textual data
• To develop practical skills in Python and its libraries for data manipulation, exploratory data analysis, clustering, and dimensionality reduction
• To apply GNU Octave and Tableau for mathematical computations, data visualization, statistical analysis, and dashboard creation.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the concepts, processes, tools, and database technologies used in Data Science, including SQL and NoSQL systems.
CO2:	Apply the Data Analytics Lifecycle to discover, prepare, model, and communicate solutions for data-driven problems.
CO3:	Analyze textual data using text mining, information retrieval, and Natural Language Processing techniques.
CO4:	Utilize Python libraries such as NumPy and Pandas for data preprocessing, exploratory analysis, clustering, and dimensionality reduction tasks.
CO5:	Perform mathematical operations using GNU Octave and create effective visualizations and dashboards using Tableau for data interpretation and decision support.

UNIT I: DATA SCIENCE CONTEXT AND DATABASES	**12 Hrs.**
Need for Data Science – Data Science Process – Business Intelligence and Data Science – Prerequisites for a Data Scientist – Tools and Skills required. Databases for Data Science: Structured Query Language (SQL): Basic Statistics, Data Munging, Filtering, Joins, Aggregation, Window	

Functions, Ordered Data, preparing No-SQL: Document Databases, Wide-column Databases and Graphical Databases.

UNIT II: DATA SCIENCE METHODOLOGY	**12 Hrs.**
Analytics for Data Science – Examples of Data Analytics – Data Analytics Lifecycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results.	

UNIT III: DATA ANALYTICS ON TEXT	**12 Hrs.**
Major Text Mining Areas – Information Retrieval – Data Mining – Natural Language Processing NLP) – Text analytics tasks: Cleaning and Parsing, Searching, Retrieval, Text Mining, Part-of-Speech Tagging, Stemming, Text Analytics Pipeline. NLP: Major components of NLP, stages of NLP, and NLP applications.	

UNIT IV: PLATFORM FOR DATA SCIENCE	**12 Hrs.**
Python for Data Science –Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset – Clustering with Python – Dimensionality Reduction. Python integrated Development Environments (IDE) for Data Science.	

UNIT V: GNU OCTAVE FOR MATHEMATICAL OPERATIONS	**12 Hrs.**
Handling Vectors and Matrices: Multiplication, Transpose, Random Matrix creation, Eigen Vectors and Eigen Values, Determinants. Arithmetic Operations – Set Operations – Plotting Data. Tableau Introduction – Dimensions, Measures, Descriptive Statistics, Basic Charts, Dashboard Design Principles, Special Chart Types, Integrate Tableau with Google Sheets.	

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Total Hours: 60

TEXT BOOKS:	
1.	Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking, O'Reilly Media, Sebastopol, California, First Edition, 2013.
2.	Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, O'Reilly Media, Sebastopol, California, Third Edition, 2022.
3.	Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media, Sebastopol, California, Second Edition, 2019.

4.	Cathy O'Neil and Rachel Schutt, Doing Data Science: Straight Talk from the Frontline, O'Reilly Media, Sebastopol, California, First Edition, 2013.
5.	Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, Sebastopol, California, First Edition, 2016.

REFERENCE BOOKS:	
1.	Cathy O'Neil and Rachel Schutt, Doing Data Science: Straight Talk from the Frontline, O'Reilly Media, Sebastopol, California, First Edition, 2013.
2.	Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in Python, Springer, Cham, Switzerland, Second Edition, 2023.
3.	Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, Sebastopol, California, First Edition, 2009.
4.	Alan Beaulieu, Learning SQL: Generate, Manipulate, and Retrieve Data, O'Reilly Media, Sebastopol, California, Third Edition, 2020.
5.	Ryan Sleeper, Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, O'Reilly Media, Sebastopol, California, Second Edition, 2018.

WEB REFERENCES:	
1.	IDS COURSE CONTENT.pdf
2.	Life Cycle Phases of Data Analytics
3.	Text Mining in Data Mining
4.	Python Variables
5.	18-Module 6_ GNU Octave for Mathematical Operations - Handling vectors and Matrices-15-04-2024.pdf - Module 6 GNU Octave as a Data Science Tool 19-05-2024 1 GNU Octave as a - College Sidekick

COs/POs/PSOs Mapping:															
COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	1	3	-	-	-	-	-	2	3	1	2	3
2	2	3	2	3	2	-	-	-	2	-	2	2	3	2	2
3	2	3	1	2	3	-	-	-	1	-	2	3	2	2	2
4	3	2	2	2	3	-	-	-	1	-	2	3	2	3	3
5	2	1	2	2	3	-	-	-	2	1	2	2	1	3	2

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

BoS Chairman

U25BA10T	Total Quality Management	L	T	P	C	Total
		2	0	0	2	30

COURSE OBJECTIVES:

• To provide students with a comprehensive understanding of Total Quality Management (TQM) principles, concepts and quality philosophies
• To familiarize students with customer-focused quality practices and continuous improvement methodologies for organizational excellence
• To develop the ability to apply statistical quality control techniques and quality management tools for decision making and process improvement
• To enable students to evaluate quality systems, benchmarking practices, and performance improvement frameworks across organizations
• To equip students with knowledge of quality implementation strategies, leadership practices, quality audits, and emerging trends in quality management

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand quality concepts and philosophies of TQM.
CO2:	Apply TQM principles and concepts of continuous improvement.
CO3:	Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality.
CO4:	Understand the TQM tools as a means to improve quality.
CO5:	Evaluate quality systems and implementation practices for organizational excellence.

UNIT I: INTRODUCTION TO QUALITY MANAGEMENT	**6 Hrs.**
Introduction to TQM – TQM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.	

UNIT II: PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT	6 Hrs.
Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques — introduction, loss function, parameter and tolerance design, signal to noise ratio. Conceptsof Quality circle, Japanese 5S principles and 8D methodology.	

UNIT III: STATISTICAL PROCESS CONTROL	6 Hrs.
Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigmaconcepts of process capability.	

UNIT IV: TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT	6 Hrs.
Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) — requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Benchmarking and POKA YOKE.	

UNIT V: QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION	6 Hrs.
Introduction to ISO 9001:2015 – Quality Management Systems - Overview of ISO 9004:2018 – Guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.	

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Total Hours: 30

TEXT BOOKS:	
1.	Oakland, J. S., "*Total Quality Management and Operational Excellence: Text with Cases"*, 5th Edition, Routledge, 2014.
2.	Bhat, K. S., "*Total Quality Management: Text and Cases"*, Himalaya Publishing House, Revised Edition, 2018.
3.	Besterfield, D. H., Besterfield-Michna, C., Besterfield, G. H., & Besterfield-Sacre, M., *"Total Quality Management"*, 3rd Edition, Pearson Education, 2011.
4.	Goetsch, D. L., & Davis, S. B., *"Quality Management for Organizational Excellence: Introduction to Total Quality"*, 9th Edition, Pearson, 2021.

5.	Evans, J. R., & Lindsay, W. M., *"Managing for Quality and Performance Excellence"*, 11th Edition, Cengage Learning, 2020.

REFERENCE BOOKS:	
1.	Feigenbaum, A. V., *"Total Quality Control"*, 4th Edition, McGraw-Hill Education, 2004.
2.	Juran, J. M., & De Feo, J. A., Juran's Quality Handbook: "The Complete Guide to Performance Excellence", 7th Edition, McGraw-Hill Education, 2017.
3.	Pyzdek, T., & Keller, P. A., The Six Sigma Handbook, 5th Edition, McGraw-Hill Education, 2021.
4.	Ishikawa, K., What Is Total Quality Control? The Japanese Way, Prentice Hall, Reprint Edition, 1985.
5.	Taguchi, G., Chowdhury, S., & Wu, Y., Taguchi's Quality Engineering Handbook, John Wiley & Sons, 2005.

WEB REFERENCES:	
1.	https://asq.org/
2.	https://www.iso.org/standard/70397.html
3.	https://www.isixsigma.com/
4.	https://www.quality.org/
5.	https://www.nist.gov/mep

COs/POs/PSOs Mapping:

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	-	1	2	1	2	-	1	1	2	1	1	2
2	3	3	2	2	2	2	1	2	1	1	2	2	2	2	2
3	3	3	2	3	3	1	-	1	1	1	2	2	2	3	2
4	3	3	2	3	3	1	-	1	1	1	2	2	2	3	2
5	2	2	2	2	2	2	2	3	2	2	2	3	1	2	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

BoS Chairman

U25VA06T	Constitution of India	L	T	P	C	Total
		1	0	0	0	**15**

COURSE OBJECTIVES:

• To study the Constituent Assembly debates and philosophical foundations of the Indian Constitution
• To examine the Preamble, Fundamental Rights, Directive Principles, and Duties as guiding values
• To understand the structure, powers, and functions of the Union Government including President, Prime Minister, and Parliament
• To study the organization and functioning of State Governments including Governor, Chief Minister, and Legislature
• To assess the role of the Supreme Court, High Courts, and judicial review in safe guarding constitutional values.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Describe the historical and philosophical foundations of the Indian Constitution.
CO2:	Interpret the Fundamental Rights, Duties, Directive Principles, and Constitutional Remedies of India.
CO3:	Summarize the powers and functions of the Union Executive and Parliament.
CO4:	Evaluate the roles and responsibilities of the State Executive and Legislature.
CO5:	Analyze the structure and role of the Indian Judiciary in upholding constitutional governance.

UNIT I: HISTORICAL BACKGROUND AND MAKING OF THE CONSTITUTION	**3 Hrs.**
Historical background of the Indian Constitution – Constituent Assembly – Framing of the Constitution – Preamble – Salient Features of the Constitution – Citizenship – Union and its Territory – Constitutional Amendments – Basic Structure Doctrine.	

UNIT II: FUNDAMENTAL RIGHTS AND DIRECTIVE PRINCIPLES	3 Hrs.
Fundamental Rights – Right to Equality – Right to Freedom – Right against Exploitation – Right to Freedom of Religion – Cultural and Educational Rights – Right to Constitutional Remedies – Directive Principles of State Policy – Fundamental Duties – Relationship between Fundamental Rights and Directive Principles.	

UNIT III: UNION GOVERNMENT	3 Hrs.
President – Vice President – Prime Minister – Council of Ministers – Parliament – Lok Sabha – Rajya Sabha – Legislative Procedure – Money Bills – Constitutional Authorities – Election Commission – Comptroller and Auditor General (CAG).	

UNIT IV: STATE GOVERNMENT AND LOCAL SELF-GOVERNMENT	3 Hrs.
Governor – Chief Minister – Council of Ministers – State Legislature – High Courts – Centre–State Relations – Panchayati Raj Institutions – Municipal Administration – Constitutional Provisions relating to Local Self-Government.	

UNIT V: JUDICIARY AND CONSTITUTIONAL GOVERNANCE	3 Hrs.
Supreme Court of India – Judicial Review – Judicial Activism – Public Interest Litigation (PIL) – Independence of Judiciary – Emergency Provisions – Constitutional Amendment Procedure – Constitutional Values – Rule of Law – Good Governance – Rights and Responsibilities of Citizens.	

Total Hours: 15

TEXT BOOKS:	
1.	Basu, D. D. (2022). Introduction to the Constitution of India (26th ed.). LexisNexis.
2.	Laxmikanth, M. (2024). Indian Polity (7th ed.). McGraw Hill Education.

REFERENCE BOOKS:	
1.	Pandey, J. N. (2024). Constitutional law of India (61st ed.). Central Law Agency.
2.	Bakshi, P. M. (2023). The Constitution of India (18th ed.). Universal Law Publishing.
3.	Shukla, V. N. (2023). Constitution of India (14th ed., revised by Mahendra Pal Singh). Eastern Book Company.
4.	Jain, M. P. (2021). Constitutional government in India (8th ed.). LexisNexis.

5.	Kashyap, S. C. (2020). Our constitution. National Book Trust.

WEB REFERENCES:	
1.	https://nptel.ac.in/courses/129106003
2.	https://nptel.ac.in/courses/129106411
3.	https://nptel.ac.in/courses/129105608

COs/POs/PSOs Mapping:

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	–	–	–	–	–	2	1	2	–	1	–	2	–	–	–
2	–	–	–	–	–	3	2	3	1	2	–	2	–	–	1
3	–	1	–	–	–	3	–	2	1	2	2	1	–	–	1
4	–	2	–	–	–	3	2	2	2	2	2	1	–	1	1
5	–	2	–	1	–	3	2	3	1	2	1	2	–	2	1

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation

BoS Chairman

U25SE02P	Skill Enhancement Course - II	L	T	P	C	Total
		0	0	1	0	15

The students must select certification courses from reputed organizations such as Texas Instruments, ARM, MATLAB, Intel, Cisco, NPTEL, AWS, Raspberry Pi, Xilinx, and Keysight, with a duration of 40–50 hours specified in the curriculum and offered through Centres of Excellence.

Course Duration and Evaluation

- The duration is **40–50 hours** as specified in the curriculum and will be offered through the Centre of Excellence.
- **Pass/Fail** will be determined based on participation, attendance, performance, and completion of the course.
- If a student fails, he/she has to repeat the course in the subsequent years.
- Passing this course is mandatory for the award of the degree.

Provider	Sample Courses (40–50 hrs)	Platform/Link
MATLAB	MATLAB Onramp and Simulink Fundamentals	https://matlabacademy.mathworks.com
Texas Instruments	Embedded Systems and MSP430 Microcontroller Programming	https://training.ti.com
ARM	ARM Cortex-M Embedded Systems Fundamentals	https://developer.arm.com
Intel	FPGA Design and Development Fundamentals	https://www.intel.com/content/www/us/en/training
Cisco	Introduction to IoT and Networking	https://www.netacad.com
AWS	IoT Foundations and Cloud for IoT	https://aws.training
Raspberry Pi	IoT and Embedded	https://projects.raspberrypi.org

	Systems	
Xilinx (AMD)	FPGA Design using Vivado	https://www.xilinx.com/support/training
Keysight	RF and Wireless Communication Fundamentals	https://education.keysight.com
NPTEL	Internet of Things / Embedded System Design / VLSI Design Flow	https://nptel.ac.in
Cadence	VLSI Design and Verification Basics	https://www.cadence.com
Siemens EDA (Mentor Graphics)	PCB Design and Electronic System Design	https://eda.sw.siemens.com
Palo Alto Networks	Cybersecurity Fundamentals for Connected Devices	https://www.paloaltonetworks.com/cyberpedia
Oracle	AI Foundations for Engineers	https://education.oracle.com
Google	Generative AI for Engineers	https://grow.google

BoS Chairman