NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode - 638 052, Tamilnadu, India, Phone: 04294 - 225585

Curriculum and Syllabi

for

Master of Computer Applications [R26]

[CHOICE BASED CREDIT SYSTEM]

[This Curriculum and Syllabi are applicable to students admitted from the academic year 2026-2027 onwards]

JULY 2026

INSTITUTE VISION AND MISSION	
VISION	• To be an Institute of excellence providing quality Engineering, Technology and Management education to meet the ever changing needs of the society
MISSION	• To provide quality education to produce ethical and competent professionals with social Responsibility • To excel in the thrust areas of Engineering, Technology and Entrepreneurship by solving real- world problems • To create a learner centric environment and improve continually to meet the changing global needs

MASTER OF COMPUTER APPLICATIONS	
VISION	• To be a Centre of excellence providing quality education in the field of Computer Applications to meet the changing needs of the society.
MISSION	• To provide quality education to produce ethical and competent master level Computer Application professionals with social responsibility. • To excel in the thrust areas of Computing and Applications by solving real- world challenges. • To provide a learner centric environment and improve continually to meet the changing global computing application needs.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	Post Graduates of Computer Applications will be able to **PEO1: Core Competency:** Apply computing skills to plan, analyze, design, develop and implement the software products for real time systems and excel as software professionals. **PEO2: Research, Innovation and Entrepreneurship:** Apply recent tools, technologies and innovative ideas in solving real world problems. **PEO3: Ethics, Human values and Life-long learning:** Exhibit professional ethics in the industry and possess the necessary skills for working in multi-disciplinary areas with a strong focus on life-long learning.
PROGRAMME SPECIFIC OUTCOMES (PSO)	Post Graduates of Computer Applications will be able to • Select appropriate data models, architecture and platform to develop software applications for real time environments. • Develop practical competency in programming languages, open source platforms and to provide a foundation for research and entrepreneurship.

PROGRAM OUTCOMES:

At the end of a programme a student will be able to demonstrate ability to

a-h	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
A	**Foundation Knowledge**	PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
B	**Problem Analysis**	PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
C	**Development of Solutions**	PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
D	**Modern Tool Usage**	PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
E	**Individual and Teamwork**	PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
F	**Project Management and Finance**	PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
G	**Ethics**	PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.
H	**Life-long learning**	PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES							
	A	B	C	D	E	F	G	H
1	3	3	3	3	2	1	2	2
2	2	3	3	3	2	2	1	3
3	1	1	2	1	3	2	3	3

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES							
	A	B	C	D	E	F	G	H
1	3	3	3	3	1	1	1	2
2	3	2	3	3	2	2	1	3

Contribution 1: Reasonable 2: Significant 3: Strong

NANDHA ENGINEERING COLLEGE (AUTONOMOUS), ERODE - 638 052

REGULATIONS - 2026 (R26) **CHOICE BASED CREDIT SYSTEM (CBCS)**

Master of Computer Applications **CURRICULUM : I - IV SEMESTERS**

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	COURSE TYPE	TEACHING AND LEARNING SCHEME			CREDITS	TCP
					L	T	P		
SEMESTER: I									
1	26CAA01	Discrete Mathematics and Automata Theory	BS	T	3	1	0	4	4
2	26CAB01	Advanced Data Structures and Algorithms	PC	T	3	0	0	3	3
3	26CAB02	Advanced Java Programming	PC	T	3	0	0	3	3
4	26CAB03	Networking and Cryptography	PC	T	3	0	0	3	3
5	26CAB04	Cloud Computing	PC	T	3	0	0	3	3
6	26CAB05	Agile Methodology	PC	T	3	0	0	3	3
7	26CAP01	Advanced Data Structures and Algorithms Laboratory	PC	P	0	0	4	2	4
8	26CAP02	Advanced Java Programming Laboratory	PC	P	0	0	4	2	4
9	26CAS01	Career Communication Lab	SD	P	0	0	2	1	2
				TOTAL	**18**	**1**	**10**	**24**	**29**

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	COURSE TYPE	TEACHING AND LEARNING SCHEME			CREDITS	TCP
					L	T	P		
SEMESTER: II									
1	26CAB06	Database Technology	PC	T	3	0	0	3	3
2	26CAB07	Full Stack Web Development	PC	T	3	0	0	3	3
3	26CAB08	Internet of Things	PC	T	3	0	0	3	3
4	26CAB09	Artificial Intelligence	PC	T	3	0	0	3	3
5		Elective I	PE	T	3	0	0	3	3

6		Elective II	PE	T	3	0	0	3	3
7	26CAP03	Database Technology Laboratory	PC	P	0	0	4	2	4
8	26CAP04	Full Stack Web Development Laboratory	PC	P	0	0	4	2	4
				TOTAL	**18**	**0**	**8**	**22**	**26**

SEMESTER: III									
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**COURSE TYPE**	**TEACHING AND LEARNING SCHEME**			**CREDITS**	**TCP**
					L	**T**	**P**		
1	26CAB10	Machine Learning	PC	T	3	0	0	3	3
2	26CAB11	Data Exploration and Visualization	PC	T	3	0	0	3	3
3	26CAB12	Organizational Behavior	PC	T	3	0	0	3	3
4		Elective III	PE	T	3	0	0	3	3
5		Elective IV	PE	T	3	0	0	3	3
6		Elective V	PE	T	3	0	0	3	3
7	26CAP05	Machine Learning Laboratory	PC	P	0	0	4	2	4
8	26CAP06	Data Exploration and Visualization Laboratory	PC	P	0	0	4	2	4
9	22CAS02	Mini Project	SD	PW	0	0	4	2	4
				TOTAL	**18**	**0**	**12**	**24**	**30**

SEMESTER: IV									
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**COURSE TYPE**	**TEACHING AND LEARNING SCHEME**			**CREDITS**	**TCP**
					L	**T**	**P**		
1	22CAS03	Project Work	SD	PW	0	0	24	12	24
				TOTAL	**0**	**0**	**24**	**12**	**24**

Basic Science Courses (BS)									
S. No.	COURSE CODE	COURSE TITLE	CATEGORY	COURSE TYPE	TEACHING AND LEARNING SCHEME			CREDITS	TCP
					L	T	P		
1	26CAA01	Discrete Mathematics and Automata Theory	BS	T	3	1	0	4	4

Programme Cores (PC)									
S. No.	COURSE CODE	COURSE TITLE	CATEGORY	COURSE TYPE	TEACHING AND LEARNING SCHEME			CREDITS	TCP
					L	T	P		
1	26CAB01	Advanced Data Structures and Algorithms	PC	T	3	0	0	3	3
2	26CAB02	Advanced Java Programming	PC	T	3	0	0	3	3
3	26CAB03	Networking and Cryptography	PC	T	3	0	0	3	3
4	26CAB04	Cloud Computing	PC	T	3	0	0	3	3
5	26CAB05	Agile Methodology	PC	T	3	0	0	3	3
6	26CAP01	Advanced Data Structures and Algorithms Laboratory	PC	P	0	0	4	2	4
7	26CAP02	Advanced Java Programming Laboratory	PC	P	0	0	4	2	4
8	26CAB06	Database Technology	PC	T	3	0	0	3	3
9	26CAB07	Full Stack Web Development	PC	T	3	0	0	3	3
10	26CAB08	Internet of Things	PC	T	3	0	0	3	3
11	26CAB09	Artificial Intelligence	PC	T	3	0	0	3	3
12	26CAP03	Database Technology Laboratory	PC	P	0	0	4	2	4
13	26CAP04	Full Stack Web Development Laboratory	PC	P	0	0	4	2	4
14	26CAB10	Machine Learning	PC	T	3	0	0	3	3
15	26CAB11	Data Exploration and Visualization	PC	T	3	0	0	3	3

16	26CAB12	Organizational Behavior	PC	T	3	0	0	3	3
17	26CAP05	Machine Learning Laboratory	PC	P	0	0	4	4	2
18	26CAP06	Data Exploration and Visualization Laboratory	PC	P	0	0	4	4	2

Programme Elective (PE) - Data Science Verticals									
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**COURSE TYPE**	**TEACHING AND LEARNING SCHEME**			**CREDITS**	**TCP**
					L	**T**	**P**		
1	26CAX01	Fundamentals of Data Science and Analytics	PE	T	3	0	0	3	3
2	26CAX02	Big Data Analytics	PE	T	3	0	0	3	3
3	26CAX03	Natural Language Processing	PE	T	3	0	0	3	3

Programme Elective (PE) - Cyber Security Verticals									
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**COURSE TYPE**	**TEACHING AND LEARNING SCHEME**			**CREDITS**	**TCP**
					L	**T**	**P**		
1	26CAX04	Ethical Hacking	PE	T	3	0	0	3	3
2	26CAX05	Cyber and AI Security	PE	T	3	0	0	3	3
3	26CAX06	Data Privacy and Protection	PE	T	3	0	0	3	3

Programme Elective (PE) - Artificial Intelligence Verticals									
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**COURSE TYPE**	**TEACHING AND LEARNING SCHEME**			**CREDITS**	**TCP**
					L	**T**	**P**		
1	26CAX07	Quantum Computing	PE	T	3	0	0	3	3
2	26CAX08	Ethics of AI	PE	T	3	0	0	3	3
3	26CAX09	Recommender Systems	PE	T	3	0	0	3	3

Skill Development (SD)									
S. No.	COURSE CODE	COURSE TITLE	CATEGORY	COURSE TYPE	TEACHING AND LEARNING SCHEME			CREDITS	TCP
					L	T	P		
1	26CAS01	Career Communication Lab	SD	P	0	0	2	1	2
2	22CAS02	Mini Project	SD	PW	0	0	4	2	4
3	22CAS03	Project Work	SD	PW	0	0	24	12	24

Bridge Courses for the MCA Students admitted under Non-Computer Science background category

Bridge Courses (BC)									
S. No.	COURSE CODE	COURSE TITLE	CATEGORY	COURSE TYPE	TEACHING AND LEARNING SCHEME			CREDITS	TCP
					L	T	P		
SEMESTER: I									
1	26CAW01	Problem Solving Techniques	BC	T	3	0	0	-	3
2	26CAW02	C Programming	BC	T	3	0	0	-	3
SEMESTER: II									
3	26CAW03	Software Engineering	BC	T	3	0	0	-	3
4	26CAW04	Computer Organization	BC	T	3	0	0	-	3

SEMESTER	BS	PC	PE	SD
I	4	19	0	1
II	0	16	6	0
III	0	13	9	2
IV	0	0	0	12
Total	4	48	15	15

Credits Total: 82

Discrete Mathematics and Automata Theory						
Course Code:	26CAA01				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	1	0	4	Total Marks	100
Total Hours of Pedagogy	60				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To develop the ability to analyze logical propositions, predicates, relations, and functions for constructing valid mathematical arguments and solving discrete mathematical problems.
- To apply graph theory, formal grammars, and finite automata concepts to model, analyze, and solve computational and engineering problems.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply propositional logic, logical equivalences, and rules of inference to analyze and validate logical arguments.	Ap	20%
CO 2	Analyze predicate logic statements using quantifiers, logical implications, and inference rules to establish the validity of arguments.	An	20%
CO 3	Apply relations, functions, and lattice concepts to model and solve problems in discrete mathematical structures.	Ap	20%
CO 4	Analyze graph-theoretic concepts and algorithms to solve connectivity, traversal, and optimization problems in networks.	An	20%
CO 5	Apply formal grammars and finite automata to model languages and analyze computational systems.	Ap	20%

Mapping of COs with POs / PSOs

COs	**POs**								**PSOs**	
	1	2	3	4	5	6	7	8	1	2
CO 1	3									
CO 2		3								
CO 3	3									
CO 4		3								
CO 5	3			2						
CO (W.A)	3	3		2						

Unit- I : Propositional Calculus	**(9+3)**
Propositions-Logical connectives-Compound propositions-Conditional and biconditional propositions-Truth tables-Tautologies and Contradictions-Logical Equivalences and implications – DeMorgan's Laws-Normal forms-Rules of inference-Arguments-Validity of arguments.	
Unit- II : Predicate Calculus	**(9+3)**
Predicates-Statement Function-Variables-free and bound variables-Quantifiers-Universe of discourse-Logical equivalences and implications for quantified statements-Theory of inference-The rules of universal specification and generalization-Validity of arguments.	
Unit- III : Relations and Functions	**(9+3)**
Properties of Binary Relations, equivalence, transitive closure, compatibility and partial ordering relations – Inverse Function Composition of functions, recursive functions Lattices – Hasse diagram, Lattice and its Properties.	
Unit- IV : Graph Theory	**(9+3)**
Basic terminology: Different types of graphs – Directed and undirected, Simple, Pseudo, Complete, Regular, Bipartite. Incidence and degree, Pendant and Isolated vertex and Null graph. Isomorphism, Sub graphs, Walk, Path and Circuit, Connected and disconnected graphs and components, operations on graphs. Euler Graphs, Fleury's Algorithm – Hamiltonian circuits and paths. Traveling salesman problem. Matrix representation of graphs – Incidence and Adjacency matrices.	
Unit- V : Grammars and Automata	**(9+3)**
Languages and Grammars - Phrase Structure Grammar - Classification of Grammars - Pumping Lemma for Regular Languages. Finite State Automata - Deterministic Finite State Automata (DFA), Non-Deterministic Finite State Automata (NFA) - Equivalence of DFA and NFA - Equivalence of NFA and Regular Languages.	
	Total (L : 45 + T : 15)

Suggested Learning Resources

Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 9th Edition, McGraw-Hill Education, 2025.
2. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 6th Edition, Pearson Education, 2019.
3. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Education, New Delhi, Reprint Edition, 2017.
4. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science, Dover Publications, Reprint Edition, 2017.
5. John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation,3rd Edition, Pearson Education, 2008.

Advanced Data Structures and Algorithms			
Course Code:	26CAB01	CIA	40
Course Type: (Theory/Practical/Integrated)	Theory	ESE	60
L:T:P:C	3:0:0:3	Total Marks	100
Total Hours of Pedagogy	45 Hours	Exam Hours	3
Pre-requisites	NIL		

Course Objectives

- To provide a deeper insight into the basic and advanced data structures.
- To develop the knowledge for the application of advanced trees and graphs in real-world scenarios.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Elaborate programming concepts and object- oriented paradigms to solve computational problems using python.	AP	20%
CO 2	Apply ADT to solve algorithmic problems efficiently.	AP	20%
CO 3	Evaluate and implement classical algorithms for sorting, searching, traversing, and optimization with complexity analysis.	AP	20%
CO 4	Understand basic tree terminology and implement different tree structures.	AP	20%
CO 5	Design and implement Python-based applications using ADTs to solve real-world computational challenges.	AP	20%

Mapping of COs with POs / PSOs

COs	**POs**								**PSOs**	
	1	2	3	4	5	6	7	8	1	2
CO 1		3					3	3	3	
CO 2	3		3							3
CO 3		3	3				3	3		
CO 4	3				3					
CO 5		3			3			3		3
CO (W.A)	3	3	3		3		3	3	3	3

Unit- I : Computational Thinking	**9**
Computational Thinking & Problem Solving: Algorithms, Flowcharts, Pseudo-code, Structure of Python Programs, Basic Coding.	
Unit- II : Abstract Data Type	**9**
Abstract Data Type (ADT): Definition - Characteristics, ADT vs Data Structure, Advantages of ADTs- Analysis of Algorithms: Time and Space Complexity- Asymptotic Notations - Big O - Big Ω - Big Θ. Stack, Queue, Array Implementation of List ADT, Applications of List ADT.	
Unit- III : Sorting and Searching	**9**
Linked List and its types, Various Representations- Operations & Applications of Linear Data Structures - Insertion sort- Merge sort - Radix sort . Searching : Linear search-Binary Search - Interpolation search, Exponential search.	
Unit- IV : Trees	**9**
Binary trees- Properties of Binary trees, B-tree, B-Tree definition-Operations on B-Tree: Searching a B- tree, Creating, Splitting, Inserting and Deleting, B+-tree.	
Unit- V : Graphs	**9**
Representation of Graphs, Topological Sorting, Graph Traversals, BFS - DFS, Shortest Path Algorithms- Dijkstra's Algorithm, Floyd - Warshall's Algorithm, Minimum Spanning Trees.	

Suggested Learning Resources

Reference Books :

1. Agarwal, B., & Baka, " Hands-on data structures and algorithms with Python" Python 3.7. Packt Publishing, 2021.
2. Goodrich, M. T., Tamassia, R., Gold wasser, "Data structures & algorithms in Python", Wiley & Sons, 2022.

Advanced Java Programming			
Course Code:	26CAB02	CIA	40
Course Type: (Theory/Practical/Integrated)	Theory	ESE	60
L:T:P:C	3 :0 :0 : 3	Total Marks	100
Total Hours of Pedagogy	45 Hours	Exam Hours	3
Pre-requisites	NIL		

Course Objectives

- To develop the ability to design, implement, and maintain robust, efficient, and scalable software applications using Java.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Develop Java programs using fundamental programming and object-oriented concepts.	AP	20%
CO 2	Apply inheritance, packages, and interfaces to build reusable Java applications.	AP	20%
CO 3	Implement exception handling, multithreading, and collections in Java applications.	AP	20%
CO 4	Perform file handling and I/O operations using Java.	AP	20%
CO 5	Develop simple applications to effectively interact with relational database systems using JDBC and Hibernate.	AP	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3	3		1					1	1
CO 2	3	2	2	1					1	1
CO 3	3	3	2	3					2	2
CO 4	2	2	2	3	1		1		3	2
CO 5	2	3	3	3	1	1	1		3	3
CO (W.A)	3	3	2	2	1	1	1		3	3

Unit- I : Introduction	**9**
Introduction to Java – Features of Java – Java Program Structure – Data Types – Variables – Arrays – Operators – Control Statements – Command Line Arguments – Classes and Objects – Constructors – Method Overloading – Passing and Returning Objects – Recursion – Access Control – Static Members – Final Keyword – Nested and Inner Classes.	
Unit- II : Inheritance, Packages and Interfaces	**9**
Inheritance Fundamentals – Using Super – Method Overriding – Dynamic Method Dispatch – Abstract Classes – Final Keyword with Inheritance – Packages – Access Protection – Importing Packages – Interfaces – Default and Static Methods in Interfaces.	
Unit- III : Exception Handling, Multithreading and Collection Framework	**9**
Exception Handling Fundamentals – Exception Types – Try, Catch, Finally – Throw and Throws – User-defined Exceptions – Multithreading: Creating Threads – Thread Life Cycle – Thread Priorities – Synchronization – Collection Framework: Collection Interfaces – ArrayList – LinkedList – HashSet – Iterator – HashMap.	
Unit- IV : File Handling	**9**
Java I/O – File Class – Byte Streams and Character Streams – File Input Stream and File Output Stream – File Reader and File Writer – Buffered Reader and Buffered Writer – Scanner Class – Print Writer – Object Serialization.	
Unit- V : Web Programming	**9**
Web Programming – Servlet API – Servlet Life Cycle – Creating and Executing a Simple Servlet – Handling Client Requests and Responses – Java Server Pages (JSP): JSP Architecture – JSP Life Cycle – Implicit Objects – Basic JSP Tags – Action Tags.	

Suggested Learning Resources

Reference Books:

1. Herbert Schildt, Java: The Complete Reference, 12th Edition, McGraw-Hill Education, 2021.
2. CDAC, Core and Advanced Java – Black Book, 1st Edition, Dreamtech Press, 2018.
3. Cay S. Horstmann, Core Java, Volume I – Fundamentals, 12th Edition, Pearson, 2021.
4. Y. Daniel Liang, Introduction to Java Programming and Data Structures, 12th Edition, Pearson, 2020.

Networking and Cryptography						
Course Code:	26CAB03				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- Develop a comprehensive understanding of computer networks, communication protocols, layered network architectures, and cryptographic techniques to analyze, design, and secure data communication systems.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Understand the basic data communication concepts and compare network types and TCP/IP–OSI models.	Ap	20%
CO 2	Apply techniques to detect and Correct the errors in transmission of data	Ap	20%
CO 3	Compare the network, transport, and application layer protocols for data communication.	An	20%
CO 4	Apply cryptographic techniques for secure data transmission.	Ap	20%
CO 5	Analyze the symmetric and asymmetric cipher algorithms for secure communication.	An	20%

Mapping of COs with POs / PSOs

COs	**POs**								**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3							3	
CO 2	3		3		3				3	
CO 3		3							3	
CO 4	3				3				3	
CO 5		2	3		3				3	
CO (W.A)	3	3	3		3				3	

Unit- I : Introduction	**9**
Data Communications – Networks – Network Types – Standards and Administration - Protocol Layering - TCP/IP Protocol Suite – OSI Model Physical.	
Unit- II : Physical and Data Link Layer	**9**
Physical Layer: Transmission Media – Line Coding and its Schemes. Data Link Layer: Transmission Modes, Introduction of DLL – Link-Layer Addressing - Error Detection and Correction: Types of Errors, Block Coding - Cyclic Codes – Checksum - Forward Error Correction: Hamming Distance - Data-Link Layer Protocols.	
Unit- III : Network, Transport and Application Layer	**9**
Switching – Circuit Switched Networks - Packet Switching – Structure of a Switch – Network Layer Services and Performance. Transport Layer: Services – Connection Establishment – Protocols – UDP - TCP – Congestion Control. Application Layer: HTTP – FTP – Domain Name Space (DNS).	
Unit- IV : Cryptography Concepts and Techniques	**9**
Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks.	
Unit- V : Symmetric and Asymmetric Key Ciphers	**9**
Symmetric key Ciphers: Block Cipher Principles, DES, AES, Block Cipher Modes (ECB, CBC, CTR, GCM). Asymmetric Key Ciphers: Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange - Applications and Comparison of Cryptographic Techniques.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw-Hill, 2019.
2. William Stallings, Cryptography and Network Security Principles and Practice, 8th Edition – Pearson, 2023.
3. Andrew S. Tanenbaum, Nick Feamster, David J. Wetherall, Computer Networks. Pearson, Sixth Edition, 2021.
4. William Stallings, Network Security Essentials, 6th Edition, Pearson, 2017.
5. Bruce Schneier, Applied Cryptography, 2nd Edition, Wiley, 2015.

Cloud Computing						
Course Code:	26CAB04				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- Apply cloud computing concepts, service and deployment models, virtualization, scalability, data management, and security techniques to design efficient and secure cloud-based solutions.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply the fundamentals of cloud computing and deployment models to real-world scenarios.	Ap	20%
CO 2	Analyze cloud service models and explore the basics of virtualization.	An	20%
CO 3	Assess hypervisor technologies and cloud scalability solutions.	Ap	20%
CO 4	Analyze cloud storage solutions and foundational cloud security principles.	An	20%
CO 5	Apply monitoring, encryption, and access management strategies in cloud environments.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3	2	2							
CO 2	2	3		3	3					
CO 3	3	3						3		
CO 4	3							3		
CO 5		3								
CO (W.A)	3	3	2	3	3			3		

Unit- I : Introduction	**9**
Introduction to Cloud Computing - Evolution of Cloud Computing – Cloud Characteristics - Elasticity in Cloud - On-demand Provisioning – NIST Cloud Computing Reference Architecture – Architectural Design Challenges.	
Unit- II : Cloud Service Models	**9**
Cloud Service Models: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Service Providers, Challenges and Risks in Cloud Adoption. Cloud Deployment Model: Public Clouds – Private Clouds – Community Clouds – Hybrid Clouds – Advantages of Cloud Computing.	
Unit- III : Virtualization	**9**
Virtualization: Definition – Benefits of Virtualization – Types of Virtualizations – Hypervisors based: Para Virtualization – Full Virtualization – Virtual Machine Monitor – Hypervisors: Xen, KVM, VMWare, Virtual Box and Hyper-V - Pros and Cons of Virtualization.	
Unit- IV : Cloud Scalability and Data Management	**9**
Scaling in the Cloud - Auto-Scaling in Cloud - Use of Load Balancers to Enhance Scalability - Elastic Compute Cloud - Cloud Storage - Database in Cloud - Relational DBMS in Cloud – Non-Relational DBMS in Cloud – Private and Public Cloud Platforms.	
Unit- V : Cloud Security Design	**9**
Challenges with Cloud Data - Challenges with Data Security - Security-as-a-Service- Data Confidentiality and Encryption - Data Availability - Data Integrity - Cloud Firewall - Virtual Firewall - Security Monitoring – Identity Management and Access Control.	
	Total (L : 45)

Suggested Learning Resources
Reference Books: 1. Michael J. Kavis “Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)" John Wiley & Michel Kavis, 2014. 2. Mehul Mahrishi Kamal Kant Hiran, Ruchi Doshi and Dr.Fagbola Temitayo, “Cloud Computing”, BPB Publications, First Edition, 2019. 3. Sandeep Bhowmik “Cloud Computing”, Cambridge University Press, 2017. 4. Kailash Jayaswal, Jagannath Kallakurch, Donald J. Houde, Deven Shah "Cloud Computing Black Book", Wiley India, 2014.

Agile Methodology						
Course Code:	26CAB05				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To enable students to apply and analyse agile methodologies and tools to enhance software development processes, quality assurance, requirements engineering, and knowledge management.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Examine agile principles, values, and project management practices.	Ap	20%
CO 2	Implement agile processes such as Scrum, XP, and Lean methods.	An	20%
CO 3	Outline knowledge management and knowledge sharing in agile environments.	Ap	20%
CO 4	Utilize agile techniques in requirements engineering and management.	Ap	20%
CO 5	Implement quality assurance practices and agile tools.	An	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3	3						3	
CO 2		3		3		3				3
CO 3	3						3			
CO 4			3		3			3	3	
CO 5	3									3
CO (W.A)	3	3	3	3	3	3	3	3	3	3

Unit- I : Introduction	**9**
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.	
Unit- II : Agile Processes	**9**
Lean Production – SCRUM – Crystal – Feature Driven Development – Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.	
Unit- III : Knowledge Management	**9**
Agile Information Systems – Agile Decision Making – Earl's Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story Cards – Story-Card Maturity Model (SMM).	
Unit- IV : Requirements Engineering	**9**
Impact of Agile Processes in RE – Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment – Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.	
Unit- V : Quality Assurance	**9**
Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003
2. Julian Michael Bass, "Agile Software Engineering Skills", Series: Undergraduate Topics in Computer Science, Springer, 2023.
3. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Routledge, 2017.
4. Robert C. Martin, "Agile Software Development: Principles, Patterns and Practices", Pearson New International Edition, Pearson Education Limited, 2013.

Advanced Data Structures and Algorithms Laboratory						
Course Code:	26CAP01				CIA	60
Course Type: (Theory/Practical/Integrated)	Practical				ESE	40
L:T:P:C	0	0	4	2	Total Marks	100
Total Hours of Pedagogy	60				Exam Hours	3
Pre-requisites	Nil					

Course Objectives

- To provide a deeper insight on the basic and advanced data structures.
- To develop the knowledge for application of the advanced trees and graphs in real world scenarios.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply the fundamentals of computational thinking to solve computational problems	AP	20%
CO 2	Use the operators and expressions to perform arithmetic, relational, and logical operations in Python programs.	AP	20%
CO 3	Use of searching and sorting in various real-life applications.	AP	20%
CO 4	Apply the basic tree terminology concept and implement different tree structures.	AP	20%
CO 5	Design and implement Python-based applications using ADTs to solve real-world computational challenges.	AP	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3		3						3	2
CO 2	3	3		3					3	3
CO 3			3						3	3
CO 4		3		3			3		2	3
CO 5			3	3				3	3	2
CO (W.A)	3	3	3	3					3	3

List of Experiments:

1. Analyzing the Basic coding of python programming using operators and String operations
2. Implement Linear data structures (Stacks, Queues, Linked Lists)
3. Linear time sorting techniques
4. Binary tree &Tree traversals
5. B-trees & B+ trees
6. Advanced Trees: 2-3tree, splay tree, red black tree etc.
7. Graph traversals (BFS, DFS, Topological sorting)
8. Determining the shortest path between pair of nodes in the given graph
9. Minimum Spanning Trees
10. Design an application for online shopping system using appropriate data structure.

Total (P : 60)

Advanced Java Programming Laboratory							
Course Code:	26CAP02					CIA	60
Course Type: (Theory/Practical/Integrated)	Practical					ESE	40
L:T:P:C	0	0	4	2		Total Marks	100
Total Hours of Pedagogy	60					Exam Hours	3
Pre-requisites	NIL						

Course Objectives

- To develop the ability to design, implement, and maintain robust, efficient, and scalable software applications using Java.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Develop Java programs using fundamental programming and object-oriented concepts.	Ap	20%
CO 2	Apply inheritance, packages, and interfaces to build reusable Java applications.	Ap	20%
CO 3	Implement exception handling, multithreading, and collections in Java applications.	Ap	20%
CO 4	Perform file handling and I/O operations using Java.	Ap	20%
CO 5	Develop simple applications to effectively interact with relational database systems using JDBC and Hibernate.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3	2							1	1
CO 2	3	2	2						1	1
CO 3	2	3	2	3					2	2
CO 4	2	2	2	3	1		1		3	2
CO 5	2	3	3	3	1	1	1		3	3
CO (W.A)	3	3	2	2	1	1	1		3	3

List of Experiments:

1. Write Java programs using variables, arrays, operators, control statements, command-line arguments, and methods.
2. Develop Java programs using classes, objects, constructors, method overloading, recursion, static members, and nested/inner classes.
3. Implement Java programs demonstrating single, multilevel, and hierarchical inheritance, method overriding, abstract classes, and dynamic method dispatch.
4. Create user-defined packages and implement interfaces with default and static methods.
5. Develop Java programs using exception handling with try-catch-finally, throw, throws, and user-defined exceptions.
6. Create multithreaded Java applications using thread creation, synchronization, and thread priorities.
7. Implement Java Collection Framework programs using ArrayList, LinkedList, HashSet, Iterator, and HashMap.
8. Develop Java programs to perform file handling using byte streams, character streams, and buffered streams.
9. Implement Java I/O applications using the File class, Scanner, PrintWriter, and object serialization.
10. Develop web applications using Servlets and JavaServer Pages (JSP) to process client requests and generate dynamic web content.

Total (P : 60)

Career Communication Lab						
Course Code:	26CAS01				CIA	60
Course Type: (Theory/Practical/Integrated)	Practical				ESE	40
L:T:P:C	0	0	2	1	Total Marks	100
Total Hours of Pedagogy	30				Exam Hours	3
Pre-requisites	Nil					

Course Objectives

- Develop advanced workplace and professional communication skills.
- Enhance communication strategies effectively in industry-oriented scenario.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Demonstrate technical documents, reports, and presentations accurately.	Ap	40%
CO 2	Apply efficient communication strategies to address professional situations and prepare effective business communication	Ap	30%
CO 3	Demonstrate professional communication skills through interviews and networking to enhance career readiness.	Ap	30%

Mapping of COs with POs / PSOs

COs	**POs**								**PSOs**	
	1	2	3	4	5	6	7	8	1	2
CO 1					3			2		
CO 2					3			2		
CO 3					3			2		
CO (W.A)					**3**			**2**		

Module - I : Workplace Communication	**10**
Listening - Business Conversation - Workplace Conflict Scenario Analysis - **Speaking -** Elevator Pitch for Software Products - Crisis Communication Role Play - Reverse JAM Activities - **Reading -** Workplace Case Scenario Analysis - Professional Chat Conversation Interpretation - **Writing -** Escalation Mail Writing - Client Response Message Drafting.	
Module - II : Technical Communication	**10**
Listening - Technical Podcast Analysis - Problem Statement Identification - **Speaking -** Technical Concept Explanation for Non-Technical Audience - Decision-Making Group Tasks - **Reading -** Product Review Analysis - Technology Trend Report Analysis - **Writing -** Technical Issue Reporting.	
Module - III : Professional Communication	**10**
Listening - HR Interaction Video Analysis - TED Talk Interpretation - **Speaking -** Mock HR and Technical Interviews - Professional Networking Conversations - Personal Branding Presentation - **Reading -** Job Portal Interpretation - Employer Expectation Analysis - **Writing -** Digital Portfolio Content Creation - Professional Profile Summary Writing.	
	Total (P : 30)

Suggested Learning Resources

Reference Books:

1. Meenakshi Raman and Sangeeta Sharma, "Technical Communication: Principles and Practice", Oxford University Press, Third Edition, 2023.
2. Courtland L. Bovee and John V. Thill, "Business Communication Today", Pearson Education, Fifteenth Edition, 2023.
3. Aruna Koneru, "Professional Communication", McGraw Hill Education, Second Edition, 2019.
4. Sanjay Kumar and Pushp Lata, "Communication Skills", Oxford University Press, Third Edition, 2018.
5. Sunita Mishra and C. Muralikrishna, "Communication Skills for Engineers", Pearson Education India, Third Edition, 2020.

Database Technology						
Course Code:	26CAB06				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- Apply database concepts to design ER-based schemas, implement and query relational databases using SQL, develop data-driven applications and evaluate NoSQL solutions for distributed data environments.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Implement the characteristics of the DBMS approach to solve real-world information management problems.	AP	20%
CO 2	Design ER diagrams and relational schemas to ensure data consistency and integrity.	AP	20%
CO 3	Implement SQL queries including advanced retrieval, updates, and views for problem-solving in relational databases.	Ap	20%
CO 4	Analyze deadlock situations and evaluate two-phase commit protocol for distributed transaction consistency.	An	20%
CO 5	Compare relational and NoSQL database solutions to determine the most suitable approach for specific application domains.	An	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3	3				3	3	3	3	3
CO 2	3		3				3		3	
CO 3							3			3
CO 4				3	3	3				
CO 5	3	3	3			3			3	
CO (W.A)	3	3	3	3	3	3	3	3	3	3

Unit- I : Introduction	**9**
Introduction to database systems – Definition of DBMS – Advantages of DBMS – Views of data – Levels of data Abstraction – Data Models and types – Database architecture – Entity Relationship Model – ER diagram – EER MODEL-Distributed databases-Parallel Databases.	
Unit- II : Relational Data Model	**9**
Relational database structure – Procedural and Non-procedural languages – Relational algebra: operations – Integrity Constraints – SQL Commands: DDL – DML – TCL – DCL – Set operations – Join Operations – Aggregation in SQL – Using the group by clause.	
Unit- III : SQL and PL/SQL	**9**
PL/SQL Block – Introduction to PL/SQL – The Advantages of PL/SQL – PL/SQL Architecture – PL/SQL Data types – Variable and Constants – Using Built-in Functions – Conditional and Unconditional Statements – Stored procedures – Procedure with Parameters (IN, OUT and IN OUT) – Procedure with Cursors – Dropping a Procedure. Functions in PL/SQL: Difference between Procedures and Functions – User Defined Functions – Nested Functions – Using stored function in SQL statements – Trigger – Types of Triggers – Row Level Triggers – Statement Level Triggers – DDL Triggers.	
Unit- IV : Transactional Processing	**9**
Transaction – Properties of transaction – Transaction state – Serialization: types – Need for Serialization – Two Phase Commit – Save Point – Concurrency – Locking protocols – Time stamp protocol.	
Unit- V : NoSQL Databases	**9**
NoSQL: Big Data Management-CAP theorem-Schemaless model-MongoDB Operations: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharing-Cassandra: Data Model, Key Space, Table Operations, CRUD Operations.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.
2. Pramod J. Sadalage, Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", First Edition, Addison-Wesley Professional, 2012.
3. Kristina Chodorow, "MongoDB: The Definitive Guide", Third Edition, O'Reilly Media, 2019.
4. Jeff Carpenter, Ebenezer Lakshmanan, "Cassandra: The Definitive Guide", Second Edition, O'Reilly Media, 2022.

Full Stack Web Development						
Course Code:	26CAB07				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To provide students with a fundamental understanding of full stack web development concepts, tools, and technologies used to design, build, and deploy modern web applications using the MERN stack

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Use client-server architecture and web communication protocols in full stack application development	Ap	20%
CO 2	Design interactive user interfaces using front-end technologies including HTML5, CSS3, Bootstrap, and JavaScript	Ap	20%
CO 3	Develop server-side applications and RESTful APIs using Node.js and Express.js	Ap	20%
CO 4	Design and implement database-driven applications using MongoDB and Mongoose, including secure authentication	Ap	20%
CO 5	Build, and deploy complete MERN stack applications using modern hosting platforms	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3									
CO 2		3	1	1	2	1			2	2
CO 3		3	2	2	2	1			2	2
CO 4										
CO 5		3	2	3	2	1	2		2	2
CO (W.A)	3	3	2	2	2	1	2		2	2

Unit- I : Introduction	**9**
Evolution of Web Applications - Full Stack Development Overview - Client-Server and Three-Tier Architecture - HTTP and HTTPS Protocols - Web Browsers and Web Servers - Git and GitHub Basics - MERN Stack Overview - Development Environment Setup (VS Code, Node.js).	
Unit- II : Front-End Development	**9**
HTML5 Structure and Semantic Elements - Forms and Validation - CSS3 Fundamentals - Flexbox and CSS Grid with Responsive Design - Bootstrap 5 - JavaScript ES6 Basics - DOM Manipulation and Event Handling.	
Unit- III : Server-Side Development and APIs	**9**
Node.js - NPM and Modules - Express.js Framework and Routing - Middleware and CORS - RESTful API Development - Fetch API and JSON - API Testing using Postman - Basic Error Handling.	
Unit- IV : Database Integration and Authentication	**9**
MongoDB - Collections and Documents - CRUD Operations - Mongoose ODM and Schema Design - Database Integration with Express - Password Hashing using bcrypt - Authentication using JWT.	
Unit- V : React and Deployment	**9**
React Fundamentals - Components and Props - State and Hooks (useState, useEffect) - React Router - Axios - Building a Simple MERN Application - Environment Variables and Web Security Best Practices - Deployment using Vercel or Render.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Jon Duckett, “HTML and CSS: Design and Build Websites”, 1st Edition, Wiley, 2011
2. Vasan Subramanian, “Pro MERN Stack, 2nd Edition”, Apress, 2019.
3. Ethan Brown, “Web Development with Node and Express”, 2nd Edition, O'Reilly, 2019
4. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, “MongoDB: The Definitive Guide”, 3rd Edition, O'Reilly, 2019
5. Alex Banks and Eve Porcello, “Learning React”, 2nd Edition, O'Reilly, 2020

Internet of Things						
Course Code:	26CAB08				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	Basic knowledge of computers and programming.					

Course Objectives

- To enable students to understand IoT fundamentals, embedded systems, communication technologies, and develop real-time IoT applications using Arduino and Raspberry Pi.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Differentiate electrical concepts, circuit laws and electronic components to interpret simple electrical circuits.	Ap	20%
CO 2	Deconstruct IoT architecture, communication models, protocols, enabling technologies, and domain-specific applications.	Ap	20%
CO 3	Implement Arduino programming for interfacing analog/digital I/O and communication protocols.	Ap	20%
CO 4	Design and implement Raspberry Pi environment and Python programming for IoT applications.	Ap	20%
CO 5	Implement IoT-based real-time applications such as home automation, smart parking, and smart irrigation.	An	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3								3	
CO 2		3			3					
CO 3	3					3				3
CO 4				3						
CO 5								3		3
CO (W.A)	3	3		3	3	3		3	3	3

Unit- I : Basic Electronics	**9**
Introduction - Current, Voltage and Resistance - Analog and Digital Signal - Conductors Vs Insulators – KCL- KVL - Basic Electronics components - calculating equivalent resistance for series and parallel circuits- Ohm's law- Color coding for a resistor – LED – LCD – LDR - Case Studies.	
Unit- II : Fundamentals of IoT	**9**
Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT Communication Models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry - Case Studies.	
Unit- III : Programming using Arduino	**9**
Introduction to Arduino processor- General Block diagram- Working of Analog and Digital I/O pins- Serial (UART), I2C Communications and SPI communication - Arduino Boards: Mega, Due, Zero and 101 - Prototyping basics - Technical description - Setting Up Arduino IDE- Introduction to Arduino programming - Case Studies.	
Unit- IV : Programming using Raspberry PI	**9**
Technical Description of Raspberry Pi - comparison of Raspberry Pi Vs Arduino - Operating Systems for RPi - Preparing SD Card for Pi - Connecting Raspberry Pi as PC - Exploring Raspberry Pi Environment- Logical design using Python - Case Studies.	
Unit- V : Applications of IoT	**9**
Various Real time applications of IoT- Home Automation - Smart Parking - Environment: Weather monitoring system - Agriculture: Smart irrigation – Domain Specific applications - Case Studies.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach," Universities Press, 2015.
2. R. Muthusubramanian, S. Salivahanan, and K. A. Muraleedharan, "Basic Electrical, Electronics and Computer Engineering," 2nd Edition, Tata McGraw Hill, 2006.
3. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols," 2nd Edition, Wiley Publications, 2013.
4. Marco Schwartz, "Internet of Things with the Arduino Yún," Packt Publishing, 2014.
5. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things," Wiley Publications, 2012.

Artificial Intelligence						
Course Code:	26CAB09				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To build simple knowledge-based systems and to apply knowledge representation, reasoning, and uncertainty-handling techniques using AI methodologies.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Implement the behavior of intelligent agents and apply agent structures to different environments.	Ap	20%
CO 2	Use heuristic search strategies and analyze their efficiency in solving complex problems.	Ap	20%
CO 3	Solve game playing strategies and apply constraint satisfaction techniques to solve problems.	An	20%
CO 4	Examine logical inference techniques and analyze knowledge representation using propositional and first-order logic.	An	20%
CO 5	Use probabilistic models and analyze decision-making under uncertainty using Bayesian methods.	An	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3									3
CO 2		3				3			3	
CO 3			3	3					3	
CO 4	3			3	3		3			3
CO 5								3	3	
CO (W.A)	3	3	3	3	3		3	3	3	3

Unit- I : Intelligent Agents	**9**
Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.	
Unit- II : Problem Solving	**9**
Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments.	
Unit- III : Game Playing and CSP	**9**
Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.	
Unit- IV : Logical Reasoning	**9**
Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution.	
Unit- V : Probabilistic Reasoning	**9**
Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education, 2015.
3. Elaine Rich, Kevin Knight & Shivashankar B. Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill Education, 2019.
4. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
5. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.

Database Technology Laboratory						
Course Code:	26CAP03				CIA	60
Course Type: (Theory/Practical/Integrated)	Practical				ESE	40
L:T:P:C	0	0	4	2	Total Marks	100
Total Hours of Pedagogy	60				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- Apply knowledge of DBMS structure and database design to implement basic query languages, utilize high-level programming concepts, and develop menu-driven database applications.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply data definition concepts to create tables, define constraints, and manage database structures effectively.	Ap	20%
CO 2	Apply SQL commands to insert, retrieve, update, delete, and manipulate data using joins and nested queries.	Ap	20%
CO 3	Analyze advanced database features such as views, triggers, aggregate functions, and data control commands to ensure data integrity and security.	An	20%
CO 4	Analyze high-level programming concepts using PL/SQL and perform database operations in MySQL environments	An	20%
CO 5	Apply backend connectivity techniques to integrate databases with applications and develop complete data-driven solutions.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3	3				3	3	3	3	3
CO 2	3		3				3		3	
CO 3							3			3
CO 4				3	3				3	
CO 5	3	3	3			3			3	
CO (W.A)	3	3	3	3	3	3	3	3	3	3

List of Experiments:

1. Data Definition, Table Creation, Constraints
2. Insert, Select Commands, Update & Delete Commands
3. Nested Queries & Join Queries
4. Views& Triggers
5. Data Control Commands& Aggregate Functions
6. Implementing High level Language (PL / SQL)
7. Implementing My SQL Operations
8. Implementing Backend Connectivity
9. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB
10. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.

Total (P : 60)

Full Stack Web Development Laboratory						
Course Code:	26CAP04				CIA	60
Course Type: (Theory/Practical/Integrated)	Practical				ESE	40
L:T:P:C	0	0	4	2	Total Marks	100
Total Hours of Pedagogy	60				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To equip students with practical skills in version control, web development, API design, database management, authentication, and deployment for building industry-standard full stack web applications.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply Git, GitHub, and HTTP protocols to support collaborative web application development.	Ap	20%
CO 2	Design responsive and interactive web pages using HTML, CSS, and JavaScript.	Ap	20%
CO 3	Develop and test RESTful web services using Node.js, Express.js, and Postman.	Ap	20%
CO 4	Implement CRUD operations with MongoDB and develop secure user authentication using JWT.	Ap	20%
CO 5	Build and deploy full-stack web applications using the MERN stack.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	2									
CO 2		3	1	1	2	1			2	2
CO 3		3	2	2	2	1			2	2
CO 4										
CO 5		3	2	3	2	1	2		2	2
CO (W.A)	2	3	2	2	2	1	2		2	2

List of Experiments:

1. Perform Git and GitHub operations including repository initialization, branching, committing, and merging.
2. Analyze HTTP request-response headers, methods, and status codes using browser developer tools and Postman.
3. Design a responsive webpage using semantic HTML5 elements and CSS3 with Flexbox/Grid layouts.
4. Create an interactive form with JavaScript-based validation and DOM manipulation.
5. Develop a RESTful API using Node.js and Express.js with custom middleware.
6. Test REST APIs using Postman and consume them in a webpage using the Fetch API.
7. Perform CRUD operations on MongoDB using Mongoose within an Express application.
8. Implement user authentication using bcrypt password hashing and JWT-based route protection.
9. Build a React application using components, hooks, and React Router for navigation.
10. Integrate front-end and back-end components into a MERN application and deploy it on a hosting platform.

Total (P : 60)

Professional Elective: Data Science Verticals

Fundamentals of Data Science and Analytics						
Course Code:	26CAX01				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					
Course Objectives						
• To apply data analytic techniques to solve real world problem.						

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply the basic concepts of Data Science and Data Analytics.	Ap	20%
CO 2	Apply data collection, cleaning, integration, and transformation techniques.	Ap	20%
CO 3	Apply the statistical measures such as mean, median, mode, and standard deviation.	Ap	20%
CO 4	Use supervised, unsupervised, and reinforcement learning techniques.	Ap	20%
CO 5	Implement Big Data processing techniques using the Hadoop ecosystem Spark	Ap	20%

Mapping of COs with POs / PSOs										
COs	**POs**								**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3						3		3
CO 2	3		3							
CO 3						3		3	3	
CO 4	3									
CO 5		3	3					3		
CO (W.A)	3	3	3					3	3	3

Unit- I : Data Science	**9**
Data Science, Evolution of Data Science, Data Science Life Cycle, Roles in Data Science -Data Scientist-Analyst-Types of Data -Structured, Unstructured, Semi-structured -Applications of Data Science in real-world domains.	
Unit- II : Data Preparation and Exploratory Data Analysis	**9**
Data Collection Methods – Data Acquisition – Data Quality – Data Cleaning – Handling Missing Values and Outliers – Data Integration – Data Transformation – Data Reduction – Feature Selection – Exploratory Data Analysis (EDA) – Data Visualization Basics – Introduction to Python Libraries (NumPy, Pandas).	
Unit- III : Statistical Foundations and Visualization	**9**
Basics of Statistics for Data Science, Measures of Central Tendency and Dispersion, Probability Basics, Correlation and Regression Overview, Data Visualization Techniques, Charts and Graphs –Bar –Line-Histogram- Scatter Plot - Introduction to Visualization Tools – Matplotlib – Seaborn - Tableau.	
Unit- IV : Data Analytics	**9**
Data Analytics – Data Analytics Life Cycle – Types of Analytics (Descriptive, Diagnostic, Predictive, Prescriptive) – Data Warehousing Concepts – Business Intelligence (BI) Concepts – Data Visualization Techniques – Dashboards and Reports – Introduction to Analytics Tools (Excel, Power BI, Tableau) – Case Studies.	
Unit- V : Advanced Data Analytics and Applications	**9**
Predictive Analytics – Prescriptive Analytics – Introduction to Big Data Analytics – Data Mining Concepts – Text Analytics – Web and Social Media Analytics – Cloud-based Analytics – Ethical Issues in Data Analytics – Data Privacy and Security – Real-world Applications in Healthcare, Finance, Retail, Manufacturing, and Smart Cities – Future Trends in Data Science and Analytics.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Peter C. Bruce, Peter Gedeck, and Janet Dobbins," Statistics for Data Science and Analytics", 1st Edition, John Wiley & Sons, 2024.
2. Ivo D. Dinov**,** "Data Science and Predictive Analytics", 2nd Edition, 2023**.**
3. Wes McKinney ,"Python for Data Science", 2nd Edition ,O'Reilly Media, 2019.

Big Data Analytics						
Course Code:	26CAX02				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- Apply big data analytics techniques to solve real-world problems, demonstrating the ability to derive actionable insights from complex datasets.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Use big data concepts and tools to understand data, roles, and real-world data science applications.	Ap	20%
CO 2	Apply data analytics lifecycle, association rules, and regression techniques to analyze data and support decision making.	Ap	20%
CO 3	Design applications using NoSQL and HADOOP.	Ap	20%
CO 4	Implement programming concepts including data types, control structures, functions, and data structures to perform data analysis effectively.	Ap	20%
CO 5	Implement write the machine learning coding for optimization.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3					3	3	3	3
CO 2	3						3	3		
CO 3		3				3				
CO 4	3				3				3	
CO 5		3			3		3	3		3
CO (W.A)	3	3			2		3	3	3	3

Unit- I : Introduction	**9**
Introduction - Characteristics and Considerations - Data Structures - Business drivers - Business Intelligence Vs Data Science - Analytical Architecture - Key Roles of the New Big Data Ecosystem - Data Scientist - Big Data Applications.	
Unit- II : Data Analytics Life Cycle	**9**
Data Analytics Life Cycle: Discovery - Data Preparation - Model Planning - Model Building - Communicate Results - Operationalize - Key Roles for a Successful Analytic Project - Case Studies. Association Rules: Apriori Algorithm - Applications of Association Rules. Regression: Linear Regression - Logistic Regression.	
Unit- III : NoSQL, HADOOP and Map Reduce	**9**
BASE Concept. NoSQL: Types of Databases - Advantages - NewSQL - SQL vs NoSQL vs NewSQL. Introduction to Hadoop: Features - Advantages - Versions - Overview of Hadoop Ecosystems - Hadoop Distributions - HDFS - MapReduce: Mapper - Reducer - Combiner - Partitioner - Searching - Sorting - Compression. Hadoop 2 (YARN): Architecture - Interacting with Hadoop Ecosystems.	
Unit- IV : Data Virtualization	**9**
Overview of Data Virtualization- Need and Benefits- Data Integration Challenges- Traditional Data Integration vs. Data Virtualization, Architecture and Components of Data Virtualization. Real-time Data Access- Data Governance and Security- Performance Considerations- Cloud-based Data Virtualization - Business Intelligence Applications - Case Studies and Best Practices.	
Unit- V : Advanced SPARK Analytics	**9**
Spark Streaming Fundamentals - Structured Streaming - Machine Learning using Spark MLlib - Graph Processing with GraphX, Performance Optimization –Caching - Partition- Lazy Evaluation- Applications and Case Studies.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Raj Kamal, Preeti Saxena, “Introduction to Hadoop, Spark and Machine Learning”, McGraw Hill Edition, 2020.
2. Jure Leskovoc, Anand Rajaraman, Jeffrey D.Ullman , “Mining of Massive Datasets” , McGraw Hill Edition, 2021.

Natural Language Processing						
Course Code:	26CAX03				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To develop knowledge of Natural Language Processing techniques for analyzing text and building language-based applications.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply the basic concepts of Natural Language Processing and its applications	Ap	20%
CO 2	Perform POS tagging and Named Entity Recognition (NER) on text data.	Ap	20%
CO 3	Use the concept of language modeling and Maximum Entropy principle	Ap	20%
CO 4	Perform lexical semantics and relationships between words	Ap	20%
CO 5	Explore real-world applications of NLP in different domains	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3						3	3	3
CO 2	3			3						
CO 3						3		3	3	
CO 4	3			3						
CO 5		3								
CO (W.A)	3	3		3				3	3	3

Unit- I : Introduction	**9**
Introduction to Natural Language Processing (NLP)- Applications of NLP, Challenges in NLP- Levels of Language Processing –Morphological-Lexical- Syntactic- Semantic- Pragmatic, Discourse- NLP Pipeline- Text Corpus and Encoding.	
Unit- II : Text Pre-Processing and Representation	**9**
Text Cleaning and Normalization-Tokenization- Stop Word Removal- Stemming and Lemmatization- Part-of-Speech (POS) Tagging- Named Entity Recognition (NER)- Bag of Words (BoW)- TF-IDF- Introduction to Word Embedding.	
Unit- III : Lagrange Language Model	**9**
Introduction to the Lagrange Language Model (Maximum Entropy Model), Principle of Maximum Entropy, Lagrange Multipliers, Feature Functions, Constraint-Based Modeling, Parameter Estimation, Model Training and Evaluation.	
Unit- IV : Lexical Semantic Analysis	**9**
Word Sense Disambiguation (WSD)-Semantic Similarity and Relatedness, Distributional Semantics- Vector Space Models- Word Embeddings -Word2Vec, GloVe, FastText- Contextual Word Representations	
Unit- V : Applications of NLP	**9**
Speech Recognition and Speech-to-Text Systems- Voice Assistants -Siri, Alexa, Google Assistant- Healthcare NLP applications- Social Media Analytics- Opinion Mining, Recommendation Systems- Legal and Financial NLP applications- Recent Trends and Future Scope of NLP.	
	Total (L : 45)

Suggested Learning Resources
Reference Books: 1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022. 2. Bird, S., Klein, E., & Loper, E., "Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit". 1st Edition, O'Reilly Media, Inc., Sebastopol, California, 2019.

Professional Elective: Cyber Security Verticals

Ethical Hacking						
Course Code:	26CAX04				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	Basic knowledge of Computer Networks and Operating Systems					
Course Objectives						
• To provide knowledge of ethical hacking, cyber threats, vulnerabilities, and security techniques to protect computer systems and networks.						

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Gain knowledge on the basics of computer- based vulnerabilities	U	20%
CO 2	Demonstrate the network and vulnerability attacks in system.	Ap	20%
CO 3	Investigation about foot printing, reconnaissance and scanning methods using tools	Ap	20%
CO 4	Analyze the basics of scanning methodologies and exploitation techniques using modern tools	Ap	20%
CO 5	Perform in a team to identify the options for network protection and firewall protection in ethical hacking.	An	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3									
CO 2		3			3				2	
CO 3	3					3				
CO 4			3	3						3
CO 5					3			3	3	
CO (W.A)	3	3	3	3	3	3		3	3	3

Unit- I : Introduction	**9**
Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer- The Internet Layer - IP Address.	
Unit- II : Computer Attacks	**9**
Network and Computer Attacks - Malware - Protecting Against Malware Attacks. - Intruder Attacks - Denial-of-Service Attacks Distributed Denial-of-Service Attacks-- Buffer Overflow Attacks- Ping of Death Attacks - Session Hijacking-Addressing Physical Security Key loggers.	
Unit- III : Foot Printing and Social Engineering	**9**
Web tools for Footprinting , Competitive Intelligence - Analyzing a Company's Web Site-Using Other Footprinting Tools-Using E- mail Addresses Using HTTP Basics-Other Methods of Gathering Information-Using Domain Name System Zone Transfers .- Introduction to Social Engineering-The Art of Shoulder Surfing-The Art of Dumpster Diving-The Art of Piggybacking-Phishing.	
Unit- IV : Port Scanning	**9**
Port Scanning- Types of Port Scans - Port-Scanning Tools – Nmap- Unicorns can — Nessus and OpenVAS-PingSweeps - Fping - Hoping-Crafting IP Packets.	
Unit- V : Desktop and Server Vulnerabilities	**9**
Windows OS Vulnerabilities-Windows File Systems-Remote Procedure Call—NetBIOS-Server Message Block-Common Internet File System-Null Sessions-Web Services-SQL Server-Buffer Overflows-Passwords and Authentication-Tools for Identifying Vulnerabilities in Windows-Best Practices for Hardening Windows Systems.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy," 2nd Edition, Syngress, Elsevier, 2013.
2. Michael T. Simpson, Kent Backman, and James E. Corley, "Hands-On Ethical Hacking and Network Defense," 3rd Edition, Cengage Learning, 2019.
3. Ric Messier, "CEH v11 Certified Ethical Hacker Study Guide," Wiley, 2021.
4. William Stallings, "Network Security Essentials: Applications and Standards," 7th Edition, Pearson, 2017.

Cyber and AI Security						
Course Code:	26CAX05				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To provide knowledge of cyber security principles and artificial intelligence-based security techniques for identifying, preventing, and mitigating cyber threats in modern digital environments.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Understand the concepts of cyber security, cyber threats, and artificial intelligence.	U	20%
CO 2	Apply network security and cryptographic techniques to secure digital systems.	Ap	20%
CO 3	Analyze AI-based approaches for cyber threat detection and incident response.	An	20%
CO 4	Assess security vulnerabilities and attacks against AI systems.	Ap	20%
CO 5	Assess emerging technologies and frameworks in cyber and AI security.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	1	3			1	2				
CO 2	1	3	3		1				3	
CO 3	1	3		3	1				3	
CO 4	1	3		3	1				3	
CO 5	1	3			1		2	3		
CO (W.A)	1	3	3	3	1	2	2	3	3	

Unit- I : Fundamentals of Cyber Security and Artificial Intelligence	**9**
Introduction to Cyber Security – Cyber Threats and Vulnerabilities – Cyber Attacks: Malware, Phishing, Ransomware, Social Engineering – Fundamentals of Artificial Intelligence – Machine Learning and Deep Learning Concepts – AI Applications in Cyber Security – Security Challenges in AI Systems – Ethical and Legal Issues in Cyber Security and AI.	
Unit- II : Network Security and Secure Communication	**9**
Network Security Concepts – Network Attacks and Defense Mechanisms – Firewalls, Intrusion Detection and Prevention Systems – Virtual Private Networks (VPNs) – Cryptography Fundamentals – Symmetric and Asymmetric Encryption – Digital Signatures and Public Key Infrastructure (PKI) – Secure Communication Protocols.	
Unit- III : AI for Cyber Defense	**9**
AI-Based Threat Detection – Machine Learning Techniques for Intrusion Detection – Anomaly Detection and Behavioral Analysis – Security Information and Event Management (SIEM) with AI – Predictive Analytics for Threat Intelligence – Automated Incident Response – Case Studies of AI-Driven Cyber Defense Systems.	
Unit- IV : Security of AI Systems	**9**
Adversarial Machine Learning – Data Poisoning Attacks – Model Evasion and Model Extraction Attacks – Privacy Issues in AI – Federated Learning Security – Explainable AI (XAI) for Security – Secure Development and Deployment of AI Models – AI Governance and Risk Management.	
Unit- V : Emerging Trends and Applications in Cyber and AI Security	**9**
Cloud Security and AI – Internet of Things (IoT) Security – Blockchain for Cyber Security – Generative AI and Cyber Security – AI-Powered Security Operations Centers (SOC) – Cyber Threat Intelligence – National and International Cyber Security Frameworks – Future Trends in Cyber and AI Security.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021.
2. William Stallings and Lawrie Brown, Computer Security: Principles and Practice, 4th Edition, Pearson Education, 2018.
3. James Graham, Richard Howard, and Ryan Olson, Cyber Security Essentials, 2nd Edition, CRC Press, 2017.
4. Clarence Chio and David Freeman, Machine Learning and Security, O'Reilly Media, 2018.

Data Privacy and Protection						
Course Code:	26CAX06				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To provide knowledge on data privacy, data protection techniques, privacy risk assessment, encryption methods, and secure storage practices for safeguarding information.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply knowledge on fundamental principles of Data privacy.	Ap	20%
CO 2	Design and development of data preservation by using data mining techniques.	Ap	20%
CO 3	Assess and evaluate privacy risks in accordance with data protection regulations.	Ap	20%
CO 4	Implement unstructured data security, IRM, and encryption techniques for data protection	Ap	20%
CO 5	Utilize storage and database security techniques to ensure risk remediation, protection mechanisms, and secure backup.	An	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3	3							3	
CO 2						3				
CO 3	3		3	3						3
CO 4	3			3						
CO 5						3		3		3
CO (W.A)	3	3						3	3	3

Unit- I : Data Privacy	**9**
Data Privacy and its Importance - Need for Sharing Data - Methods of Protecting Data - Importance of Balancing Data Privacy and Utility – Introduction to Anonymization Design Principles - Nature of Data in the Enterprise Static Data Anonymization on Multidimensional Data: Introduction - 36 Classification of Privacy Preserving Methods - Classification of Data in a Multidimensional Data Set - Group-Based Anonymization.	
Unit- II : Privacy Preserving Data Mining	**9**
Privacy Preserving Graph Data - Privacy Preserving Time Series Data – Privacy Preservation of Longitudinal Data - Privacy Preservation of Transaction Data - Static Data Anonymization: Threats to Anonymized Data-Threats to Data Structures-Threats by Anonymization Techniques.	
Unit- III : Privacy Regulations	**9**
UK Data Protection Act 1998. - Federal Act of Data Protection of Switzerland 1992 - Payment Card Industry Data Security Standard (PCI DSS) - The Health Insurance Portability and Accountability Act of 1996 (HIPAA) : Effects of Protection - Anonymization Considerations - Anonymization Design for HIPAA - Explicit Identifiers - Quasi-Identifiers - Sensitive Data. – Anonymization Design Checklist.	
Unit- IV : Data Security	**9**
Securing Unstructured Data : Structured Data vs. Unstructured Data – At Rest ,in Transit and in Use - Approaches to secure Unstructured Data – Newer Approaches to Secure Unstructured Data. Information Rights Management : Overview – IRM Technology Details – Getting Started with IRM. Encryption: History of Encryption – Symmetric KeyCryptography – Public Key Cryptography.	
Unit- V : Contemporary Issues	**9**
Storage Security: Evolution – Modern Storage Security – Risk Remediation – Best Practices. Database Security : General Concepts – Database Security Layers – Database-Level Security – Database Backup and Recovery – Database Auditing and Monitoring.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Venkataramanan, Nataraj, and Ashwin Shriram. Data Privacy: Principles and Practice. CRC Press, 2017
2. Paul Voigt & Axel von dem Bussche, *The EU General Data Protection Regulation (GDPR): A Practical Guide*, Springer, 2023.
3. Charu C. Aggarwal, *Data Privacy: Foundations, New Developments and Applications*, Springer, 2021.
4. David Salomon, Data Privacy and Security, Springer,2003

Professional Elective: Artificial Intelligence Verticals

Quantum Computing						
Course Code:	26CAX07				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To apply the fundamental principles of quantum mechanics, quantum entanglement and cryptography, quantum computing architecture and hardware, and quantum algorithms to solve computational problems.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Apply the fundamental postulates of quantum mechanics, wave function collapse and quantum decoherence.	Ap	20%
CO 2	Analyse quantum entanglement, interpretations of quantum mechanics and quantum key distribution protocols.	An	20%
CO 3	Apply quantum gates and circuits to design basic quantum computing architectures.	Ap	20%
CO 4	Examine quantum hardware platforms, decoherence mitigation techniques and topological quantum computing.	An	20%
CO 5	Implement quantum algorithms including Deutsch-Jozsa, Simon's, Shor's and Grover's algorithms.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3	3						3	
CO 2		3		3						3
CO 3	3						3			
CO 4			3					3	3	
CO 5	3									3
CO (W.A)	3	3	3	3			3	3	3	3

Unit- I : Basics of Quantum Theory	**9**
Quantum Mechanics – Bra-Ket Notation – Hamiltonian – Wave Function Collapse – Schrödinger's Equation – Quantum Decoherence – Quantum Electrodynamics – Quantum Chromodynamics – Feynman Diagram.	
Unit- II : Quantum Entanglement and QKD	**9**
Quantum Entanglement – Interpretation – Copenhagen Interpretation – Many-Worlds Interpretation – Decoherent Histories – Objective Collapse Theory – Quantum Key Exchange (QKE) – BB84 Protocol – B92 Protocol – SARG04 – Six-State Protocol.	
Unit- III : Quantum Architecture	**9**
Qubits – Quantum Gates – Hadamard Gate – Phase Shift Gates – Pauli Gates – Swap Gates – Fredkin Gate – Toffoli Gates – Controlled Gates – Ising Gates – Gottesman–Knill Theorem – Quantum Circuits – D-Wave Quantum Architecture – SQUID.	
Unit- IV : Quantum Hardware	**9**
Qubits – Photons – Electron – Ions NMRQC – Bose-Einstein Condensate Quantum Computing – GaAs Quantum Dots – Addressing Decoherence – Supercooling – Dealing with Noise – Filtering Noise – Topological Quantum Computing – Basic Braid Theory – Topological Computing.	
Unit- V : Quantum Algorithms	**9**
Deutsch's Algorithm – Deutsch-Jozsa Algorithm – Bernstein-Vazirani Algorithm – Simon's Algorithm – Shor's Algorithm – Quantum Period-Finding Function – Grover's Algorithm.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Easton II, William (Chuck), "Quantum Computing Fundamentals", 1st Edition, Addison-Wesley Professional (Pearson Education, Inc.), 2021.
2. Nielsen, M. A., and Chuang, I. L., "Quantum Computation and Quantum Information", Cambridge University Press, 2010.
3. Hidary, J. D., "Quantum Computing: An Applied Approach", Springer, 2021.
4. Kaye, P., Laflamme, R., and Mosca, M., "An Introduction to Quantum Computing", Oxford University Press, 2007.
5. Sutor, R. S., "Dancing with Qubits: How Quantum Computing Works and How It Can Change the World", Packt Publishing, 2019.

Ethics of AI						
Course Code:	26CAX08				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To learn about the ethical initiatives in the field of Artificial Intelligence and apply AI standards, regulations, and responsible deployment across society, industry, and law.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Outline the impact of AI on society, environment, psychology, and law.	Ap	20%
CO 2	Interpret international ethical frameworks applied to AI applications and case studies.	Ap	20%
CO 3	Examine AI standards, transparency, data privacy, and algorithmic bias in system design.	An	20%
CO 4	Implement moral theories and roboethics principles in robotics and ICT systems.	Ap	20%
CO 5	Assess challenges and opportunities in AI deployment for industries, medicine, and society.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1				3						3
CO 2		3					3		3	
CO 3	3					3		3		3
CO 4			3						3	
CO 5		3			3				3	
CO (W.A)	3	3	3	3	3	3	3	3	3	3

Unit- I : Introduction	**9**
Definition of morality and ethics in AI – Impact on society – Impact on human psychology – Impact on the legal system – Impact on the environment and the planet – Impact on trust.	
Unit- II : Ethical Initiatives in AI	**9**
International ethical initiatives – Ethical harms and concerns – Case study: healthcare robots, Autonomous Vehicles, Warfare and Weaponization.	
Unit- III : AI Standards and Regulation	**9**
Model Process for Addressing Ethical Concerns During System Design – Transparency of Autonomous Systems – Data Privacy Process – Algorithmic Bias Considerations – Ontological Standard for Ethically Driven Robotics and Automation Systems.	
Unit- IV : Roboethics	**9**
Robot – Roboethics – Ethics and Morality – Moral Theories – Ethics in Science and Technology – Ethical Issues in an ICT Society – Harmonization of Principles – Ethics and Professional Responsibility – Roboethics Taxonomy.	
Unit- V : Challenges and Opportunities	**9**
Challenges – Opportunities – Ethical issues in Artificial Intelligence – Societal Issues Concerning the Application of Artificial Intelligence in Medicine – Decision-making role in industries – National and International Strategies on AI – ChatGPT basics, Prompt Engineering.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Y. Eleanor Bird et al., “The Ethics of Artificial Intelligence: Issues and Initiatives”, EPRS European Parliamentary Research Service, PE 634.452, March 2020.
2. Patrick Lin, Keith Abney, George A. Bekey, “Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press, January 2014.
3. Paula Boddington, “Towards a Code of Ethics for Artificial Intelligence Artificial Intelligence: Foundations, Theory, and Algorithms”, Springer, November 2017.
4. Mark Coeckelbergh, “AI Ethics”, The MIT Press Essential Knowledge Series, April 2020.

Recommender Systems						
Course Code:	26CAX09				CIA	40
Course Type: (Theory/Practical/Integrated)	Theory				ESE	60
L:T:P:C	3	0	0	3	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To apply and evaluate recommender system techniques including collaborative filtering, content-based methods, and context-aware approaches for intelligent real-world applications.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Examine the concepts and applications of recommender systems.	Ap	20%
CO 2	Distinguish collaborative filtering models with content-based recommendation.	Ap	20%
CO 3	Conduct investigation about the issues in recommender systems and experimental setup.	An	20%
CO 4	Examine context-aware recommender system approaches based on their performance, properties, and evaluation settings.	An	20%
CO 5	Implement the knowledge sources and recommendation types.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1		3		3						3
CO 2		3							3	
CO 3	3			3	3	3				3
CO 4		3						3	3	
CO 5			3				3		3	
CO (W.A)	3	3	3	3	3	3	3	3	3	3

Unit- I : Introduction	**9**
Introduction – Recommender Systems Function – Data and Knowledge Sources – Recommendation Techniques – Application and Evaluation – Issues with Recommender Systems.	
Unit- II : Content-Based Recommendation	**9**
High-level architecture of content-based systems – Advantages and drawbacks of content-based filtering – Item Representation – Learning User Profiles and Filtering – Trends and Future Research – Neighborhood-based Recommendation – Components of Neighborhood Methods.	
Unit- III : Collaborative Filtering Based Recommendation	**9**
Preliminaries: Baseline predictors – The Netflix data – Implicit feedback – Matrix factorization models – Neighborhood models – Enriching neighborhood models – Between neighborhood and factorization – Constraint-based Recommenders.	
Unit- IV : Context-Aware Recommender Systems	**9**
Context in Recommender Systems – Paradigms for Incorporating Context in Recommender Systems – Combining Multiple Approaches – Case Studies – Additional Issues in Context-Aware Recommender Systems – Evaluating Recommender Systems: Experimental Settings – Recommendation System Properties.	
Unit- V : Evaluation Techniques	**9**
IPTV Architecture – Recommender System Architecture – Recommender Algorithms – Recommender Services – System Evaluation – Knowledge Sources – Domain Knowledge Sources – Mapping Domains to Technologies.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Charu C. Aggarwal, “Recommender Systems: The Textbook”, First Edition, Springer, 2016.
2. Francesco Ricci, Lior Rokach, Bracha Shapira, “Recommender Systems Handbook”, 3rd Edition, Springer, 2022.
3. Manouselis N., Drachsler H., Verbert K., Duval E., “Recommender Systems for Learning”, Springer, 1st Edition, 2013.
4. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich, “Recommender Systems: An Introduction”, Cambridge University Press, 1st Edition, 2011.

Bridge Courses (BC)

Semester - I

Problem Solving Techniques						
Course Code:	26CAW01				CIA	100
Course Type: (Theory/Practical/Integrated)	Theory				ESE	-
L:T:P:C	3	0	0	0	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To apply systematic problem solving approaches and fundamental algorithms to solve computational problems efficiently.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Understand the systematic approach of problem solving techniques for the given problem	U	20%
CO 2	Use the suitable approach and algorithms to solve the fundamental problems	Ap	20%
CO 3	Devise an efficient approach to solve specific factoring-related problems	Ap	20%
CO 4	Implement array techniques to perform the insert, delete and removal of duplicate elements in an array	Ap	20%
CO 5	Apply text processing and recursive algorithm techniques to implement text line justification, keyword searching and pattern matching	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	3									
CO 2	3	1							2	2
CO 3	3	1							2	2
CO 4	3	1								
CO 5	3	1						1	2	2
CO (W.A)	3	1						1	2	2

Unit- I : Introduction	**9**
Problem-Solving Aspect: Problem definition phase, Getting started on a problem, The use of specific examples, Working backwards from the solution – General problem-solving strategies - Problem solving using top-down design – Implementation of algorithms.	
Unit- II : Fundamentals of Algorithms	**9**
Exchanging the values of two variables – Counting - Summation of a set of numbers - Factorial computation - Reversing the digits of an integer – Base Conversion.	
Unit- III : Factoring Methods	**9**
Finding the square root of a number – The smallest divisor of an integer – Greatest common divisor of two integers - Generating prime numbers – Computing the prime factors of an integer.	
Unit- IV : Array Techniques	**9**
Array order reversal – Array counting or histograming – Finding the maximum number in a set - Removal of duplicates from an ordered array - Partitioning an array – Finding the k^{th} smallest element – Longest monotone subsequence.	
Unit- V : Text Processing and Pattern Searching	**9**
Text line length adjustment – Left and right justification of text – Keyword searching in text – Text line editing – Linear pattern search. Recursive algorithms: Towers of Hanoi – Permutation generation.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. R. G. Dromey, "How to Solve it by Computer", Pearson India, 2008.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson Freed, "Fundamentals of Data Structures in C", Universities Press, 2nd Edition, 2008.
3. George Polya, Jeremy Kilpatrick, "The Stanford Mathematics Problem Book: With Hints and Solutions", Dover Publications, 2009 (Kindle Edition 2013).
4. Greg W. Scragg, "Problem Solving with Computers: An Introduction to Computer Science", Jones & Bartlett Learning, 1st Edition, 1996.

C Programming						
Course Code:	26CAW02				CIA	100
Course Type: (Theory/Practical/Integrated)	Theory				ESE	-
L:T:P:C	3	0	0	0	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To develop programming skills in C by applying control structures, arrays, functions, structures, pointers, and file handling techniques to design and implement efficient solutions for real-time computational problems.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Implement the control structures in program development.	Ap	20%
CO 2	Apply arrays and functions to develop solutions for real-time problems.	Ap	20%
CO 3	Develop programs using structures to solve computational problems.	Ap	20%
CO 4	Use pointers to design solutions for real-time programming applications.	Ap	20%
CO 5	Perform file handling operations in C to manage data effectively.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	2									
CO 2	2								2	2
CO 3	2								2	2
CO 4	3			1						
CO 5	3	1		1					2	2
CO (W.A)	2	1		1					2	2

Unit- I : Fundamentals	**9**
Structure of a C program – Identifiers – Keywords – Data types – Variables – Constants – Operators – Input and Output operation. Control Structures – Conditional statements and switch statement- Goto statement - Looping statement – Break and Continue – nested for statement.	
Unit- II : Arrays and Functions	**9**
Arrays - Declaration of arrays – Initialization of arrays – processing with arrays. Functions: Function definition – Function call – Actual and formal arguments – Local and global variables – Function prototypes – types of functions – recursive functions.	
Unit- III : Structures	**9**
Structures – Advantages of structures – accessing elements of a structure – nested structures – array of structures – functions and structures.	
Unit- IV : Pointers	**9**
Pointers: pointer variable – pointer operator – pointer arithmetic – pointers and arrays – pointers and strings – array pointers – dynamic allocation	
Unit- V : Files	**9**
Files: File data type – opening and closing a file – file functions.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, *The C Programming Language (ANSI C)*, 2nd Edition, Pearson Education. (Latest Pearson reprint/eText edition, 2021).
2. Herbert Schildt, *C: The Complete Reference*, 4th Edition, McGraw-Hill Education, 2000. *(Still a standard reference; no newer edition is available.)*
3. R. G. Dromey, *How to Solve It by Computer*, Pearson Education India, Reprint Edition, 2007.
4. Yashavant Kanetkar, *Let Us C*, 21st Edition, BPB Publications, 2025.

Semester-II

Software Engineering						
Course Code:	26CAW03				CIA	100
Course Type: (Theory/Practical/Integrated)	Theory				ESE	-
L:T:P:C	3	0	0	0	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					
Course Objectives						
• To apply software engineering principles for effective software development.						

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Compare the process frameworks of the software process models such as waterfall, incremental, and spiral.	Ap	20%
CO 2	Analyze the requirements engineering process, including feasibility study, elicitation, validation, and management of requirements.	Ap	20%
CO 3	Design UML diagrams such as class, sequence, use case, and component diagrams.	Ap	20%
CO 4	Perform black-box, white-box, validation, and system testing for the given programming construct.	Ap	20%
CO 5	Assess software risks and quality management practices.	Ap	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	1	3			1	2				
CO 2	1	3	3		1				2	2
CO 3	1	3		3	1				2	2
CO 4	1	3		3	1					
CO 5	1	3			1		2	3	2	2
CO (W.A)	1	3			1		2	3	2	2

Unit- I : Introduction to Software Engineering	**9**
Evolving role of software - Generic view of process - a layered technology - a process framework - Process models: The waterfall model, Incremental model, Spiral model.	
Unit- II : Software Requirements	**9**
Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management.	
Unit- III : Design Engineering	**9**
Creating an architectural design: architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.	
Unit- IV : Testing Strategies	**9**
A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.	
Unit- V : Risk Management	**9**
Reactive vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM. Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Roger S. Pressman, Software Engineering - A Practitioner's Approach, 6th Edition, McGraw Hill International Edition.
2. Ian Somerville, Software Engineering, 7th Edition, Pearson Education.

Computer Organization						
Course Code:	26CAW04				CIA	100
Course Type: (Theory/Practical/Integrated)	Theory				ESE	-
L:T:P:C	3	0	0	0	Total Marks	100
Total Hours of Pedagogy	45				Exam Hours	3
Pre-requisites	NIL					

Course Objectives

- To provide knowledge about digital logic, computer organization, processor architecture, instruction execution, and memory management.

Course Outcomes		Cognitive Level	Weightage of COs in ESE
CO 1	Design digital circuits by simplifying Boolean functions	AP	20%
CO 2	Apply computer organizations principles to explain interaction among functional units during program execution.	AP	20%
CO 3	Apply addressing modes and instruction formats to determine operand access during program execution.	AP	20%
CO 4	Examine the designing and processor organization	AP	20%
CO 5	Perform mapping between virtual and physical memory	AP	20%

Mapping of COs with POs / PSOs

COs	POs								PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO 1	1	3			1	2				
CO 2	1	3	3		1				2	2
CO 3	1	3		3	1				2	2
CO 4	1	3		3	1					
CO 5	1	3			1		2	3	2	2
CO (W.A)	1	3	3	3	1	2	2	3	2	2

Unit- I : Digital Fundamentals	**9**
Number Systems and Conversions – Boolean Algebra and Simplification – Minimization of Boolean Functions – Logic Gates – NAND – NOR Implementation.	
Unit- II : Basic Structure of Computers	**9**
Functional units – Basic operational concepts – Bus structures – Performance and Metrics – Instruction and instruction sequencing – Hardware – Software Interface.	
Unit- III : Addressing Modes and ALU	**9**
Addressing modes – Instructions sets – RISC and CISC – ALU design – Fixed point and Floating point operation.	
Unit- IV : Processor Design	**9**
Processor basics – CPU Organization – Data path design – Control design – Basic concepts – Hard wired control – Micro programmed control – Pipeline control.	
Unit- V : Memory and I/O System	**9**
Memory systems – Virtual memory – Caches – Design methods – Associative memories – Input / Output system – Programmed I/O – DMA and Interrupts.	
	Total (L : 45)

Suggested Learning Resources

Reference Books:

1. Morris Mano, “Digital Design”, Fourth Edition, Prentice Hall of India, 2007.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw Hill, 2002.
3. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Eighth Edition, Pearson Education, 2010.