CMS COLLEGE OF ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
(Affiliated to Anna University | Approved by AICTE |Accredited by NAAC – 'A' Grade)
Appachigoundenpathy, Kummittipathi (PO), Coimbatore – 641 032.

REGULATIONS 2026

Curriculum & Syllabus.

M.E. – Computer Science and Engineering.

Applicable to the students admitted during the Academic year 2026 – 2027 onwards.

CMS COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

(Affiliated to Anna University, Chennai | Approved by AICTE |
Accredited by NAAC – 'A' Grade
Appachigoundenpathy, Kummittipathi (PO), Coimbatore – 641 032.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.E. – Computer Science and Engineering

CHOICE BASED CREDIT SYSTEM(CBCS)

Regulations 2026

Curriculum & Syllabus

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

INSTITUTION VISION:

A Centre of excellence, capable of empowering seekers of knowledge through holistic education.

INSTITUTION MISSION:

Create worthy citizens by providing holistic, qualitative, value based education and makes them creative members of global society.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION:

To achieve academic excellence in Computer science engineering by imparting in depth knowledge to the students, facilitating research activities and to produce comprehensive knowledge seekers and human individuals, capable of building a strong and developed nation.

MISSION:

- To establish a continuous Industry Institute Interaction to make students ready for the industrial environment.
- To enhance talents of the students in the field of Software and Service industries, in not only getting employment, but also in establishing the industries.
- To create center of Excellence by establishing the Incubation Centers to meet global research Challenges.
- Imparting education that encourages rapport building with other professionals to cater the needs of the society.

POSTRGRADUATE AUTONOMOUS CURRICULUM

Programme: M.E. Computer Science and Engineering **Regulations:2026**

Abbreviations:

BS – Basic Sciences(Mathematics)	**L** – Laboratory Course
ES – Engineering Science	**T** – Theory Course
PC-Programme Core,	**LIT** – Laboratory Integrated Theory
PE-Programme Elective	**PW** – Project Work
SD – Skill Development	**TCP** – Total Contact Period(s)
SL –Self-Learning	

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop proficiency as a computer science engineer with an ability to solve a wide range of computational problems and have sustainable development in industry or any other work environment

PEO2: Analyze and adapt quickly to new environments and technologies, gather new information, and work on emerging technologies to solve multidisciplinary engineering problems.

PEO3: Possess the ability to think analytically and logically to understand technical problems with computational systems for a lifelong learning which leads to pursuing research

PEO4: Adopt ethical practices to collaborate with team members and team leaders to build technology with cutting-edge technical solutions for computing systems

PEO5: Strongly focus on design thinking and critical analysis to create innovative products and become entrepreneurs

PROGRAM OUTCOMES (POs)

1. An ability to independently carry out research /investigation and development work to solve practical problems
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Advanced Computing and Problem Solving: Analyze, design, and implement advanced algorithms, architectures, and computational models to develop sustainable and scalable solutions, aligning with industry and societal needs to solve complex problems in diverse domains.

PSO2: Research and Innovation Competence: Undertake independent research and apply advanced tools and methodologies to propose innovative solutions for real-world and interdisciplinary computing challenges, demonstrating research aptitude.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

M.E. COMPUTER SCIENCE AND ENGINEERING

REGULATION 2026

CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER – I

S.No.	Course Code	Course Name	Course Type	L - T - P - J	TCP	Credits	Category
1.	26PMA101	Advanced Mathematical Methods (CSIE)	T	3 - 1 - 0 - 0	4	4	BS
2.	26PCS101	Advanced Data Structures and Algorithms	LIT	3 - 0 -4 - 0	7	5	ES (PC)
3.	26PCS102	Advanced Database Technologies	T	3 - 0 - 0 - 0	3	3	ES (PC)
4.	26PCS103	Modern Operating Systems and Virtualization	T	3 - 0 - 0 - 0	3	3	ES (PC)
5.	26PCS104	Research Methodology and IPR	T	3 - 0 - 0 - 0	3	3	ES (PC)
6.	26PCS105	Machine Learning	T	3 - 0 - 0 - 0	3	3	ES (PC)
7.	26PCSS01	Technical Seminar	-	0 - 0 -2 - 0	2	1	SD
8		Self-Learning Courses	-	-	-	-	SL
						22	

SEMESTER – II

S.No.	Course Code	Course Name	Course Type	L - T - P - J	TCP	Credits	Category
1.	26PCS201	Multicore Architectures	T	3 - 0 - 0 - 0	3	3	ES (PC)
2.	26PCS202	Information and Cyber Security	T	3 - 0 - 0 - 0	3	3	ES (PC)
3.	26PCS203	Cloud and Big Data Analytics	LIT	3 - 0 - 2 - 0	5	4	ES (PC)
4.	26PCS204	Quantum Computing	T	2 - 0 - 0 - 0	2	2	ES (PC)
5.		Programme Elective I	T	3 - 0 - 0 - 0	3	3	ES (PE)
6.	26PCSS02	Industrial Training	-	-	-	2	SD
7.	26PCSS03	Mini Projects	-	-	-	2	SD
8.		Self-Learning Course		-	-	1	SD
						20	

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

SEMESTER – III

S.No.	Course Code	Course Name	Course Type	L - T - P - J	TCP	Credits	Category
1.		Programme Elective II	T	3 - 0 - 0 - 0	3	3	ES(PE)
2.		Programme Elective III	T	3 - 0 - 0 - 0	3	3	ES(PE)
3.		Programme Elective IV	T	3 - 0 - 0 - 0	3	3	ES(PE)
4.		Programme Elective V	T	3 - 0 - 0 - 0	3	3	ES(PE)
5.	26PCSS04	Industrial Training	-	-	-	1	SD
6.	26PCSS05	Project Work I	-	0 - 0 - 0 - 12	12	6	SD
						19	

SEMESTER – IV

S.No.	Course Code	Course Name	Course Type	L - T - P - J	TCP	Credits	Category
1.	26PCSS06	Project Work II	PW	0 - 0 - 0 - 24	24	12	SD
					24	**12**	

Total Credits: 73

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

PROGRAMME ELECTIVE COURSES

S.No.	Course Code	Course Name	Course Type	L - T - P - J	TCP	Credits	Category
1.	26CSP901	Advanced Software Testing and Quality Assurance	T	3 - 0 - 0 - 0	3	3	ES(PE)
2.	26CSP902	Agile Methodologies	T	3 - 0 - 0 - 0	3	3	ES(PE)
3.	26CSP903	Web of Things	T	3 - 0 - 0 - 0	3	3	ES(PE)
4.	26CSP904	Text and Speech Processing	T	3 - 0 - 0 - 0	3	3	ES(PE)
5.	26CSP905	Advanced Deep Learning and Neural Networks	T	3 - 0 - 0 - 0	3	3	ES(PE)
6.	26CSP906	Quantum Cryptography	T	3 - 0 - 0 - 0	3	3	ES(PE)
7.	26CSP907	Quantum Machine Learning	T	3 - 0 - 0 - 0	3	3	ES(PE)
8.	26CSP908	AI in IoT	T	3 - 0 - 0 - 0	3	3	ES(PE)
9.	26CSP909	Web 3.0	T	3 - 0 - 0 - 0	3	3	ES(PE)
10.	26CSP910	Advanced Large Language Models	T	3 - 0 - 0 - 0	3	3	ES(PE)
11.	26CSP911	Edge and Fog Computing	T	3 - 0 - 0 - 0	3	3	ES(PE)
12.	26CSP912	Green Computing and Sustainability	T	3 - 0 - 0 - 0	3	3	ES(PE)
13.	26CSP913	Cognitive Computing	T	3 - 0 - 0 - 0	3	3	ES(PE)
14.	26CSP914	Agentic AI	T	3 - 0 - 0 - 0	3	3	ES(PE)
15.	26CSP915	Mixed Reality	T	3 - 0 - 0 - 0	3	3	ES(PE)
16.	26CSP916	Block chains Architecture and Design	T	3 - 0 - 0 - 0	3	3	ES(PE)
17.	26CSP917	Human-Centered AI	T	3 - 0 - 0 - 0	3	3	ES(PE)
18.	26CSP918	Vibe Coding	T	3 - 0 - 0 - 0	3	3	ES(PE)
19.	26CSP919	Federated Learning	T	3 - 0 - 0 - 0	3	3	ES(PE)
20.	26CSP920	Deep Learning for Computer Vision	T	3 - 0 - 0 - 0	3	3	ES(PE)
21.	26CSP924	Advanced Compiler Design	T	3 - 0 - 0 - 0	3	3	ES(PE)

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PMA101	Advanced Mathematical Methods (CSIE)	T	L	T	P	J	C
			3	1	0	0	4

Course Objectives

1	Develop an in-depth understanding of advanced concepts in linear algebra, multivariate analysis, and number theory for computer science applications.
2	Apply mathematical tools such as eigenvalue decomposition, SVD, and multivariate statistical methods to real-world computing and data-driven problems.
3	Analyze and implement number-theoretic techniques for cryptography, security, and algorithmic problem-solving in computer science.

Syllabus

Linear Algebra — **15 Hours**

Vector spaces, norms, Inner Products, Eigenvalues using QR transformations, QR factorization, generalized eigenvectors, Canonical forms, singular value decomposition and applications, pseudo inverse, least square approximations.

Activity:

Assignment : Matrix Decomposition and Least-Squares Error Optimization.

Quiz: Objective-Type Test.

Multivariate Analysis — **15 Hours**

Random vectors and matrices, Mean vectors and covariance matrices, Multivariate normal density and its properties, Principal components, Population principal components, Principal components from standardized variables.

Activity:

Assignment : Dimensionality Reduction and Principal Component Analysis (PCA).

Quiz: Objective-Type Test.

Elementary Number Theory — **15 Hours**

The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences; Principles of mathematical induction and well ordering principle. Primality Testing algorithms, Chinese Remainder Theorem, Quadratic Congruence.

Activity:

Assignment : Modular Congruences and Simultaneous Equation Solving.

Quiz: Objective-Type Test.

Advanced Number Theory — **15 Hours**

Advanced Number Theory, Primality Testing algorithms, Chinese Remainder Theorem, Quadratic Congruence, Discrete Logarithm, Factorization Methods, Side Channel Attacks, Shannon Theory, Perfect Secrecy, Semantic Security.

Activity:

Assignment : Public-Key Cryptosystem Security Audit.

Quiz: Objective-Type Test.

Total Lecture Periods: 60 Hours

References:	
1	Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning.
2	Richard A. Johnson & Dean W. Wichern, Applied Multivariate Statistical Analysis,Pearson.
3	Neal Koblitz, A Course in Number Theory and Cryptography, Springer.
4	Victor Shoup, A Computational Introduction to Number Theory and Algebra, Cambridge University Press.
E-resources:	
1	https://ocw.mit.edu/courses/18-06-linear-algebra
2	https://nptel.ac.in/courses/111105041
3	https://crypto.stanford.edu/pbc/notes/numbertheory

Course Outcomes	
CO No.	**Course Outcomes**
1	Apply linear algebra techniques for computational problem-solving
2	Analyze multidimensional data using statistical methods and PCA.
3	Utilize number theory and modular arithmetic in mathematical computations.
4	Assess cryptographic algorithms and security concepts based on advanced number theory.

CO	PO1	PO2	PO3	PSO1	PSO2
1	3	–	3	3	1
2	3	–	3	3	2
3	2	–	3	3	1
4	3	2	3	3	2
AVG	2.75	0.50	3.00	3.00	1.50

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS101	Advanced Data Structures and Algorithms	LIT	L	T	P	J	C
			3	0	4	0	5

Course Objectives

1	To explore advanced linear, tree, and graph data structures and their applications.
2	To design efficient algorithms using appropriate algorithmic paradigms.
3	To evaluate computational complexity and identify tractable vs. intractable problems.

Syllabus

Linear Data Structures and Memory Optimization: **18 Hours**

Advanced arrays: Sparse arrays, dynamic arrays, cache-aware structures, Linked lists: Skip lists, unrolled linked lists, XOR linked lists, Stacks and Queues: Priority queues, double-ended queues, circular buffers, Hashing: Perfect hashing, cuckoo hashing, extendible hashing. Optimizing E-Commerce Product Search Using Advanced Linear Data Structures and Memory-Efficient Techniques–Use case.

Activities: Memory Race, Hash Table Challenge, Data Structure Selection Game

Practicals:

- Implement skip lists and measure performance compared with balanced BST.
- Experiment with cache-aware data structures and analyze memory utilization.

Advanced Tree Data Structures **18 Hours**

Balanced Trees: AVL, Red-Black Trees, Splay Trees, Treaps, Scapegoat Tree Multi-way Trees: B-Trees, B+ Trees, R-Trees, Segment Trees, Fenwick Trees, Suffix Trees and Tries for string processing, Applications in indexing, text retrieval, computational geometry.

Activities: Tree Construction Workshop, Database Indexing Activities, ange Query Competition

Practicals:

- Implement B+ tree for database indexing use-case.
- Design a suffix tree-based algorithm for DNA sequence matching.

Graph Data Structures and Algorithms **18 Hours**

Representation: Adjacency list/matrix, incidence matrix, compressed storage, Traversals: DFS, BFS with applications, Shortest Path Algorithms: Dijkstra, Bellman-Ford, Floyd-Warshall, Johnson's algorithm, Minimum Spanning Trees: Prim's, Kruskal's, Borůvka's algorithm, Network Flow Algorithms: Ford-Fulkerson, Edmonds-Karp, Push-Relabel. Implementing Algorithms with Time and Space Complexity –Use case.

Activities: Campus Navigation, Traffic Flow Simulation

Practicals:

- Implement Johnson's algorithm for sparse graph shortest paths.
- Demonstration of Maximum flow in traffic or network routing simulation.

Algorithm Design and Paradigms	**17 Hours**

Divide and Conquer: Karatsuba's multiplication, Strassen's algorithm, Greedy Methods: Huffman coding, interval scheduling, set cover approximation, Dynamic Programming: Matrix chain multiplication, Floyd-Warshall, knapsack variants, Backtracking and Branch-and-Bound, Randomized Algorithms and Probabilistic Analysis.

Activities: Algorithm Strategy Game, Huffman Coding Activities.

Practicals:

- Implement Strassen's algorithm and compare with naive matrix multiplication.
- Develop a randomized algorithm for primality testing (Miller–Rabin).

Computational Complexity and Approximation Algorithms	**17 Hours**

Complexity Classes: P, NP, NP-Complete, NP-Hard, Reductions: Polynomial-time reductions, Cook-Levin theorem (overview), Approximation Algorithms: Vertex cover, set cover, TSP, k-center problem, Heuristic Algorithms: Local search, simulated annealing, genetic algorithms.

Activities: Complexity Classification Quiz, Traveling Salesperson Challenge, Debate Session

Practicals:

- Implement approximation algorithm for vertex cover.
- Complexity analysis of a chosen NP-hard problem and implement a heuristic.

Advanced Topics and Emerging Trends	**17 Hours**

Randomized Algorithms – Monte Carlo Algorithms, Parallel and Distributed Algorithms – PRAM Model, Divide and Conquer in Parallel, Load Balancing, Streaming Algorithms – Data Stream Models, Sketching and Sampling, Frequency Moments, Advanced String Matching – Suffix Trees, Suffix Arrays, Pattern Matching in Linear Time.

Activities: String Matching Challenge, Parallel Programming Challenge

Practicals:

- Implement randomized and streaming algorithms on real-world datasets.
- Design of parallel and distributed algorithms.

Total Lecture Periods: 45 Hours

Total Laboratory Periods: 60 Hours

Reference:

1	Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to algorithms. MIT Press.
2	La Rocca, M. (2021). Advanced algorithms and data structures. Manning Publications.
3	Goodrich, M. T., Tamassia, R., & Mount, D. M. (2011). Data structures and algorithms in C++. John Wiley & Sons, Inc.

4	Weiss, M. A. (2014). Data structures and algorithm analysis in C++. Pearson Education.
5	Drozdek, A. (2013). Data structures and algorithms in C++. Cengage Publications.
E-resources:	
1	https://www.theiotacademy.co/blog/data-structures-and-algorithms-in-c/
2	https://github.com/afrid18/Data_structures_and_algorithms_in_cpp
3	https://www.udemy.com/course/introduction-to-algorithms-and-data-structures-in-c/?srsltid=AfmBOorEZlkgV7QzaEh6IqzAaKLjC-IpFU1NGgWFoHMLhOos-UDVKjCK

Course Outcomes	
CO No.	**Course Outcomes**
1	Recall and explain the principles, characteristics, and operations of advanced data structures and algorithmic techniques.
2	Apply advanced linear, tree, and graph data structures to solve computational and real-world problems.
3	Analyze the performance, memory utilization, and complexity of various data structures and algorithms.
4	Evaluate different algorithmic approaches, including exact, approximation, and heuristic methods, for solving complex problems.
5	Design and develop efficient solutions using advanced algorithm design paradigms such as divide-and-conquer, dynamic programming, randomized, and parallel algorithms.
6	Implement and compare modern techniques such as streaming, distributed, and advanced string processing algorithms for large-scale applications.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	2	3	2	1
2	2	1	3	3	2
3	3	2	3	3	2
4	3	2	3	3	3
5	3	2	3	3	3
6	3	3	3	3	3
Avg	2.50	2.00	3.00	2.83	2.33

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

26PCS102	Advanced Database Technologies	T	L	T	J	C
			3	0	0	3

Course Objectives

1	To strengthen the understanding of enhanced ER models and their transformation into relational models with indexing and file structures.
2	To understand object-oriented and object-relational database concepts and querying using OQL.
3	To explore techniques in query processing, execution, and optimization strategies.

Syllabus

Entity Relationship Model	**8 Hours**
Entity Relationship Model Revised-Subclasses, Superclasses and Inheritance - Specialization and Generalization-Union Types Aggregation. **Activity:**Design ER Model for a specific use case.	
Enhanced Entity Relational Model	**9 Hours**
Relational Model Revised, Converting ER and EER Model to Relational Model-SQL and Advanced Features, File Structures, Hashing, and Indexing. **Activity:**Demonstration of SQL Implementation.	
Object Relational Databases	**9 Hours**
Object Database Concepts-Object Database Extensions to SQL, The ODMG Object Model and ODL, Object Database Conceptual Design-Object Query Language OQL-Language Binding in the ODMG Standard. **Activity:**Demonstration of Object Query Language.	
Query Processing and Optimization, Distributed Databases	**9 Hours**
Query Processing, Query Trees and Heuristics, Query Execution Plans, Cost Based Optimization. Real-Time Bidding, E-mail Marketing, Affiliate Marketing, Social Marketing Mobile Marketing, Distributed Database Concepts, Data Fragmentation, Replication and Allocation, Distributed Database Design Techniques, Distributed Database Design Techniques, Distributed Database Architectures. **Activity:**Design of Query Evaluation Plans.	
NOSQL Systems and Bigdata, Advanced Database Models	**10 Hours**
Introduction to NOSQL Systems-The CAP Theorem, Document, based NOSQL Systems, Key-value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Deductive Database Concepts, Introduction to Information Retrieval and Web Search. **Activity:**Demonstration of Concurrency cloud and Transactions.	
Total Lecture Periods: 45 Hours	

E-resources:	
1	https://www.edx.org/learn/sql/stanford-university-databases-advanced-topics-in-sql
2	https://www.coursera.org/courses?query=sql&productDifficultyLevel=Advanced
References:	

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

1	Elmasri, R., & Navathe, S. B. (2016). Fundamentals of database systems. Pearson Education.
2	Silberschatz, A., Korth, H. F., & Sudarshan, S. (2020). Database system concepts, McGraw Hill Education.
3	Ceri, S., & Pelagatti, G. Distributed databases: Principles and systems. McGraw Hill.
4	Ramakrishnan, R., & Gehrke, J. (2004). Database management systems. McGraw Hill.

Course Outcomes	
CO No.	**Course Outcomes**
1	Recall the concepts of Entity Relationship models, Enhanced ER models, relational models, object-oriented databases, and advanced database systems.
2	Explain the principles of database design, query processing, distributed databases, NoSQL systems, and Big Data technologies.
3	Apply database modeling techniques, SQL, OQL, indexing methods, and database tools to develop database applications.
4	Analyze query execution plans, optimization techniques, transaction processing, and distributed database architectures to improve database efficiency.
5	Evaluate different database models, NoSQL systems, and distributed database approaches based on application requirements.
6	Design and implement advanced database solutions using modern database technologies, NoSQL platforms, and Big Data frameworks.

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
1	1	2	3	2	1
2	1	2	3	2	1
3	2	1	3	3	2
4	3	2	3	3	2
5	3	2	3	3	3
6	3	3	3	3	3
AVG	2.17	2.00	3.00	2.67	2.00

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS103	Modern Operating Systems and Virtualization	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To analyze the architectures and design issues of advanced operating systems.
2	To develop the model for process synchronization and recovery in complex environments
3	To evaluate algorithms for distributed coordination, resource management, fault tolerance, and security.

Syllabus

Advanced Process and Thread Management	**9 Hours**
Multithreading models, thread pools, context switching, Synchronization issues and solutions: semaphores, monitors, lock free data structures, CPU scheduling in multi-core systems. **Activity:**CPU scheduler simulation for multicore systems.	
Memory and Resource Management,Virtualization and Containerization	**9 Hours**
Virtual memory, demand paging, page replacement policies-Huge pages, NUMA-aware memory management-Resource allocation in cloud-native environments, Hypervisors (Type I & II), KVM, QEMU, Xen Containers: Docker, LXC, systemd-nspawn-OS-level virtualization and namespaces. **Activity:**Simulate demand paging and page replacement algorithms.	
Distributed Operating Systems and File Systems, Security and Trust	**9 Hours**
Distributed scheduling, communication, and synchronization-Distributed file systems: NFS, GFS, HDFS Transparency issues and fault tolerance. Access control models: DAC, MAC, RBAC-OS hardening techniques, sandboxing, SELinux, AppArmor-Secure boot, rootkit detection, trusted execution environments. **Activity:**Deploy and configure Docker containers with various images, Simulate distributed process synchronization.	
Real-Time and Embedded Operating Systems	**9 Hours**
Real-time scheduling algorithms (EDF, RM)-POSIX RT extensions, RTOS architecture- TinyOS, FreeRTOS case studies. **Activity:**Implement Role-Based Access Control (RBAC) using Linux user and group permissions.	
Edge and Cloud OS: Future Paradigms	**9 Hours**
Serverless OS, unikernels, lightweight OS for edge computing-Mobile OS internals (Android, iOS)-OS for quantum and neuromorphic computing (intro). **Activity:**Analyze FreeRTOS task scheduling behavior, Analyze Android's system architecture using emulator tools.	
Total Lecture Periods: 45 Hours	

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Tanenbaum, A. S., & Bos, H. (2023). Modern operating systems. Pearson.
2	Buyya, R., et al. (2022). Content delivery networks and emerging operating systems. Springer.
3	Silberschatz, A., Galvin, P. B., & Gagne, G. (2022). Operating system concepts. Wiley
4	Anderson, T., & Dahlin, M. (2021). Operating systems: Principles and practice. Recursive Books.
5	Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C. (2020). Operating systems: Three easy pieces.
E - Resources:	
1	Prof. Smruti Ranjan Sarangi, "Advanced Distributed Systems", IIT Delhi, NPTEL, https://onlinecourses.nptel.ac.in/noc22_cs80/preview
2	Prof. Rajiv Misra, "Cloud Computing and Distributed Systems", IIT Patna, NPTEL, https://nptel.ac.in/courses/106104182

Course Outcomes	
CO No.	**Course Outcomes**
1	Recall the concepts of advanced process management, memory management, virtualization, distributed systems, and modern operating system architectures.
2	Explain the principles of multithreading, synchronization mechanisms, resource management, security models, and real-time operating systems.
3	Apply operating system concepts such as CPU scheduling, memory allocation, containerization, and access control mechanisms to solve system-level problems.
4	Analyze the performance of scheduling algorithms, virtual memory techniques, distributed systems, and real-time operating systems under different environments.
5	Evaluate various operating system approaches including virtualization, security frameworks, cloud, edge, and embedded OS based on application requirements.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	–
2	2	–	2	2	1
3	3	1	3	3	1
4	3	2	3	3	2
5	2	2	3	3	2
AVG	2.20	1.67	2.60	2.60	1.50

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS104	Research Methodology And IPR	T	L	T	P	J	C
			2	0	0	0	2

Course Objectives

1	To equip students with the knowledge and skills required to conduct scientific research systematically, analyze and report research outcomes ethically, and understand Intellectual Property Rights and patenting procedures for protecting innovations and research contributions.

Syllabus

Research Problem Formulation	**4 Hours**
Objectives of research, types of research, research process, approaches to research; conducting literature review – information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap.	
Research Design And Data Collection	**6 Hours**
Statistical design of experiments types and principles; data types & classification; data collection – methods and tools.	
Data Analysis, Interpretation And Reporting	**10 Hours**
Sampling, sampling error, measures of central tendency and variation; test of hypothesis- concepts; data presentation types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research.	
Intellectual Property Rights And Patents	**10 Hours**
Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, copy rights, applicability of these IPR; IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance. Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process – patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.	
Total Lecture Periods: 30 Hours	

References:

1	Cooper Donald R., Schindler Pamela S. and Sharma J. K., 'Business Research Methods'. Eleventh edition, Tata McGraw Hill Education, 2012.
2	Soumitro Banerjee, 'Research methodology for natural sciences. IISc Press, Kolkata, 2022.
3	Catherine J. Holland, 'Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets'. Entrepreneur Press, 2007.
4	David Hunt, Long Nguyen, Matthew Rodgers, 'Patent searching: tools & techniques'. Wiley, 2007
5	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, 'Professional Programme Intellectual Property Rights, Law and

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

	practice'. September 2013.
E - Resources:	
1	**IEEE Xplore Digital Library** – https://ieeexplore.ieee.org
2	**WIPO Academy** – https://www.wipo.int/academy
3	**Indian Patent Office** – https://ipindia.gov.in
4	**Mendeley Reference Manager** – https://www.mendeley.com

Course Outcomes	
CO No.	**Course Outcomes**
1	Outline the principles of research problem formulation, research design, data Bloom's Level CO2 collection, the basic features and significance of IPR.
2	Utilize research methodology principles to develop a research plan, conduct literature reviews, analyze data using appropriate statistical methods, and prepare structured research reports or proposals following ethical guidelines.

CO	PO1	PO2	PO3	PSO1	PSO2
1	2	1	2	1	2
2	3	3	2	2	3
AVG	2.50	2.00	2.00	1.50	2.50

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS105	Machine Learning	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	Understand the fundamental concepts, types, processes, and evaluation techniques of machine learning.
2	Apply supervised learning algorithms and mathematical foundations for solving regression and classification problems.
3	Analyze tree-based learning, ensemble methods, clustering, and dimensionality reduction techniques for data analysis.
4	Explain reinforcement learning principles, probabilistic graphical models, and sequential learning methods.
5	Develop neural network and deep learning models using perceptrons, multilayer networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs) for intelligent applications.

Syllabus

Machine Learning Fundamentals — **9 Hours**

Machine learning, Types of machine learning: Supervised learning – Unsupervised learning, Machine learning process, Model evaluation and testing, Parametric vs nonparametric models.

Activity: Draw and explain the complete machine learning workflow from data collection to model evaluation.

Supervised Learning Methods — **9 Hours**

Basics of learning theory: Concept learning – Hypothesis space – Bias-variance tradeoffs, Mathematical basics for machine learning: Bayes' theorem – Conditional probability and basic statistics, Introduction to probability distributions, Decision theory, Information theory, Regression: Introduction – Linear regression – Least squares – Under fitting and overfitting – Cross validation – Lasso regression – Logistic regression, Classification: Linear and nonlinear models – Support vector machines – Kernel methods – K-Nearest neighbors, Evaluation of classification algorithms.

Activity: Implement Linear Regression and Logistic Regression on a sample dataset and compare their performance.

Tree-Based And Unsupervised Learning — **9 Hours**

Learning with trees: Constructing decision tree using ID3 – Classification and Regression Trees (CART), Decision by committee: Ensemble methods – Bagging – Boosting – Random forest, Clustering – K-means – Mixtures of gaussians – Vector quantization – The self-organizing feature map, Dimensionality reduction: Linear discriminant analysis – Principal components analysis – Independent components analysis.

Activity: Group a set of objects (fruits, stationery, or animals) based on similar characteristics to understand the concept of clustering.

Reinforcement And Probabilistic Models — **9 Hours**

Reinforcement learning: Q learning – Deterministic and nondeterministic rewards and actions – Temporal difference learning – Markov decision process, Introduction to graphs, Inference in graphical models, Bayesian belief networks, Markov chain, Markov model, Hidden Markov Models (HMM), Inference, Learning, Generalization.

Activity: Draw a simple state-transition diagram to illustrate the concept of a

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Markov model.	
Neural Networks And Deep Learning	**9 Hours**
Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions-Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases. **Activity:**Present a case study on the use of deep learning in applications such as image recognition, speech recognition, or healthcare.	
Total Lecture Periods: 45 Hours	

References:	
1	Tom M. Mitchell, 'Machine Learning'. Affiliated East-West Press Pvt. Ltd., 2025.
2	Ethem Alpaydin, 'Introduction to Machine Learning'. Third edition, Prentice Hall of India, 2005.
3	Stephen Marsland, 'Machine Learning – An Algorithmic Perspective'. Chapman and Hall, CRC Press, 2015.
4	Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, 'Mathematics for Machine Learning'. Cambridge University Press, 2020.
5	Kevin P. Murphy, 'Machine Learning: A Probabilistic Perspective'. MIT Press, 2012.
E - Resources:	
1	**Coursera – Machine Learning Specialization** https://www.coursera.org/specializations/machine-learning-introduction
2	**Stanford Online – Machine Learning Courses** https://online.stanford.edu/courses?keywords=machine+learning

Course Outcomes	
CO No.	**Course Outcomes**
1	Explain the fundamentals of machine learning, different learning paradigms, model evaluation techniques, and parametric/nonparametric approaches.
2	Apply supervised learning algorithms, probability theory, regression, and classification techniques to develop predictive machine learning models.
3	Analyze and implement decision trees, ensemble learning methods, clustering algorithms, and dimensionality reduction techniques for data mining applications.
4	Demonstrate reinforcement learning algorithms and probabilistic graphical models, including Bayesian Networks, Markov Models, and Hidden Markov Models, for sequential decision-making problems.
5	Design and implement neural network and deep learning models, including Perceptron, Multilayer Perceptron (MLP), Convolutional Neural Networks (CNNs), and Recurrent Neural Networks (RNNs), to solve real-world intelligent computing problems.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	1	3	2	1
2	2	1	3	3	2
3	3	1	3	3	2
4	3	2	3	3	3
5	3	2	3	3	3
AVG	2.40	1.40	3.00	2.80	2.20

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS201	Multicore Architectures	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course enables students to learn parallel programming models, tools, and techniques using shared and distributed memory systems. The course emphasizes the implementation and performance evaluation of parallel applications using OpenMP and MPI.

Syllabus

Multicore Systems and Architectures — **9 Hours**

Evolution from Single-core to Multicore Systems - SIMD vs MIMD Architectures - Shared and Distributed Memory Systems - Cache Coherence and Memory Consistency.

Activities:

- Draw and compare the architecture of single-core and multicore processors.
- Discuss the advantages of multicore systems in everyday applications (e.g., smartphones, laptops).

Thread Management and Synchronization Techniques — **9 Hours**

Synchronization primitives: Mutex - Locks - Semaphores - Data races and deadlocks - Inter-thread communication: Condition variables- Pipes.

Activity: Conduct a role-play where students simulate multiple threads sharing a common resource to understand synchronization, data races, and deadlocks.

Parallel Programming using OpenMP for Shared Memory — **7 Hours**

OpenMP architecture and memory model - Directives and work-sharing constructs - Parallelizing Loops and Task Management - Performance optimization.

Activity: Divide a simple task (such as arranging books or sorting cards) among student groups to demonstrate the concept of parallel execution and workload sharing.

Message Passing Programming with MPI: — **9 Hours**

MPI programming concepts - Point-to- point and collective communication - Derived data types and synchronization - Performance tuning.

Activity: Organize a message-passing game where students pass information between groups to illustrate point-to-point and collective communication.

Evaluating Parallel Performance and Scalability: — **11 Hours**

Measuring and analyzing performance - Scalability metrics - Use of Profiling Tools for Performance Bottlenecks. Tree search, N-body simulation, graph algorithms - Comparative Analysis of OpenMP and MPI Implementations - Trends in multicore and manycore processors.

Activity: Compare the time taken by individuals versus teams to complete the same task and discuss concepts such as speedup, scalability, and performance bottlenecks.

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Text Books:	
1	Michael J. Quinn, Parallel Programming in C with MPI and OpenMP, McGrawHill, 2004.
2	Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.
3	Victor Alessandrini, Shared Memory Application Programming, Morgan Kaufmann, 2015.
4	Rohit Chandra et al., Parallel Programming in OpenMP, Morgan Kaufmann, 2000
5	Gerassimos Barlas, Multicore and GPU Programming, Morgan Kaufmann, 2014.
Reference:	
1	NPTEL Course: https://nptel.ac.in/courses/106104189
2	OpenMP Official Documentation: https://www.openmp.org
3	MPI Forum: https://www.mpi-forum.org
4	Coursera: https://www.coursera.org/learn/parallel-programming-in-java
5	Book PDF: Multicore Application Programming by Darryl Gove (Intel site)

Course Outcomes	
CO No.	**Course Outcomes**
1	Outline the concepts of multicore architectures, memory models, parallel computing paradigms, and synchronization mechanisms.
2	Describe the principles of thread management, inter-thread communication, OpenMP, MPI, and parallel programming models.
3	Implement parallel programs using threads, OpenMP, MPI, and synchronization techniques for solving computational problems.
4	Analyze parallel algorithms, performance metrics, scalability factors, and bottlenecks using profiling tools.
5	Evaluate different parallel programming approaches and multicore architectures based on performance, scalability, and application requirements.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	–
2	1	–	2	2	–
3	3	1	3	3	1
4	3	2	3	3	2
5	2	2	3	3	2
6	3	3	3	3	3
AVG	2.17	2.00	2.67	2.67	2.00

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS202	Information And Cyber Security	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	Understand the principles, governance, and regulatory aspects of information and cyber security.
2	Apply advanced techniques to secure networks, operating systems, and enterprise infrastructures.
3	Analyze cryptographic techniques and cloud security mechanisms for secure communication and data protection.
4	Investigate cyber threats using incident response, digital forensics, and cyber threat intelligence techniques.
5	Evaluate emerging cyber security technologies and develop secure solutions for modern computing environments.

Syllabus

Foundations Of Information And Cyber Security — **9 Hours**

Introduction to Information Security – Cyber Security Concepts – Security Goals (Confidentiality, Integrity, Availability) – Threats, Vulnerabilities and Risk Management – Cyber Attack Lifecycle – Security Governance – Information Security Policies and Standards – Authentication, Authorization and Access Control – Identity and Access Management (IAM) – Security Compliance and Regulations (ISO 27001, NIST Cybersecurity Framework, GDPR, IT Act 2000).

Activity: Identify five common cyber threats encountered in daily life (e.g., phishing, weak passwords) and explain how the CIA triad applies to each.

Network And System Security — **9 Hours**

Network Security Architecture – Firewalls and Next-Generation Firewalls – Intrusion Detection and Prevention Systems (IDS/IPS) – Virtual Private Networks (VPNs) – Secure Network Protocols – Wireless Network Security – Operating System Security – Linux and Windows Security – Endpoint Protection – Malware Analysis – Vulnerability Assessment and Penetration Testing (VAPT) – Security Hardening.

Activity: Create strong passwords following best practices and evaluate them using a password strength checker. Review basic firewall and antivirus settings on a computer.

Cryptography And Cloud Security — **9 Hours**

Principles of Cryptography – Symmetric and Asymmetric Encryption – Hash Functions – Digital Signatures – Public Key Infrastructure (PKI) – Key Management – Secure Communication Protocols (SSL/TLS, HTTPS, IPSec) – Cloud Computing Security – Cloud Security Models – Cloud Identity Management – Container Security – Virtualization Security – Secure DevOps (DevSecOps).

Activity: Encrypt and decrypt a short message using a Caesar cipher or an online encryption tool.

Cyber Threat Intelligence And Incident Response — **9 Hours**

Cyber Threat Intelligence (CTI) – Threat Modeling – Security Information and Event Management (SIEM) – Security Operations Center (SOC) – Incident Response Lifecycle – Digital Forensics – Log Analysis – Evidence Collection – Malware Investigation – Ransomware Detection and Prevention – Disaster Recovery – Business Continuity Planning – Cyber Crisis

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Management. **Activity:**Identify sample emails and phishing indicators such as suspicious links, urgent language, and unexpected attachments.	
Advanced Cyber Security Technologies And Applications	**9 Hours**
Artificial Intelligence in Cyber Security – Machine Learning for Threat Detection – Zero Trust Architecture – Blockchain for Cyber Security – Internet of Things (IoT) Security – Industrial Control Systems (ICS) Security – Web Application Security – Secure Software Development Lifecycle (SSDLC) – Ethical Hacking – Emerging Cyber Threats – Cyber Security Case Studies and Future Trends. **Activity:** Analyze a recent cyberattack and summarize its cause, impact, and preventive measures.	
Total Lecture Periods: 45 Hours	

References:	
1	Computer Security: Principles and Practice, Pearson, 2024.
2	Cryptography and Network Security: Principles and Practice, Pearson, 2023.
3	Network Security Essentials: Applications and Standards, Pearson, 2022.
4	Cyber Security Essentials, CRC Press, 2021.
5	Security Engineering: A Guide to Building Dependable Distributed Systems, Wiley, 2020.
E-resources:	
1	CISA – Cybersecurity and Infrastructure Security Agency https://www.cisa.gov
2	Open Web Application Security Project (OWASP WebGoat) https://owasp.org/www-project-webgoat/

Course Outcomess	
CO No.	**Course Outcomes**
1	Explain the principles, governance frameworks, risk management practices, and security standards in cyber security.
2	Apply advanced network, system, and endpoint security techniques to protect enterprise computing environments.
3	Analyze cryptographic methods, secure communication protocols, and cloud security architectures for protecting digital assets.
4	Investigate cyber incidents using threat intelligence, digital forensics, and incident response methodologies.
5	Design secure cyber security solutions using AI, blockchain, Zero Trust, IoT security, and secure software engineering practices for real-world applications.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	2	3	2	1
2	2	1	3	3	2
3	3	1	3	3	2
4	3	2	3	3	3
5	3	2	3	3	3
AVG	2.40	1.60	3.00	2.80	2.20

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS203	Cloud and Big Data Analytics	LIT	L	T	P	J	C
			3	0	2	0	3

Course Objectives

1	To understand cloud computing paradigms and service models.
2	To study big data characteristics, technologies and storage.
3	To explore Hadoop ecosystem and processing tools.
4	To analyze, store, and visualize large-scale data.
5	To develop and deploy cloud-based big data applications.

Syllabus

Cloud Computing — **9 Hours**

Introduction to Cloud Computing - Service Models: IaaS, PaaS, SaaS - Deployment Models: Public, Private, Hybrid, Community - Virtualization: Hypervisors, VM provisioning - Cloud providers: AWS, Azure, Google Cloud overview.

Practicals:

Study and comparison of Cloud Service Models (IaaS, PaaS, SaaS) and Deployment Models (Public, Private, Hybrid, Community).

Create and configure a Virtual Machine (VM) using Oracle VirtualBox/VMware and explore cloud computing services using AWS, Microsoft Azure, or Google Cloud Platform.

Activity: Create a free-tier AWS account and explore EC2, S3.

Big Data Ecosystem & Hadoop — **9 Hours**

Big Data characteristics (Volume, Velocity, Variety, Veracity, Value) - Challenges in Big Data - Hadoop Architecture and HDFS - MapReduce Programming Model – YARN.

Practicals:

Install and configure Hadoop in Pseudo-Distributed Mode and perform HDFS file operations.

Develop a Hadoop MapReduce program (Word Count) and monitor job execution using YARN.

Activity: Watch Hadoop tutorial and submit a summary report.

Data Storage & Processing Techniques — **9 Hours**

NoSQL Databases: MongoDB, Cassandra, HBase - Data Ingestion: Sqoop, Flume - Hive, Pig – Architecture and Querying - Data Cleaning and Preparation.

Practicals:

Perform CRUD operations and query execution using MongoDB (NoSQL Database).

Create Hive tables, load datasets, and perform data analysis using HiveQL.

Activity: HiveQL assignments on datasets from Kaggle.

Advanced Big Data Analytics — **9 Hours**

Introduction to Apache Spark - Spark vs. MapReduce - Spark SQL, Data Frames, RDDs-Machine Learning using Spark MLlib - Real-time processing: Kafka and Spark Streaming.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Practicals: Perform data processing using Apache Spark RDDs, DataFrames, and Spark SQL. Build a simple Machine Learning model using Spark MLlib and demonstrate real-time data processing using Kafka and Spark Streaming. **Activity:** Mini-project using PySpark on COVID or Traffic dataset.	
Cloud Integration and Security	**9 Hours**
Data on Cloud – Storage and Compute Services - Data Security and Privacy in Cloud - Cloud-based Data Analytics Use Cases - CloudNative vs Traditional Applications - Case Study: Smart Cities / Healthcare Analytics. **Practicals:** Explore Cloud Storage and Compute Services by deploying a simple application on AWS, Azure, or Google Cloud Platform. Implement cloud security mechanisms using Identity and Access Management (IAM), data encryption, and analyze a cloud-based use case (Smart City or Healthcare Analytics). **Activity:** Create a cloud deployment report using Azure/AWS.	
Total Lecture Periods: 45 Hours	
Total Laboratory Periods: 15 Hours	

References:	
1	Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing: Principles and Paradigms, Wile
2	Tom White, Hadoop: The Definitive Guide, O'Reilly Media
3	Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing.
4	Kleppmann, Martin, Designing Data-Intensive Applications, O'Reilly.
5	Alan Gates, Programming Pig, O'Reilly.
6	Jure Leskovec et al., Mining of Massive Datasets, Cambridge University Press.
E-Resources:	
1	https://www.nasa.gov/smallsat-institute/sst-soa/thermal-control

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and service models of cloud computing and big data analytics used in modern data-driven environments
2	Apply cloud computing services, big data processing frameworks, and analytics tools to manage, process, and analyze large-scale datasets in cloud environments.
3	Analyze cloud-based big data processing frameworks and analytics techniques to understand their performance, scalability, and resource utilization.
4	Evaluate big data analytics tools, cloud platforms, and data processing models for their effectiveness in handling large-scale and complex datasets.
5	Design scalable cloud-based big data analytics solutions by selecting appropriate architectures, platforms, and analytical methods for real-world applications.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	1
2	3	1	3	3	1
3	3	2	3	3	2
4	2	2	3	3	2
5	3	3	3	3	3
AVG	2.40	2.00	2.80	2.80	1.80

"3" -High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26PCS204	Quantum Computing	T	L	T	P	J	C
			2	0	0	0	2

Course Objectives

1	To provide a mathematical foundation for Quantum Computing and provide the basics of working
2	To interpret the various aspects and applications of quantum computing.
3	To examine the factors that affect Quantum computation

Syllabus

Physical properties and mathematical foundations — **6 Hours**

Double Slit Experiment; Light: Particle Vs Wave; Heisenberg Uncertainty Principle.Vector spaces – basis; Inner product; Outer product; Tensor product; Linear operators.

Activities:

• Simulate the experiment using an interactive virtual lab
• Construct simple operators and visualize action on vectors

Quantum computing postulates and gates — **6 Hours**

Review of postulates, Bloch sphere, Single qubit states and gates, superposition; Two Qubit States and Gates - Bell States, Entanglement, CNOT gate, Phase oracles, Pauli Gates.

Activities:

• Group quiz to match postulates to physical implications
• Visualization with Bloch sphere simulators

Quantum computing circuits — **6 Hours**

Dirac's notation for quantum computing, Computational Basis, Orthonormality, Hadamard and Phase Gates- building quantum circuits.

Activities:

• Use IBM Q Composer to build and simulate custom circuits
• Hands-on: Apply X, H, Z gates and observe results on simulators

Fundamental Quantum Algorithms — **6 Hours**

Deutsch–Josza Algorithm, Grover search algorithm: Problem definition, Amplitude amplification, Grover oracle, diffuser, multiple solutions in the search space.

Activities:

• Construct DJ circuit for a 3-bit input function
• Simulation of Grover's algorithm with multiple marked elements

Programming on a real quantum computer — **6 Hours**

Coding a real time quantum computer via IBMQ to carry out basic quantum measurement and state analysis.

Activities:

• Connect Qiskit with IBMQ using personal API token
• Hands-on: Create 1- and 2-qubit circuits using Hadamard, X, Z, and measurement gates
• Compare real and simulated results and Observe impact of quantum noise

Total Lecture Periods: 30 Hours

Text Books:	
1	Chuck Easttom, "Quantum Computing Fundamentals", 1st edition, Published by Addison-Wesley Professional (June 1st 2021)
2	Qiskit TextBook - https://qiskit.org/textbook/preface.html (2022)
References:	
1	Kasirajan, Venkateswaran. Fundamentals of quantum computing. Springer International Publishing, 2021.
2	Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Cambridge, 2020
3	Nielsen, Michael A., and Isaac L. Chuang, "Quantum Computation and Quantum Information" Cambridge University Press (5 April 2013)
E Resources:	
1	IBM Quantum Learning Platform – https://quantum.ibm.com
2	Qiskit Documentation and Tutorials – https://docs.quantum.ibm.com
3	MIT OpenCourseWare – https://ocw.mit.edu

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental principles, postulates, and computational models of quantum computing and their significance in next-generation computing systems.
2	Apply quantum programming tools and quantum computing platforms to implement, simulate, and analyze quantum circuits and algorithms.
3	Analyze quantum algorithms and quantum circuit models to understand their computational advantages, limitations, and performance characteristics.
4	Evaluate quantum computing paradigms, error correction techniques, and hardware technologies for their suitability in solving complex computational problems.
5	Design quantum circuits and algorithmic solutions by selecting appropriate quantum gates, qubit architectures, and computational models for real-world problem scenarios.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	3	1	3	3	2
3	3	2	3	3	2
4	2	2	3	3	3
5	3	3	3	3	3
AVG	2.40	2.00	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP901	Advanced Software Testing and Quality Assurance	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	Provide an in-depth understanding of advanced software testing techniques and their role in quality assurance
2	Explore automated testing frameworks, tools, and methods for test design and test process improvements
3	Enable students to design test plans, develop test cases, and assess test results critically

Syllabus

Foundations and Test Lifecycle — **9 Hours**

Evolution of software testing in agile and DevOps ecosystems -Software Test Life Cycle (STLC) phases: Requirements analysis to test Closure - Quality attributes: reliability, maintainability, testability - Introduction to testing types and classifications.

Activity: Mapping STLC to Agile/DevOps pipelines.

Types of Testing and Risk-Based Approaches: — **9 Hours**

Types of testing: Unit, Integration, System, Acceptance, Regression, Smoke, and Sanity - Risk-based testing and test Prioritization - Aligning testing strategies with product risk and delivery goals.

Activity: Test strategy design for risk-based scenarios

Advanced Test Design Techniques: — **9 Hours**

Black-box and white-box test strategies: BVA, ECP, decision tables, control/data flow - State transition and use-case testing - Modelbased testing, combinatorial testing, and cause-effect graphing - Mutation testing, fault injection, fuzz testing - Test case minimization and prioritization Techniques.

Activity: Create test cases for a real-world problem using model-based design

Test Automation and Continuous Testing: — **9 Hours**

Design of reusable and maintainable automation frameworks - Open-source tools: Selenium, TestNG, JUnit, Robot Framework, Cypress - Performance testing: JMeter and basic LoadRunner Concepts - Integration with Jenkins and GitHub for continuous testing - BDD and TDD using Cucumber.

Activity: Implement a hybrid automation framework for a web-based application.

Software Quality Assurance Frameworks and Metrics — **9 Hours**

Quality planning, control, assurance, and improvement - SQA tools and activities: Reviews, audits, inspections - Quality models: McCall, Boehm, ISO 9126 / ISO 25010 -Metrics for testing: test coverage, defect density, MTBF, test effort -Cost of quality and defect leakage.

Activity: Analyze QA strategy in enterprise software (e.g., ERP or banking)

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Glenford J. Myers, The Art of Software Testing, 3rd edition, Wiley
2	Paul C. Jorgensen, Software Testing: A Craftsman's Approach, 4th edition, CRC Press
3	Ron Patton, Software Testing, Second Edition, Sams Publishing, Pearson Education, 2007
4	Aditya Mathur, Foundations of Software Testing, 2nd edition, Pearson, 2013
5	Pressman & Maxim, Software Engineering: A Practitioner's Approach, McGraw-Hill.
E-Resources:	
1	. MIT OpenCourseWare (Software Testing
2	NPTEL (Sftware Testing by Prof. Nandini Prasad, IIT Kharagpur)

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, principles, and processes involved in advanced software testing and quality assurance for reliable software development.
2	Analyze software systems and testing strategies to identify defects, assess risks, and ensure compliance with quality standards.
3	Evaluate software testing techniques, quality models, and assurance frameworks to determine their effectiveness in diverse development environments
4	Design comprehensive testing and quality assurance strategies by selecting appropriate testing tools, automation frameworks, and quality metrics for real-world software projects.
5	Apply software testing methodologies, test design techniques, and automation tools to develop, execute, and manage effective test cases for software applications.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	1
2	3	1	3	3	2
3	2	2	3	2	2
4	3	3	3	3	3
5	3	1	3	3	1
AVG	2.40	1.75	2.80	2.60	1.80

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP902	Agile Methodologies	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	Introduce students to the principles, values, and practices of Agile software development.
2	Provide hands-on experience with Agile tools and techniques used in industry
3	Develop the ability to plan, manage, and deliver software in Agile environments.

Syllabus

Evolution of Software Development and Agile Foundations	**8 Hours**

Evolution of Software Development Methodologies - Challenges in traditional models that led to Agile - The Agile Manifesto - Agile Values and Principles.
Activity: Agile vs Waterfall in large-scale government or startup projects (e.g., FBI Sentinel, Spotify)

Agile Mindset and Cultural Transformation	**9 Hours**

Agile Mindset in Individuals and Teams - Characteristics of Agile teams and leaders - Lean Thinking in Software Development - Cultural Shift from Traditional to Agile Thinking - Applying Lean in Agile - Agile vs Traditional Methodologies.
Activity: Reflective write-up on Agile mind set adoption challenges in traditional teams

Agile Process Models and Frameworks	**9 Hours**

Scrum: Roles, artifacts, events - Extreme Programming (XP): Pair programming, test-first, refactoring - Kanban: Flow, work-inprogress (WIP), pull systems - SAFe (Scaled Agile Framework) and Disciplined Agile Delivery (DAD) - Feature-Driven Development (FDD), Crystal, LeSS, Nexus.
Activity: Team simulation using Scrum ceremonies (sprint planning, stand-ups, retrospectives)

Agile Project Management and Planning	**8 Hours**

User stories and story mapping - Estimation techniques: Planning poker, T-shirt sizing - Product backlog grooming and sprint planning - Agile metrics: Velocity, burndown chart, cumulative flow diagram (CFD) - Risk management in Agile.
Activity: Lab Component: Automate testing and CI/CD for a sample app

Agile Engineering Practices and Industry Case Studies	**11 Hours**

Test-Driven Development (TDD) and Behaviour Driven Development (BDD) - Continuous Integration and Continuous Delivery (CI/CD) - DevOps principles and its relationship with Agile - Refactoring, code smells, clean code - Design patterns in Agile context. Agile scaling frameworks and challenges - Distributed Agile teams and remote collaboration - Agile in non-software contexts (e.g., education, HR, manufacturing) - Agile contracting and governance - Agile case studies from Google, Spotify, IBM, and startups Suggested Activities.
Activity: Project based experiential learning: End-to-end Agile project using Scrum/Kanban and CI/CD pipeline

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Ken Schwaber & Jeff Sutherland, Software in 30 Days: How Agile Managers Beat the Odds, Wile
2	Mike Cohn, User Stories Applied: For Agile Software Development, Addison- Wesley
3	Craig Larman & Bas Vodde, Scaling Lean & Agile Development, Addison-Wesley
E-Resources:	
1	NPTEL: Agile Software Development – Prof. Rajib Mall (IIT Kharagpur)
2	MIT Open Course Ware Agile content

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, principles, and processes involved in advanced software testing and quality assurance for reliable software development
2	Analyze software systems and testing strategies to identify defects, assess risks, and ensure compliance with quality standards.
3	Evaluate software testing techniques, quality models, and assurance frameworks to determine their effectiveness in diverse development environments
4	Design comprehensive testing and quality assurance strategies by selecting appropriate testing tools, automation frameworks, and quality metrics for real-world software projects.
5	Apply software testing methodologies, test case design techniques, and automation tools to develop, execute, and manage effective test cases for software applications.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	1
2	3	1	3	3	2
3	2	2	3	2	2
4	3	3	3	3	3
5	3	1	3	3	1
AVG	2.40	1.75	2.80	2.60	1.80

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP903	Web of Things	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To equip students with the knowledge and skills to integrate Internet of Things (IoT) devices with web technologies using the Web of Things (WoT) framework. This course enables learners to design interoperable, secure, and scalable smart applications by leveraging standardized WoT architectures, Thing Descriptions, and scripting interfaces.

Syllabus

Introduction to Web of Things — **9 Hours**

Evolution: From IoT to WoT, Architecture of WoT: Thing Description, Binding, Servient, Protocol Bindings, Web protocols overview (HTTP, Web Sockets, MQTT, CoAP), WoT Scripting and Interaction Models (Properties, Actions, Events).

Activities:
- Mind map comparison of IoT vs WoT
- Analysis of WoT reference architecture

WoT Standards and Thing Description (TD) — **9 Hours**

W3C WoT Architecture and Building Blocks, Thing Description (TD): Syntax, Vocabulary, JSON-LD format, TD Schema validation and interpretation, Semantic Annotation in TD .

Activities:
- Write TD for a smart device in JSON-LD
- Validate TD using WoT tools

Implementation of WoT Servients — **9 Hours**

WoT Servient structure: Exposed vs Consumed Things, Node-WoT framework, WoT Scripting API, Protocol bindings: HTTP, MQTT, CoAP.

Activities:
- Present security issues in WoT
- Design secure architecture for smart home

Interoperability, Security, and Privacy — **9 Hours**

Interoperability challenges, Security mechanisms: HTTPS, OAuth2.0, Access Control, Privacy and anonymization, Trust and identity in WoT ecosystems.

Activities:
- Present case studies of real-world WoT
- Brainstorm WoT smart city features

Applications and Future Trends, Integration in WoT — **9 Hours**

Smart Cities, Smart Homes, e-Health, IIoT, Cloud and Edge integration, Data analytics and AI in WoT, Future directions: Digital twins, Metaverse. Integrating an Arduino to WoT – Integrating BeagleBone to WoT – Integrating an Intel Edition to WoT – Integrating other Embedded systems to WoT.

Activities: Create a simple project to integrate an embedded device with WoT

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Michael Kuniavsky, *Smart Things: Ubiquitous Computing User Experience Design*, Morgan Kaufmann, 2010
2	Dom Guinard & Vlad Trifa, *Building the Web of Things*, Manning Publications, 2016
3	akima Chaouchi, *The Internet of Things: Connecting Objects to the Web*, Wiley, 2010.
4	Peter Waher, *Mastering Internet of Things*, Packt Publishing, 2018.
5	Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress, 2016
Web resource:	
1	W3C WoT Working Group Documents: https://www.w3.org/WoT/H

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and enabling technologies of the Web of Things for connecting smart devices to web-based platforms.
2	Implement and validate Web of Things applications using modern development tools, APIs, cloud platforms, and testing methodologies to ensure reliable, efficient, and real-time smart system operation.
3	Analyze Web of Things frameworks and communication protocols to understand their performance, interoperability, and scalability in distributed environments
4	Evaluate Web of Things platforms, data integration techniques, and security mechanisms for their suitability in various application domains.
5	Design Web of Things–based solutions by selecting appropriate architectures, protocols, and services to develop scalable and secure smart applications.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	1
2	3	1	3	3	2
3	3	1	3	3	2
4	2	2	3	2	3
5	3	3	3	3	3
AVG	2.40	1.75	2.80	2.60	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP904	Text and Speech Processing	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To introduce the fundamental principles and practices of text and speech processing, equipping students with theoretical understanding and practical skills in natural language and speech technologies, including parsing, information extraction, speech recognition, and synthesis

Syllabus

Introduction to Text and Speech Processing — **9 Hours**

NLP pipeline overview Human speech production and acoustic phonetics Text normalization: tokenization, stemming, lemmatization Basics of speech signal: sampling, frequency, noise.

Activities:

- Speech waveform analysis using Praat
- Tokenization and stemming with NLTK

Text Processing Techniques — **9 Hours**

Attributes – Formant speech synthesis – Concatenative speech synthesis – Prosodic modification of speech - Part-of-speech tagging Parsing techniques: CFG, Dependency Parsing Named Entity Recognition (NER), Chunking, Language modeling: N-gram models .

Activities:

- POS tagging using spaCy
- Building a rule-based NER system

Speech Signal Processing — **9 Hours**

Feature extraction: MFCC, PLP, LPC Acoustic modeling: HMM, GMM Basics of ASR (Automatic Speech Recognition) Hidden Markov Models for Speech.

Activities:

- Extract MFCC features using Python Group
- Basic ASR using pre-trained models

Speech Synthesis and Applications — **8 Hours**

Text-to-speech (TTS) systems Speech databases and corpora Evaluation metrics: WER, CER Applications: Voice Assistants, Dictation Systems.

Activities:

- TTS Demo using pyttsx3
- Compare open-source TTS tools

NLP and Speech in Practice — **10 Hours**

Sentiment analysis Chatbots and dialog systems Multilingual and low-resource NLP Ethics in speech and text technology. RNN's and LSTM – The Transformer – Large Language Models – Masked Language Models.

Activities:

- Building a chatbot using Rasa
- Ethical issues in speech surveillance

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson, 3rd edition draft, 2023.
2	Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson, 2011.
3	Recognition, Pearson, 2011. 3. Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
4	Thomas Schultz and Katrin Kirchhoff, Multilingual Speech Processing, Academic Press, 2006.
5	Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019
Web resource:	
1	https://web.stanford.edu/~jurafsky/slp3/
2	https://www.nltk.org/
3	https://www.nltk.org/book/

Course Outcomess	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, models, and techniques involved in text and speech processing for natural language and audio-based applications.
2	Analyze text and speech processing algorithms to understand their performance, accuracy, and limitations in real-world language and audio processing tasks.
3	Evaluate text and speech processing methods, models, and systems to assess their effectiveness for various linguistic and speech-based applications
4	Design text and speech processing solutions by selecting and integrating appropriate models, features, and techniques for intelligent language and speech applications
5	Implement and validate text and speech processing systems using modern NLP and speech technologies, evaluating their performance through suitable metrics and experimental analysis.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	1
2	3	1	3	3	2
3	2	2	3	3	2
4	3	2	3	3	3
5	3	3	3	3	3
AVG	2.40	2.00	2.80	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP905	Advanced Deep Learning and Neural Networks	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course aims to provide a comprehensive understanding of neural network architectures and their training methodologies. The course explores optimization techniques, regularization methods, and state-of-the-art architectures including encoder-decoder models, attention mechanisms, variational auto encoders, GANs, and transformer-based models

Syllabus

Neural Networks	**9 Hours**
Introduction – Perceptron – Multilayer Feed forward networks – Back propagation – Activation functions – Loss Function – Regularization: Data Augmentation - Noise Robustness – Early Stopping – Bagging – Dropout – batch normalization. **Activity:**Understanding the working principle of Neural Networks	
CNN and RNN	**9 Hours**
Convolutional Neural Networks – Convolution Operation – Architecture Overview – Input layers – Convolutional layers – pooling layers – fully connected layers Recurrent Neural networks – LSTM – Bidirectional RNNs – RNN Language model – Word Level RNN - Deep Recurrent Networks – Recursive Neural Networks. **Activity:**Reproduction of research paper related to CNN and RNN	
Optimization and Deep Networks	**9 Hours**
Optimization in deep learning – Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks - Spatial Transformer Networks Tuning Deep Networks – Basic Concepts – Matching input data and network architecture – relating model goal and output layers – Working layer count, parameter count and Memory – weight initialization strategies – using activation functions – applying loss function – Dealing with overfitting. **Activity:**Simple application using deep neural network with three layers	
Encoder / decoder Models and Regressive Models	**8 Hours**
Encoder Decoder Models - Attention Mechanism - Attention over images – Hierarchical Attention – Variational auto encoders – Autoregressive models – NADE – MADE - PixelRNN – Generative Adversarial Networks (GANs) – Graph Convolution Network – Deep Belief Network. **Activity:**Design of any Regressive, Generative and Graph Models	
Unit 5 - Advanced Applications of Neural Networks and Deep Learning	**10 Hours**
Object Detection: RCNN, Faster RCNN, and Yolo – MobileNet – DarkNet – Object Tracking - Audio WaveNet - Natural Language Processing Word2Vec Joint Detection - Face Recognition - Scene captioning Language Transformer Models. Deep learning for Computer Vision – Deep learning for Time Series – Deep learning for text – Generative Deep learning Suggested. **Activity:**Design of face recognition model.	
Total Lecture Periods: 45 Hours	

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	François Chollet, “Deep Learning with Python ”, 2nd Edition, Manning Pubns Co, 2021
2	Josh Patterson, Adam Gibson,” Deep Learning: A Practitioner‟s Approach”, 1st Edition, O‟Reilly Media, Inc, 2017.
3	Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation, 2016
4	Dr.Adrian Rosebrock, Deep Learning for Computer Vision with Python: Starter Bundle‖, PyImage Search, 1st Edition, 2017
5	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
Web resource:	
1	https://www.deeplearningbook.org/
2	http://neuralnetworksanddeeplearning.com/
3	https://pyimagesearch.com/
4	https://www.tensorflow.org/learn

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and learning paradigms of deep learning and neural networks used in advanced intelligent systems
2	Analyze deep learning models and neural network architectures to understand their learning behavior, performance, and optimization characteristics
3	Evaluate deep learning techniques, neural network models, and training strategies to assess their effectiveness for complex data-driven applications
4	Design advanced deep learning solutions by selecting and integrating suitable neural network architectures, training algorithms, and optimization methods for real-world problems.
5	Implement and validate deep learning models using modern frameworks and tools, and assess their effectiveness through experimental analysis and performance evaluation.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	2	2	1
2	3	1	3	3	2
3	2	2	3	3	2
4	3	2	3	3	3
5	3	3	3	3	3
AVG	2.40	2.00	2.80	2.80	2.20

“3”-High, “2” -Medium, “1” – Low, “-” – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP906	Quantum Cryptography	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	The objective of this course is to introduce the principles of quantum information and computation, along with key quantum algorithms and their practical applications. It also aims to provide a clear understanding of post-quantum and advanced quantum cryptographic techniques essential for secure communication in the quantum era.

Syllabus

Quantum Information — **9 Hours**

Qubit - Single and Multiple qubits – Mathematical Model for Quantum mechanics – Quantum measurements – Quantum Computation and No-cloning: Phase shift – Bit flips – Hadamard transform – Arbitrary Transforms – Entanglement - Quantum gates and circuits: CNOT gate – CCNOT gate – Reversible gates Universal quantum gates - quantum circuit – quantum parallelism.

Activities:

• Build and simulate quantum circuits using Qiskit (or another quantum simulator)

• Create a Bell state using a Hadamard gate followed by a CNOT gate.

Quantum Algorithms — **9 Hours**

Deutsch's algorithm – Phase Kickback – Generalizing to n bits: Deutsch-Jozsa algorithm – Simon's algorithm: Analysis - Quantum Fourier Transform, Grover's Algorithm, Shor's Algorithm.

Activity: Simulate both Deutsch's algorithm (1-bit) and the Deutsch-Jozsa algorithm (n-bit) using Qiskit.

Quantum Cryptanalysis — **9 Hours**

Quantum order finding – Factoring – Discrete logarithms, Hidden subgroup problems (HSP) – Key Exchange: Diffie-Hellman (DH) problems - Computational DH – Decisional DH – Indistinguishable Chosen Plaintext Attack (IND-CPA): Applications in RSA Encryption and Elgamal Encryption.

Activity: Simulate Shor's Algorithm using Qiskit or any quantum simulator to factor small numbers

Post-Quantum Cryptography — **9 Hours**

Post Quantum Crypto: Introduction to lattices – Codes – Isogenies - Lattice Problems. Learning with Errors (LWE) and Short Integer Solution (SIS) problem. Connection to dihedral hidden subgroup problem - Public Key Encryption (PKE) from LWE - Fully Homomorphic Encryption (FHE).

Activity: Implement a simplified version of a public-key encryption scheme based on the LWE problem using Python or SageMath

Quantum Cryptography - I and II — **9 Hours**

Quantum Key Distribution and bit commitment – Random Oracles - Quantum One Time Pad and Encryption - Quantum PKE – Quantum FHE - Quantum Indifferentiability - Quantum Money. Quantum key distribution with imperfect devices – beyond point -to - point quantum key distribution – device independent Quantum cryptography.

Activity: Simulate the BB84 protocol for quantum key distribution between two parties in Python using Qiskit

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Quantum Computation and Quantum Information, M. A. Nielsen and I. Chuang, Cambridge University Press, 2012.
2	Quantum Computing from the Ground Up, Riley Tipton Perry, World Scientific Publishing Ltd., 2012.
3	Quantum algorithms via linear Algebra Primer, Richard J. Lipton Kenneth W. Regan, The MIT Press Cambridge, 2014.
4	Quantum Computing: An Applied Approach, Jack D. Hidary, 1st Edition, Springer, 2019.
E-resources:	
1	Quantum Algorithms and Cryptography (Video) – NPTEL
2	Introduction to Quantum Computing: Quantum Algorithms and Qiskit (Video) – NPTEL
3	Practical Quantum Computing with IBM Qiskit for Beginners (Video) – Coursera

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental principles, protocols, and security concepts of quantum cryptography and their significance in secure communication systems.
2	Analyze quantum cryptographic protocols and security mechanisms to understand their robustness, vulnerabilities, and performance characteristics.
3	Evaluate quantum cryptographic techniques and implementations to assess their effectiveness in ensuring confidentiality and secure key distribution.
4	Design secure communication systems by applying appropriate quantum cryptographic protocols, architectures, and security strategies for real-world applications.
5	Implement and validate quantum cryptographic solutions using simulation tools and performance metrics to assess security, efficiency, and reliability in quantum-enabled communication environments.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	3	1	3	3	2
3	2	2	3	3	3
4	3	2	3	3	3
5	3	3	3	3	3
AVG	2.40	1.60	3.0	2.80	2.40

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP907	Quantum Machine Learning	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	The objective of the Quantum Machine Learning (QML) course is to provide students with a comprehensive understanding of the intersection between quantum computing and machine learning. This course aims to equip students with the theoretical foundation and practical skills necessary to design, develop, and implement quantum algorithms for solving complex machine learning problems.

Syllabus

Introduction to Quantum Computing and Quantum Machine Learning	**8 Hours**

Basics of Quantum Computing: Qubits, Superposition, and Entanglement - Quantum Gates, Circuits, and Measurement - Quantum Algorithms: Grover's and Shor's Algorithm - Introduction to Quantum Machine Learning (QML) - Classical vs Quantum ML - Applications of Quantum ML.

Activities:

• Implement a quantum circuit using Qiskit to demonstrate superposition and entanglement (Create a simple Bell state).

• Use Qiskit to implement and visualize Grover's search algorithm for an unsorted database problem.

Quantum Information Theory and Quantum Algorithms	**8 Hours**

Quantum Entropy and Quantum Information - Quantum Teleportation and Superdense Coding - No-Cloning Theorem and Quantum Cryptography - Quantum Fourier Transform (QFT) - Quantum Phase Estimation (QPE).

Activities:

• Implement a Quantum Fourier Transform (QFT) using Qiskit and visualize the output on a simple example (e.g., the 3-qubit QFT).

• Simulate quantum teleportation using Qiskit to transfer quantum information between two qubits.

Quantum Algorithms for Machine Learning	**9 Hours**

Quantum Support Vector Machines (QSVM) - Quantum Principal Component Analysis (QPCA) - Quantum k-Nearest Neighbors (QkNN) -Quantum Neural Networks (QNN) Use Qiskit to perform Quantum Principal Component Analysis (QPCA) on a synthetic dataset for dimensionality reduction.

Activities:

• Implement Quantum Support Vector Machine (QSVM) using Qiskit to classify a small dataset (e.g., Iris dataset).

• Use Qiskit to perform Quantum Principal Component Analysis (QPCA) on a synthetic dataset for dimensionality reduction.

Quantum Optimization and Hybrid Quantum-Classical Models, Applications, Tools, and Future	**10 Hours**

Variational Quantum Eigensolver (VQE) - Quantum Approximate Optimization Algorithm (QAOA) - Hybrid Quantum-Classical Algorithms - Applications of Quantum Optimization in Machine Learning. Applications of Quantum Machine Learning in Finance, Healthcare, NLP, and Drug Discovery - Quantum

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Programming Tools: Qiskit, TensorFlow Quantum - The Future of Quantum ML: Challenges and Opportunities. **Activities:** • Implement the Variational Quantum Eigensolver (VQE) to find the ground state energy of a Hamiltonian using Qiskit. • Create a Quantum Approximate Optimization Algorithm (QAOA) to solve a Max Cut problem on a simple graph using Qiskit.	
Advanced Quantum Machine Learning – I and Quantum Machine Learning – II	**10 Hours**
Quantum Mechanics and Data-Driven Physics - Kernelizing Quantum Mechanics - Qubit Maps - One-Qubit Transverse-Field Ising Model and Variational Quantum Algorithms. Two-Qubit Transverse-Field Ising Model and Entanglement - Variational Algorithms, Quantum Approximate Optimization Algorithm, and Neural Network Quantum States with Two Qubits - Quantum Reservoir Computing. **Activities:** • Use TensorFlow Quantum to build a simple quantum classifier and run it on a small dataset. • Explore Qiskit and create a quantum-based recommendation system using hybrid quantum-classical methods.	
Observations from an Industry Exposure Visit: For the Quantum Machine Learning (QML) course, a hands-on learning experience can be organized where students visit a quantum computing research lab, a quantum software company, or a machine learning- focused organization that integrates quantum computing into real-world applications.	
During this visit, students will have the opportunity to observe cutting-edge workflows involving quantum algorithms, quantum optimization techniques, and hybrid classical-quantum models applied to machine learning tasks. Students will gain insights into how these technologies are deployed to solve complex, high-dimensional problems in industries like finance, healthcare, and optimization. Following the visit, students will write a reflection report summarizing their observations, discussing the tools and technologies encountered, and reflecting on the practical challenges faced in quantum machine learning applications.	
Total Lecture Periods: 45 Hours	

E-resources/E-materials:	
1	**Qiskit Documentation** https://qiskit.org/documentation/ **IBM Quantum Experience** https://quantum-computing.ibm.com/
2	**Quantum Computing for the Very Curious** https://quantum.country/qcvc
3	Google Quantum AI https://quantumai.google/
4	**TensorFlow Quantum** https://www.tensorflow.org/quantum
References:	

1	Claudio Conti, Quantum Machine Learning Thinking and Exploration in Neural Network Models for Quantum Science and Quantum Computing, Springer Nature Link Publications 2024
2	Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2nd Edition, 2010.
3	Peter Wittek, Quantum Machine Learning: What Quantum Computing Means to Data Mining, Springer, 2014.
4	Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 1st Edition, 2019.
5	Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 1st Edition, 2014.
6	Nathan Wiebe, Ashish Kapoor, Krysta Svore, Quantum Machine Learning, Springer, 1st Edition, 2021.
7	Brendon S. H. Tan, Quantum Computing and Quantum Information Science, CRC Press, 1st Edition, 2021.
NPTEL/MOOC/SWAYAM Courses:	
1	**NPTEL – Introduction to Quantum Computing** https://nptel.ac.in/courses/106/105/106105226/
2	**NPTEL – Quantum Computing and Quantum Information** https://nptel.ac.in/courses/106/106/106106220/
3	**Swayam – Quantum Machine Learning: Algorithms and Applications** https://swayam.gov.in/nd1_noc21_cs56/
4	**Coursera – Quantum Computing and Machine Learning** https://www.coursera.org/learn/quantum-machine-learning
5	**Udemy – Quantum Machine Learning** https://www.udemy.com/course/quantum-machine-learning/

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, models, and principles of quantum machine learning and their role in next-generation intelligent systems.
2	Analyze quantum machine learning algorithms and hybrid quantum–classical models to understand their computational advantages and limitations.
3	Evaluate quantum machine learning techniques and frameworks to assess their effectiveness for complex data-driven and optimization problems.
4	Design quantum machine learning solutions by selecting appropriate quantum circuits, learning models, and hybrid architectures for real-world applications.
5	Implement and validate quantum machine learning models using quantum computing frameworks and simulation tools, and assess their performance through suitable evaluation metrics.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP908	AI in IoT	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To gain a deep understanding of AI concepts, IoT architectures, and their convergence for intelligent systems.
2	To build and train machine learning and deep learning models suited for IoT data processing using TensorFlow / Keras.
3	To apply data normalization, filtering, and feature engineering to enhance AI model accuracy.
4	To deploy AI models on edge devices for low-latency decision-making in IoT environments.
5	To implement AI-based cyber security solutions for intrusion detection and anomaly detection in IoT networks.

Syllabus

Introduction to AI in IoT	**9 Hours**

Fundamentals of AI and IoT - IoT Architecture and AI Integration - AI Models for IoT (Machine Learning, Deep Learning) - AI-Driven IoT Applications (Smart Cities, Healthcare, Industrial IoT) - Ethical Considerations in AI-Enabled IoT – Case Study: Smart Agriculture with AI-Enabled IoT Sensors.

Activities:

• Analytical study of AI integration within IoT ecosystems, focusing on architectural layers, data flow, and intelligence distribution across device, edge, and cloud.

• Simulation-based generation and statistical analysis of IoT sensor data using computational tools (e.g., Jupyter Notebook) to interpret trends, patterns, and variability.

Data Acquisition & Pre-processing in AI-Enabled IoT	**9 Hours**

Sensor Data Collection & Processing - AI-Based Data Normalization, Filtering & Feature Engineering - Challenges in Data Handling & Storage for AI Models - Ethical Considerations in AI-Driven Data Processing – Case Study: Predictive Maintenance in Smart Factories.

Activities:

• Develop a conceptual framework for real-time sensor data preprocessing, detailing data collection, normalization, filtering, and feature engineering stages.

• Analyze AI-enhanced IoT data filtering techniques, focusing on methodologies, performance metrics, and practical challenges.

AI Models for IoT Data Processing & Decision-Making	**9 Hours**

Supervised & Unsupervised AI Models in IoT - Classification, Clustering & Anomaly Detection - Deep Learning Models for IoT: CNNs, RNNs - Performance Metrics & Model Optimization – Case Study: AI-Driven Traffic Monitoring System.

Activities:

• Analyze and justify the selection of appropriate AI models for real-time IoT data classification, considering problem context, data characteristics, and performance constraints.

• Conduct structured discussions or guided demonstrations on deep learning models (CNNs, RNNs) for IoT applications, focusing on architecture, working principles, and suitability for time-series data.

Edge AI & Security for IoT Systems	**9 Hours**

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Edge AI Deployment Strategies - Edge AI for Real-Time Decision-Making - Deploying AI Models in Resource-Constrained IoT Devices - AI-Powered Security & Intrusion Detection in IoT Networks - Ethical Implications & Privacy Concerns – Case Study: AI-Based Intrusion Detection in Healthcare IoT Networks. **Activities:** • Conceptually analyze AI-powered anomaly detection frameworks for IoT systems, focusing on model architecture, detection strategies, and performance evaluation criteria. • Critically review and present recent research articles on security and privacy mechanisms in IoT systems, with emphasis on AI-based intrusion detection approaches.	
AI in IoT – Industry Trends and Ethics	**9 Hours**
Industry Applications of AI in IoT - Smart Cities, Healthcare, & Industrial IoT - Scaling AI for Large-Scale IoT Deployments - Sustainability & Scalability Challenges in AI-Enabled IoT. Monetization Strategies & AI Business Models in IoT - Green AI and IoT Regulations and Standardization - Edge AI advancements for real-time IoT decision-making - Quantum AI & IoT interoperability for future applications - Case Study: AI-Driven Smart Cities for Sustainable Urban Development. **Activities:** • Undertake an analytical case study of AI-driven Smart Cities, examining sustainability, scalability, governance frameworks, and ethical considerations. • Prepare a conceptual design proposal for a real-time IoT-based decision making system, detailing system architecture, AI model rationale, deployment strategies, and regulatory compliance aspects.	
Total Lecture Periods: 45 Hours	

References:	
1	Fadi Al-Turjman, “Artificial Intelligence in IoT”, Springer, 2019
2	Ambika Nagaraj,” The Role of AI in Enhancing IoT-Cloud Applications”, Bentham Books, 2023
3	Rajkumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Elsevier, 2016
4	Jason Ioannou, "Data Analytics for IoT and Smart Systems", Springer, 2020
5	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2016 .
6	Weisong Shi, "Edge Computing: Vision and Challenges", Springer, 2020
7	Mauro Conti, "Security and Privacy in the Age of IoT", Springer, 2020
8	François Chollet, “Deep Learning with Python” (2nd Edition), Manning Publications, 2021
9	Stuart Russell & Peter Norvig, “Artificial Intelligence: A Modern Approach (4th Edition), Pearson, 2020
10	Arshdeep Bahga & Vijay Madisetti, “Internet of Things: A Hands-On Approach” (2nd Edition), Universities Press, 2016
Web References	
1	https://www.springer.com/gp/campaign/artificial-intelligence/artificial-intelligence-in-iot

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

2	https://iotworldmagazine.com/2025/01/16/2675/list-of-top-50-best-ai-automation-tools- in-2025
3	https://www.opensourceforu.com/2025/02/open-source-ai-frameworks-integrating-ai- with-iot/

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and applications of integrating artificial intelligence techniques with Internet of Things (IoT) systems.
2	Analyze AI-enabled IoT systems to understand data processing, learning models, and decision-making mechanisms in distributed environments.
3	Evaluate AI techniques and IoT platforms to assess their effectiveness, scalability, and reliability for intelligent connected applications.
4	Design intelligent IoT solutions by selecting appropriate AI models, sensing strategies, and system architectures for real-world applications.
5	Implement and validate AIoT applications using modern development tools, IoT platforms, and machine learning frameworks, and assess their performance through suitable evaluation metrics.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP909	Web 3.0	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To understand the progression from Web 1.0 and Web 2.0 to Web 3.0, with an emphasis on decentralization, semantic interoperability, and enhanced privacy.
2	To gain hands-on expertise in blockchain technology, consensus algorithms, smart contract development, and dApp design by employing open standards.
3	To deploy NFT tokenization models and digital identity systems in accordance with W3C standards.
4	To develop the ability to integrate emerging technologies (IoT, AI, Semantic Web) while ensuring accessibility, security, and global interoperability.
5	To critically assess decentralized governance models and regulatory challenges, proposing innovative solutions based on industry best practices.

Syllabus

Introduction	**9 Hours**

Evolution of the Internet – Transition from Web 1.0 (static/read-only) to Web 2.0 (interactive/centralized) and on to Web 3.0 (decentralized) – Core Concepts – Principles – Decentralisation – Semantic Interoperability - Exploration of Web 3.0's layered structure: Blockchain, Decentralized storage, P2P networks, and Semantic Web protocols.

Activity: Presentations on key historical transitions and share related research papers before in-class discussions.

Blockchain Technology & Distributed Ledger Systems	**9 Hours**

Blockchain Architecture – Consensus Mechanism – Proof-of-Work (PoW), Proof-of-Stake (PoS), and hybrid models – Pros and Cons - Directed Acyclic Graphs (DAGs) and emphasis on RESTful API design following open standards.

Activities:

• Pre-record lectures on consensus mechanisms and present comparative analyses.

• Reproduce comparative studies on consensus mechanisms using available simulation tools.

Smart Contracts, dApps, Block chain Integration	**9 Hours**

Fundamentals of design, deployment, and management of smart contracts on Blockchain platforms - Decentralized Applications (dApps) - Integration of Blockchain back - ends with front-end systems - HTML5, semantic HTML, and ARIA/WCAG.

Activities:

• Team-based development of the dApp, with roles distributed for front-end, smart contract, and oracle integration.

• Mini-tutorials on dApps and present case studies of dApps projects in class.

Digital Asset Tokenization (NFTs) and Decentralized Storage, Digital Identity, and Peer-to-Peer (P2P) Networking	**9 Hours**

Digital Asset Tokenization & NFTs - ERC-721/1155 standards - Metadata structuring with JSON-LD for interoperability - Oracle Services – Dynamic and real-time data - Decentralized Storage Systems – Storage Protocols – IPFS –

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Filecoin. Security – Scalability – Interoperability with traditional systems – Digital Identity – Decentralized Identity (DIDs) self-sovereign identity principles, and W3C DID and verifiable credentials standards. **Activities:** • Team-based development of the NFT smart contract • Mini-tutorials on Decentralized storage .	
Decentralized Governance & Tech Integration	**9 Hours**
Decentralized Governance & DAOs – Token – based governance – Structure of DAOs – voting mechanism - Regulatory & Economic Frameworks – Technology integration - Semantic Web protocols (RDF, OWL, SPARQL), AI for data curation, and IoT for real-time data collection - open standard compliance. **Activities:** • Case studies on DAO governance and present summaries of regulatory research. • Collaboration in groups to design and prototype DAO governance models and IoT integration solutions.	
Total Lecture Periods: 45 Hours	

References:	
1	Prabhat Kumar Srivastav, Prateek Singhal, Basudeo Singh, Nitin Sharma, "Web 3.0 | The Next Generation's Internet and Understanding the Concept", CRC Press, 2024.
2	Imran Bashir, "Mastering Blockchain: Unlocking the World of Cryptocurrencies", Latest Edition, Packt Publishing, 2023.
3	Andreas M. Antonopoulos and Gavin Wood, "Mastering Ethereum: Building Smart Contracts and DApps", 2nd Edition, O'Reilly Media, 2018.
4	Alex Tapscott, "Web3: Charting the Internet's Next Economic and Cultural Frontier, Portfolio", 2023.
Web References	
1	https://ipfs.tech/
2	https://docs.filecoin.io/
3	https://identity.foundation/
4	https://www.w3.org/TR/did-1.0/
5	https://www.aragon.org/

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, technologies, and architectural principles of Web 3.0 and their impact on next-generation internet applications.
2	Analyze Web 3.0 platforms and decentralized technologies to understand their functionality, performance, and security implications.
3	Evaluate Web 3.0 technologies, protocols, and applications to assess their suitability for decentralized and user-centric systems.
4	Design Web 3.0–based applications by selecting appropriate decentralized architectures, protocols, and technologies for real-world use cases.
5	Assess emerging Web 3.0 trends, decentralized governance models, and blockchain ecosystems to recommend suitable solutions for future internet applications.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	2	3
AVG	2.20	0.80	3.00	2.60	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP910	Advanced Large Language Models	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course provides the basic knowledge to understand and harness the capabilities of cutting-edge language models. Large Language Models (LLM) have revolutionized the way we interact with text, enabling us to communicate, analyse. and generate content with unprecedented sophistication.
2	This course will help the students to learn LLM from the introduction to the uses and limitations, the inner workings of LLMs, equipping the students with thc tools to explore their versatile applications in content creation, code generation, sentiment analysis, and more.

Syllabus

Building Blocks of Modern LLM's and Pre-Training Methods — **9 Hours**

Large language model basics, Large Language model architecture, Transformer Architecture, Attention all you need – Encoder – Decoder. Pre-training and Language Modeling, Auto-Regressive Language Modelling and Auto-Encoder Language Modelling, Early experiments with decoder and auto-encoder pretraining -Transformer Decoding Pretraining by Denoising Task.

Activities:

• Introduces the large language model basics and building blocks of language models.
• A detailed study about language architecture and transformer architecture.
• Analyze a real-world application for the Modern LLM.

LLM Pretraining Methods — **9 Hours**

Masked Language Modeling, BERT Pretraining with Masked LM, Autoregressive LM and Masked LM, LLM pretraining data, preprocessing clean text, Scaling Up pretraining data using the web, Language Model (LM)-Decoding Strategies.

Activities:

• Study the algorithm for Auto-Regressive and Auto-Encoder language modelling and implement the code to analyses the model flow.
• Implement the decoding strategies, scaling methods and experiment the same.

Parameter Efficient Tuning Methods — **9 Hours**

Categories of PETM – Prefix tuning, Prompt tuning- Adapters, Compacters- Layer freezing-Bias terms, Fine-tuning- diff pruning, Low Rank Adaptation (LoRA) – Advantages and Pitfalls, Explainability and LLMs, ethical considerations.

Activities:

• Study the algorithm for LLM pretraining and implement the code to analyses the model flow.
• Implement the LM decoding strategies and experiment the same

In-Context Learning, Prompt Engineering and Alignment — **9 Hours**

In-Context Learning, Fine-tuning - Zero-shot learning- Few-shot learning, Basics of prompting –Instruction prompting, Chain of thought prompting –Prompt selection, Automatic prompt design, Case Study: Visual Questions and Answering Systems, Sentiment training with Multi language dataset – CLIP.

Activities:

Implement the LoRA methods for the standard dataset using the python code and analyze the results.

Generation Based Automatic Evaluation Methods	9 Hours
What is Evaluation – Human Evaluation- Intrinsic Vs Extrinsic Evaluation, Why automatic evaluation- Ranking-Multiple metrics, GLUE-GEM- Beyond metrics, Human Evaluation metric – Quantitative and Qualitative evaluation, Human annotation- Reporting- Challenges in Evaluation, Evaluation metrics. **Activities:** • Learning the zero- shot learning, few-shot learning and prompt selection • Build the question and answering systems • Sentiment analysis using Multi-Language dataset	
Total Lecture Periods: 45 Hours	

References:	
1	Sebastian Raschka, Build a Large Language Model (From Scratch), September 2024, Manning Publications.
2	Tanmoy Chakraborty, Introduction to Large Language Models, Wiley Publications
3	Jay Alammar, Maarten Grootendorst, Hands on Large Language Models, Language Understanding and Generation, Shroff Publishers.
4	Amaratunga, Thimira, Understanding Large Language Models: Learning Their Underlying Concepts and Technologies, Springer Verlag, 2023
5	Raj Arun R, Mastering Large Language Models with Python, AVA publications 2024
E-Resources	
1	NPTEL Course: Introduction to Large Language Modelling
2	https://github.com/HandsOnLLM/Hands-On-Large-Language-Models

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and capabilities of advanced large language models and their applications in intelligent systems.
2	Analyze large language model architectures and training methodologies to understand their performance, scalability, and limitations.
3	Evaluate large language models and deployment strategies to assess their effectiveness, ethical considerations, and applicability in real-world scenarios.
4	Design applications and systems leveraging advanced large language models by selecting appropriate architectures, fine-tuning strategies, and deployment frameworks.
5	Implement and validate LLM-based applications using modern APIs, orchestration tools, and evaluation metrics to ensure performance, safety, and reliability.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP911	Edge and Fog Computing	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course aims to provide students with a comprehensive understanding of designing computing systems that process data closer to where it's created, rather than sending everything to distant cloud servers. Students will learn to build smart applications that work across different computing layers - from powerful cloud servers to small edge devices like sensors and smartphones. By the end, students can create practical solutions for smart cities, healthcare, and industry that respond quickly and work efficiently.

Syllabus

Cloud to Edge Computing Paradigms	**9 Hours**

Evolution from Cloud to Fog and Edge Computing - IoT Architecture Requirements and Latency Limitations - Fog vs Edge vs Cloud: Differences in Computation and Storage - Multi-access Edge Computing (MEC) Concepts - Multi-tier Architectural Models for Distributed Systems.

Activities:

- Case Study: IoT solution using fog or edge
- Group Discussion: Business opportunities in edge markets

Edge Offloading and System Optimization	**9 Hours**

Edge Offloading Strategies and Placement Issues - Challenges in Latency, Energy Efficiency, QoS, and Privacy - Queuing Theory and System Performance Metrics - Optimization Techniques using Machine Learning for Slice Orchestration.

Activities:

- Performance Comparison: Cloud vs Edge
- Mathematical Modeling: Latency or offloading simulation

Resource Federation and Network Slicing	**7 Hours**

Cloud-to-Fog-to-Things (C2F2T) Integration - Network Slicing for 5G/6G: Slice Types and Lifecycle - Resource Virtualization: SDN, NFV, and Container-Based Federation - Modeling and Simulation for Resource Management.

Activities:

- Implementation Case Study: 5G network slicing for verticals
- Quiz: Virtualization and resource slicing concepts

Middleware for Edge Systems and Intelligence and Analytics	**10 Hours**

Middleware Design Goals: Heterogeneity, Discovery, Scalability – Service Orchestration at the Edge - Lightweight Containers: Docker and Kubernetes on Constrained Devices - Edge Cluster Formation and Node Coordination - Communication Protocols: MQTT, CoAP, and Microservices - Distributed Storage, Synchronization, and Fault Recovery.

Data Management at the Fog Layer: Caching, Placement, Lifecycle - Federated Learning and Distributed ML for Edge Analytics - Stream Processing and Real-Time Analytics Frameworks - Use Cases: Smart Cities, Healthcare, Smart Homes - Security Challenges: ML-Based Threat Detection, Behavioral Analysis - Privacy Techniques: Differential Privacy, Federated Anonymization.

Activities:

- Prototype: Middleware architecture on edge devices
- Containerization Project: Docker/Kubernetes deployment
- Security Analysis: Vulnerabilities in edge middleware

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Advanced Technologies for Secure and Efficient Edge Computing and Emerging Trends	**10 Hours**
Blockchain for Fog Resource Security and Transparency - Software-defined Edge Networks and Intent-Based Networking - Green and Sustainable Edge Computing- Security and Privacy Challenges in Edge Environments. Edge AI and TinyML: Neural Compression, Quantization, Model Deployment - 6G Vision: Ultra-Low Latency, Terahertz Communications - Advanced Paradigms: Digital Twins, Serverless Edge, Cognitive Networks. **Activities:** ● Research Project: Emerging tech integration with edge computing ● Presentation: Future research directions and innovation trends ● Technical presentation on future research directions in edge computing	
Total Lecture Periods: 45 Hours	

References:	
1	Rajiv Pandey, Sunil Kumar Khatri, Neeraj Kumar Singh, Parul Verma, Artificial Intelligence and Machine Learning for EDGE Computing, 1st Edition,2022, Academic Press
2	S. Goundar, Ed., 'Edge Computing - Technology, Management and Integration'. IntechOpen,2023.
3	Ahmed Banafa, Secure And Smart Internet of Things (loT) using Blockchain and Artificial Intelligence (AI).2018, River publications
4	Javid Taheri, Schahram Dustdar, Albert Zomaya, Shuiguang Deng, Edge Intelligence From Theory to Practice, 2023, Springer
5	Fog, Edge, and Pervasive Computing in Intelligent IoT Driven Applications Deepak Gupta, Aditya Khamparia ,2021, Wiley-IEEE Press
E-Resources:	
1	Kubernetes on Edge: K3s Documentation and Tutorials - https://k3s.io/
2	Foundation of Cloud IoT Edge ML, NPTEL, Prof. Rajiv Misra, IIT Patna - https://archive.nptel.ac.in/courses/106/104/106104242/
3	Open5GS Documentation - https://open5gs.org/
4	Eclipse IoT Working Group - https://iot.eclipse.org/
5	TensorFlow Lite for Microcontrollers - https://www.tensorflow.org/lite/microcontrollers
6	Apache Flink Training - https://flink.apache.org/
7	Hyperledger Fabric Tutorials - https://hyperledger-fabric.readthedocs.io/
8	Subedi, P., Alsadoon, A., Prasad, P.W.C. et al. Network slicing: a next generation 5G perspective. J Wireless Com Network 2021, 102 (2021). https://doi.org/10.1186/s13638-021-01983-7

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Course Outcomes	
CO No.	**Course Outcomes**
1	Explain the evolution of cloud-to-edge paradigms and describe the role of edge and fog computing in real-time IoT applications.
2	Design and optimize network slicing strategies for integrated cloud–fog–edge systems using mathematical modeling and optimization techniques.
3	Develop middleware architectures and container-based solutions for distributed edge computing environments.
4	Implement intelligent data management systems and machine learning solutions at the fog layer for real-time analytics.
5	Evaluate emerging technologies and research directions in edge and fog computing for future system design.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	1	3	3	2
3	2	1	3	3	2
4	3	1	3	3	3
5	3	2	3	2	3
AVG	2.20	1.00	3.00	2.60	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP912	Green Computing and Sustainability	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To understand the principles of green computing
2	To assess environmental impacts of computing technologies and need for green computing.
3	To explore sustainable IT practices and energy-efficient hardware system for sustainability growth.

Syllabus

Introduction to Green Computing	**9 Hours**

Scope - Environmental Impact of Computing - Need for Sustainable Computing – Power-Aware Resource Management - Green IT - OCED Green IT Framework – Greening IT - Benefits and Challenges - Quantifying IT Energy Efficiency.
Activity: Review: E-waste management.

Green Hardware	**9 Hours**

Life cycle of hardware - Reuse, Recycle and Dispose Green Design and Manufacturing of Computers- Green Software - Energy-Saving Software Techniques.
Activity: Demo: DAQ tools

Sustainable Software Development	**9 Hours**

Attributes – metrics – Methodology - Energy aware Software Engineering - Green Algorithms.
Activity: Case study: Project's Carbon Footprint

Green Data Center and Data Storage	**9 Hours**

Infrastructure for Energy Efficiency – server power management. Practices for Improving the Energy Efficiency of Data Storage - Optical Interconnects for Green Computers and Data Centers.
Activity: Poster presentation: Energy issues in Data Centers Case study: Energy-efficient cloud computing

Managing Green IT and Nonregulatory Government Initiatives	**9 Hours**

Strategizing Green Initiatives – Implementation - Green IT Laws, Standards and Protocols- Regulatory Environment and IT Manufacturers.Green Building Standards - Sustainability Reporting and Green Audits.
Activities:
Demo: Green IT Laws in India. Debate: Role of IT professional in Green Computing.
Perform Energy audit in computer lab using software tools.

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	San Murugesan, Harnessing Green IT: Principles and Practices, Wiley, 2012.
2	Suyel Namasudra(Editor), Green and Sustainable Computing, 1st Edition, Volume 87, Elsevier, 2012.
3	Toby Velte, Anthony Velte, Robert Elsenpeter, "Green IT: Reduce Your Information System's Environmental Impact", McGraw Hill, 2008.
4	Bhuvan Unhelkar, "Green IT Strategies and Applications: Using Environmental Intelligence", CRC Press, 2011.
5	Balamurugan Balusamy, Naveen Chilamkurti, Seifedine Kadry, Green Computing in Smart Cities: Simulation and Techniques, Springer Singapore, 2020.
6	Mike Halsey, The Green IT Guide - How to Make Your IT Systems and Business Sustainable and Carbon Neutral, Apress, 2025
E - Resources:	
1	Prof. Deepu Philip, Prof. Amandeep Singh | IIT Kanpur Link http://onlinecourses.nptel.ac.in/noc21_mg85/preview
2	Prof. Sayak Banerjee | IIT Hyderabad Link "https://onlinecourses.nptel.ac.in/noc23_me138/preview"

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, principles, and practices of green computing and sustainability in modern information technology systems.
2	Analyze computing systems and technologies to assess their energy efficiency, environmental impact, and sustainability metrics.
3	Evaluate green computing strategies, sustainable IT practices, and regulatory frameworks for their effectiveness in reducing environmental impact.
4	Design sustainable computing solutions by selecting energy efficient architectures, technologies, and practices for environmentally responsible systems
5	Implement and validate green computing practices using energy-aware tools, optimization techniques, and performance metrics to improve system sustainability.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	2	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.60	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP913	Cognitive Computing	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To understand the core principles of cognitive computing and how they emulate human thought processes.
2	To apply cognitive computing to solve complex, unstructured, and real-world problems
3	Develop cognitive computing applications.

Syllabus

Human cognition — **9 Hours**

Introduction to Cognitive Computing – Elements of a Cognitive System - Design Principles for Cognitive Systems - Artificial Intelligence, Natural Language Processing and Machine Learning in Cognitive Computing.

Activities:

Concept Quizzes: Human cognition and Cognitive Computing

Research paper review on cognitive systems

Cognitive architectures — **9 Hours**

ACT-R, Soar, OpenCog - Knowledge Representation and Reasoning - Machine Learning models in cognitive systems - Human-like Learning: Supervised, Unsupervised, Reinforcement.

Activity: Demo on IBM Watson APIs (Language Translator)

Role of NLP — **9 Hours**

Role of NLP in a Cognitive System - NLP pipeline: POS tagging, NER, parsing Sentiment Analysis and Question Answering Debate: Sentiment analysis and its challenges in Regional Languages. Semantic Web - Semantic Understanding: Ontologies and Knowledge Graphs.

Activity: Ideathon: Innovative solution to health care problems.

Cognitive Agents — **9 Hours**

Cognitive Agents - Rule-based Agents and Expert Systems - Decision Support Systems -Emotion-aware computing and human-computer interaction- Cognitive bias and ethics in decision making.

Activity: Mini project: Develop health care chatbot. Prototype Demonstrations.

Cognitive Computing Applications — **9 Hours**

Process of Building a Cognitive Application - IBM's Watson as a Cognitive System- Business Implications of Cognitive Computing. Healthcare, Finance, Education, Legal, Robotics-Building a Cognitive Healthcare Application - Emerging Cognitive Computing Areas - Cognitive cloud- Cognitive IoT - Cognitive Chatbots - Neuromorphic computing and brain-inspired models.

Activities:

Prototype Demonstrations.

Project demo and peer review.

Total Lecture Periods: 45 Hours

References:	
1	Velankar, Mahalle & Shinde – Cognitive Computing for Machine Thinking, CRC Press, 2024.
2	Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles – Cognitive Computing and Big Data Analytics, Wiley, 2015.
3	Peter Fingar , Cognitive Computing: A Brief Guide for Game Changers, Meghan Kiffer, 2015
4	Building Cognitive Applications with IBM Watson Services, Redbooks, 2017
5	Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O'Reilly, 2009.
6	Fuchun Sun, Qinghu Meng, Zhumu Fu, Bin Fang (Editors), Communications in Computer and Information Science (CCIS, volume 1918) – Springer Series, 2024.
E-Resources	
1	Prof. Sharba Bandyopadhyay, Prof. Rajlakshmi Guha | IIT Kharagpur, IIT Kharagpur Link https://onlinecourses.nptel.ac.in/noc22_ee122/preview
2	Cognition and its Computation, IIT Kharagpur Prof. Sharba Bandyopadhyay, Prof. Rajlakshmi Guha Link "https://nptel.ac.in/courses/108105185"

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and paradigms of cognitive computing and their role in intelligent decision-making systems
2	Analyze cognitive computing models and learning mechanisms to understand perception, reasoning, and knowledge representation in intelligent systems.
3	Evaluate cognitive computing techniques, frameworks, and applications to assess their effectiveness in solving complex real-world problems.
4	Design cognitive computing solutions by selecting appropriate models, algorithms, and system architectures for human-centric intelligent applications.
5	Implement and validate cognitive computing systems using machine learning, knowledge-based reasoning, and hybrid AI approaches, and assess their performance in real-world scenarios.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP914	Agentic AI	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	Understand the foundations and architecture of intelligent agents
2	Design agents capable of autonomous and rational decision-making.
3	Apply reinforcement learning for adaptive agent behavior.
4	Explore coordination in multi-agent and human-AI systems.
5	Analyse the ethical implications of agentic systems and develop real-world applications using modern agent-based AI frameworks.

Syllabus

Foundations of Intelligent Agents — **9 Hours**

Introduction to Agentic AI: History, Motivation, Applications - Agents and Environments: Sensors, Actuators, Environment Types - Types of Agents: Simple Reflex, Goal-Based, Utility-Based, Learning Agents - Architectures: Reactive, Deliberative, Hybrid, Subsumption.
Activity: Report preparation about types of Agents, role and architecture of each agent

Agent Decision-Making and Planning — **9 Hours**

Rationality and Utility Theory - Task Environment Analysis - AI Planning Techniques: STRIPS, Classical Planning - Decision-Making under Uncertainty: MDPs, Bayesian Models, Game Theory.
Activity: Design a simple application for making decision using AI in python

Learning in Agentic Systems — **9 Hours**

Reinforcement Learning:Q-Learning, SARSA - Value and Policy Iteration - Deep RL: DQNs, Policy Gradient Methods, Actor-Critic - Tools: OpenAI Gym, PettingZoo, 57 TensorFlow RL.
Activity: Write a case study for Tools about OpenAI and TensorFlow with proper application

Multi-Agent Systems and Collaboration — **9 Hours**

Multi-Agent Coordination: Cooperation, Competition - Agent Communication and Negotiation - Human-AI Collaboration: Interactive and Mixed-Initiative Systems - Platforms: NetLogo, RoboCup Simulation.
Activity: Create Autonomous agents using NettLogo platform

LLM Agents and Embodied Cognition — **9 Hours**

Language-based Agents: Tool Use, Planning, and Reasoning - Memory-Augmented, and Situated Agents, - Agents in Robotics and Smart Environments - Unity ML-Agents, Hugging Face Tools. AI Alignment, Fairness, Explainability - Social and Environmental Implications- Case Studies: Autonomous Vehicles, Conversational Agents - Course Project Evaluation and Presentations.
Activities:
Design a simple application based on LLM-based tool-using agents
Agent-based simulations for real-world problems

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Artificial Intelligence: A Modern Approach, Russell & Norvig, 4th Ed., Pearson, 2021
2	Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Shoham & Leyton-Brown, CUP, 2009
3	Reinforcement Learning: An Introduction, Sutton & Barto, 2nd Ed., MIT Press, 2018

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and principles of agentic artificial intelligence and autonomous agent systems.
2	Analyze agentic AI models and decision-making mechanisms to understand autonomy, goal-directed behavior, and interaction in intelligent agents.
3	Evaluate agentic AI frameworks, learning strategies, and coordination techniques to assess their effectiveness in complex and dynamic environments.
4	Design agentic AI solutions by selecting appropriate agent architectures, learning methods, and coordination mechanisms for real-world applications.
5	Demonstrate and validate agentic AI systems using simulation environments, frameworks, and evaluation metrics to assess performance, autonomy, and adaptability.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP915	Mixed Reality	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course to define mixed reality and differentiate between virtual reality and augmented reality. It is used to describe the core ideas behind holograms and start designing and developing 3D applications. It also used to understand what mixed reality offers in real-world apps.

Syllabus

Defining Virtual and Augmented Reality	**9 Hours**
Four Key Elements of Virtual Reality Experience Looking at Some Other Types of Virtual and Augmented Reality. **Activity:**Assignment about Virtual Reality Experience for real world applications	
Exploring the Current State of Virtual Reality	**9 Hours**
Looking at the Available Form Factors, Focusing on Features. Room-scale versus stationary experience. Inside-out tracking. Tracking devices Haptic feedback, Audio, Considering Controllers. Mobile devices AR headsets. AR glasses. Hand tracking. Motion controllers Hand and Gesture Tracking, Whole Body Tracking. **Activity:**Create a flipped class room for exploring the current state of Virtual Reality	
Simple VR Environment Development	**9 Hours**
Interacting with the Virtual World, Interactions: Manipulation, Navigation, and Communication, **Creating** Basic objects in Sketchup tool, Grouping and Components, Development of Virtual Environment using SketchUp tool,connecting the VR environment to Meta Quest 2 (HMD) using VR Sketch, Navigation in the Virtual Environment. **Activity:**Create a flipped class room for exploring the current state of Augmented Reality	
Creating 2D/3DProjects	**9 Hours**
Getting started with Unity, Installing Unity Hub and Unity Editor, Editor interface, Creating Projects with templates, Asset store, creating a simple 2d game using game objects, Scripting in c#, Visual Scripting, creating a simple 3D game by importing game objects from asset store, Building the projects to desktop OS/ Mobile OS. **Activities:** Create a Simple Virtual Environment for a simple real - world application Create a simple 3D game using Visual Scripting	
Setting Up for AR Development	**9 Hours**
Installing XR plugins for AR devices, Installing the AR Foundation package, Building the Simple AR scene in project, Importing the Sample assets, Using AR Session and AR Session Origin, AR Camera, Adding AR Ray cast Manager, Building and running the scene. Placing an object on a plane, Writing the Place Object on Plane script, creating a prefab for placing on the scene. **Activity:**Write a case study about setting up for AR development	
Total Lecture Periods: 45 Hours	

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Jonathan Lenowes, Augmented Reality with Unity AR Foundation,2021 Packt Publishing
2	William R. Sherman, Alan B. Craig, Understanding-Virtual-Reality-Interface-Application-and-Design-The-Morgan-Kaufmann-Series-in-Computer-Graphics
3	Virtual &Augmented Reality for Dummies by Paul Mealy, Wiley Publications 2013
4	Chen, Virtual, Augmented and Mixed Reality. Applications and Case Studies, Springer Publications 2019.
5	Rajiv Chopra, Virtual and Augmented Reality, Khanna Publishing House, 2021

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, technologies, and components of mixed reality and their applications in immersive digital environments.
2	Analyze mixed reality systems and interaction techniques to understand performance, usability, and user experience in immersive applications.
3	Evaluate mixed reality platforms, devices, and development frameworks to assess their suitability for various application domains.
4	Design mixed reality applications by selecting appropriate hardware, software frameworks, and interaction models for real-world use cases.
5	Develop and validate mixed reality applications using game engines, XR toolkits, and testing methods to ensure usability, performance, and immersive experience quality.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP916	Blockchains Architecture and Design	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	The objective of this course is to study the Blockchain Technology and its uses across a range of fields, with an emphasis on Blockchain fundamentals, Smart contracts, Consensus processes and Security issues.

Syllabus

Introduction to Blockchain	**9 Hours**

Introduction to Blockchain – Layers of Blockchain – Types of Blockchain – Generic Elements of Blockchain – Basic Cryptographic primitives used in Blockchain – Hash Functions – Merkle Tree – Structure of Block – Linking Blocks in the Blockchain – Mining the Block – Validating a New Block – Assembling and Selecting Chains of Blocks.

Activity: Quiz on core Blockchain concepts like hashing, signing data and building Merkle tree

Bitcoin and Consensus Mechanisms	**9 Hours**

Bitcoin Overview – Bitcoin Scripts – Bitcoin Transactions – Bitcoin Network and Payments – Consensus mechanism – Types of Consensus mechanism. Proof of Work (PoW) – Consensus Protocols for Permissionless Blockchain Environment – Consensus Protocols for Permissioned Blockchain Environment.

Activity: Debates and Discussion on the pros and cons of various consensus protocols

Smart Contracts and Ethereum	**9 Hours**

Smart Contract – Definition – Ricardian Contracts – Introduction to Ethereum – Ethereum Network – Components of the Ethereum – Ethereum Virtual Machine (EVM) – Ethereum Development Environment – Solidity Language.

Activity: Identify and set up Ethereum testnet – Transfer ethers between accounts

Web3 And Hyperledger Fabric	**9 Hours**

Exploring Web3 with Geth – Contract Deployment – Interacting with contracts via frontends – Truffle – Introduction to Hyperledger – Reference Architecture – Hyperledger Fabric – Hyperledger Sawtooth – Corda.

Activity: Presentation prepared on Smart Contract and Ethereum concepts from research papers

Blockchain Applications And Future Directions	**9 Hours**

Blockchain for Government: Border control – Voting – Citizen Identification – Blockchain for Health Industry – Blockchain for Finance: Insurance – Post Trade Settlement – Financial Crime Prevention. Scalability – Privacy – Emerging Trends – Limitations of Current Blockchain Platforms – Open Research Challenges.

Activities:

Explore and Discuss research papers related to Hyperledger and Blockchain technology

Research and present use cases like supply chain, digital identity, etc.

Total Lecture Periods: 45 Hours

References:	
1	Imran Bashir, “Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, Dapps, cryptocurrencies, Ethereum,and more”, Third Edition, Packt Publishing, 2020.
2	Andreas M. Antonopoulos, David A. Harding, “Mastering Bitcoin: Programming the open Blockchain”, Third Edition, O’Reilly Publishing, 2023.
3	Ahmed Banafa, “Blockchain Technology and Applications“, First Edition, River Publishers, 2024.
4	Melanie Swan, “Blockchain: Blueprint for New Economy”, First Edition, O’Reilly Publishing, 2015.
5	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, “Beginning
6	Blockchain : A Beginner’s Guide to Building Blockchain Solutions“ , 1st edition, Apress, NewYork, 2018.

E-Resources:	
1	Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
2	Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
3	https://www.tutorialspoint.com/blockchain/index.htm
4	https://www.nptel.ac.in/courses/106105184 by Prof.S.Chakraborty and P.Jayachandran,IIT Kharagpur

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, components, and operational principles of blockchain architectures and distributed ledger technologies.
2	Analyze blockchain consensus mechanisms, data structures, and network architectures to understand security, performance, and scalability issues.
3	Evaluate blockchain platforms, smart contract frameworks, and architectural designs to assess their suitability for various decentralized applications.
4	Design blockchain-based systems by selecting appropriate architectures, consensus protocols, and smart contract models for real-world use cases.
5	Develop and validate blockchain applications using smart contract tools, decentralized frameworks, and testing environments to ensure security, efficiency, and reliability.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP917	Human - Centered AI	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	The course aims to introduce the fundamentals of Human-Centered Artificial Intelligence (HCAI), focusing on its principles, frameworks, and societal impact. This course includes fairness, privacy, reliability, and ethical considerations in the development of intelligent systems. Additionally, it explores governance structures, best practices, and regulatory measures to ensure safe and trustworthy AI deployment.

Syllabus

Introduction To Human-Centered AI	**9 Hours**
Overview of AI development - Defining Human-Centered AI (HCAI) - Difference between traditional AI and HCAI - Process of design thinking - Cognitive models. **Activity:**Explore the key innovations and challenges involved in human-AI collaboration across different sectors.	
Human Factors and AI	**9 Hours**
People and Computers: Are They in the Same Category? - HCAI principles - Impact of AI on society - Importance of human values. **Activity:**Explore the impact of AI on ethics and human centric approaches.	
Fairness and Bias, Privacy	**9 Hours**
Sources of bias, Group fairness-Exploratory data analysis, limitation of a dataset - Group fairness and Individual fairness-Counterfactual fairness. Attack models-Privacy: Preserving Learning-Differential privacy-Fedrated learning. **Activity:**Use AI platforms to detect and analyze various types of bias	
HCAI Framework,Design	**9 Hours**
Levels of automation - Defining reliable, safe, and trustworthy systems - Two-dimensional HCAI framework: life-critical systems - Golden rules for design - Application examples. Science and innovation goals - Intelligent agents - Tele-bots - Assured autonomy: design, control centers - Social robots: active appliances - Enhancing human capabilities. **Activities:** Explore why a coin flip is used in sensitive surveys to protect privacy Prepare a presentation on Human-Centered AI: Model Explainability with LIME and SHAP	
HCAI Governance Structures	**9 Hours**
Ethical implications of emerging AI technologies - Software engineering best practices - Establishing safety cultures in organizations - Independent oversight and certification - Role of government regulation. **Activities:** Survey and analyze recent research papers emphasizing Human-Centered AI (HCAI) Explore national policies, ethical guidelines, and legal frameworks aimed at ensuring the safe and responsible use of Artificial Intelligence across the world	
Total Lecture Periods: 45 Hours	

References:	
1	Human-Centered AI: A New Synthesis, Ben Shneiderman, 1st Edition, Oxford University Press, 2022.
2	Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Virginia Dignum, Springer Nature, 2019.
3	Interpretable Machine Learning, Christoph Molnar, 1st Edition, Lulu, 2019. [eBook, Available Online]
4	Designing the User Interface: Strategies for Effective Human-Computer Interaction, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist, 6th Edition, Pearson Education, 2018.
5	Interaction Design: Beyond Human-Computer Interaction, Jenny Preece, Helen Sharp, Yvonne Rogers, 5th Edition, Wiley Student Edition, Wiley, 2019.
6	Human-Computer Interaction, Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, 3rd Edition, Pearson Education, 2004.
7	AI Ethics, Paula Boddington, Springer, 2023.
8	The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities, Luciano Floridi, Springer, 2023.
E-Resources:	
1	NPTEL Video Lecture Notes on "Responsible & Safe AI Systems"
2	https://aclanthology.org/2021.acl-long.330.pdf
3	https://arixv.org/pdf/2004.09456

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, principles, and design philosophies of human-centered artificial intelligence for developing responsible and user-focused AI systems.
2	Analyze human-AI interaction models and ethical considerations to understand usability, transparency, and trust in intelligent systems.
3	Evaluate human-centered AI approaches, frameworks, and applications to assess their effectiveness in enhancing user experience and societal impact.
4	Design human-centered AI solutions by selecting appropriate interaction techniques, ethical guidelines, and evaluation strategies for real-world applications.
5	Develop and validate human-centered AI systems using user-centered design methods, prototyping tools, and evaluation metrics to ensure usability, fairness, and transparency.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	2	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP918	Vibe Coding	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course introduces the basics of AI-assisted coding and Vibe Coding. Participants will learn to use AI tools, build simple applications, and understand the roles and ethics involved. By the end, they will create their own AI-powered projects.

Syllabus

Introduction To Vibe Coding and Human-Ai Collaboration — **9 Hours**

Introduction to Vibe Coding-Basic Prompting Techniques for Coding Tasks-Roles and - Responsibilities in Human-AI Collaboration-AI Assistant-Prompt Engineer-Developer-Designing Simple AI-Augmented Workflows-Interaction Between AI-Generated Code and Developer Feedback.

Activities:

• Students take on roles such as AI, prompt engineer, and developer to simulate collaborative coding.

• Students learn prompting basics at home and participate in a class quiz and discussion.

Tools And Platforms for Ai-Assisted Coding — **9 Hours**

Overview of AI-Assisted Coding Tools-Cursor, v0, Bolt, etc.-Features and Use Cases of Each Tool-Setting Up and Navigating AI-Coding Platforms-Building Simple Web Applications with AI -Integration-Workflow Prototyping Using AI Tools.

Activities:

• Students explore AI tools (e.g., Cursor or v0) at home and build a basic app in class.

• Groups design a simple development workflow using AI tools and explain tool selection and purpose.

AI Prompt Design, Oversight, and Ethical Coding Practices — **9 Hours**

Vibe Coder's Toolkit: Prompts, Context, and Flow-Prompt Optimization Techniques-Human Oversight in AI Coding Systems-Ethical and Responsible AI Usage-Challenges and Best Practices in AI-Augmented Development. Evolving Developer Roles in the AI Era-The Shift from Coding to Orchestration and Strategy-AI Integration Across the Software Development Lifecycle-Human-AI Collaboration in Debug, Design, and Deployment-Strategic Thinking and Adaptability in AI-Augmented Teams.

Activities:

• Team presents a complete AI workflow, including prompt design, context handling, and oversight strategy.

• Class discussion on accountability, code quality, and risks of over-reliance on AI in software development.

Code Quality, Reliability, and Ethical Development — **8 Hours**

Long-Term Maintainability of AI-Generated Code-Refactoring AI-Assisted Code for Clarity and Standards-Documentation Strategies for Mixed Human-AI Codebases-Common Security and Reliability Issues in Vibe Code-Ethical Coding Practices in AI-Augmented Environments-Navigating Cultural Shifts in 'Vibe Coding' and Accountability.

Activities:

• Showcase how AI transforms developer roles across the SDLC.

• Simulate a modern dev team using AI tools and complete a quiz based on workflow

observations.	
Applied Projects and Real-World Ai Applications	**10 Hours**
AI-Powered Task Manager and To-Do Lists-Resume Builder with Smart AI Suggestions-Note-Taking App with Auto-Organization-Recipe Generator with Ingredient Substitution Logic-Visual Memory Game Using AI Tools-Non-diagnostic Health Symptom Checker. Planning and Scoping AI-Assisted Applications-Workflow Mapping from Idea to Deployment-Integrating Front-End, Back-End, and AI Logic-Testing and Deploying AI-Augmented Applications-Human Oversight and Continuous Improvement Loops-Project Ownership and Accountability in AI Codebases. **Activities:** • Build a working prototype (e.g., to-do list, resume builder) using AI-assisted tools. • Present the final project and complete a quiz on the design and development process.	
Total Lecture Periods: 45 Hours	

References:	
1	Ted Winston, Mastering Vibe Coding: Build, Debug, and Ship Software with AI Assistants like Cursor, Replit, and GPT, Kindle Edition, April 25, 2025.
2	Ethan Voss, Vibe Coding: Build & Sell Apps Without Coding Experience: How to Use AI to Create Profitable Apps Even If You've Never Written a Line of Code, Kindle Edition, 26 March 2025.
3	Amit Iyer, Beginner's Guide to Vibe Coding: Exploring Features, Use Cases and Understanding Vibe Coding, Paperback, 19 March 2025.
4	Gene Kim, Steve Yegge, Vibe Coding: Building Production-grade Software With GenAI, Chat, Agents, and Beyond, Paperback, 21 October 2025.
5	Addy Osmani, Beyond Vibe Coding, O'Reilly Media, Inc., August 2025. ISBN: 9798341634756

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, philosophy, and practices of vibe coding and its role in modern, collaborative, and creative software development.
2	Analyze vibe coding workflows, tools, and collaborative practices to understand productivity, creativity, and developer experience.
3	Evaluate vibe coding approaches, platforms, and community-driven practices to assess their effectiveness in real-world software development scenarios.
4	Design software development solutions using vibe coding principles by selecting appropriate tools, collaboration strategies, and creative workflows.
5	Develop and validate software applications using vibe coding environments, AI-assisted tools, and collaborative platforms to ensure functionality, usability, and iterative improvement.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	2	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.60	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP919	Federated Learning	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	Understand the fundamentals, architecture, and real-world relevance of Federated Learning.
2	Learn core FL algorithms, privacy techniques, and system challenges in decentralized settings.
3	Apply FL frameworks and tools to build practical applications through hands-on project work.

Syllabus

Introduction to Federated Learning	**9 Hours**

Definition and Scope – Motivation: Data Privacy, Decentralization, Compliance (GDPR, HIPAA) – Centralized vs. Federated vs. Distributed Learning – Types of FL: Horizontal, Vertical, and Transfer FL – Real-World Applications: Mobile Keyboard (GBoard), Healthcare, IoT – FL System Architecture – Federated Learning Workflow and Lifecycle – Communication Protocols.
Activity: Create a Quiz for understanding Federated Learning Basics

Federated Learning Algorithms	**9 Hours**

Federated Averaging (FedAvg) – Federated SGD (FedSGD) – FedProx for handling system heterogeneity – Personalized Federated Learning (pFedMe, FedPer, FedBN) – FL with Non-IID Data – Aggregation and Weight Update Strategies – Convergence Issues – Performance Metrics.
Activity: Create a flipped class room for Understanding federated learning algorithms

Privacy and Security in FL	**9 Hours**

Security Threats in FL – Differential Privacy (DP): Concept, Application in FL – Secure Multiparty Computation (SMC) – Homomorphic Encryption (Overview) – Secure Aggregation Protocols – Byzantine Robustness – Model Inversion Attacks – Data Poisoning – Mitigation Strategies.
Activity: Ask students to submit an assignment on Privacy and security in FL

System & Communication Challenges	**8 Hours**

Device Heterogeneity – Intermittent Availability – Resource Constraints (Memory, Battery, Network) – Client Selection Strategies – Communication Efficiency: Quantization, Compression, Sparsification – Dropout and Partial Client Participation – FL over Edge Devices – Energy-aware FL.
Activity: Create a flipped class room communication challenges

Applications and Frameworks	**10 Hours**

FL Applications in Healthcare, Finance, Smart City, Recommender Systems – Case Studies – Tools and Frameworks: TensorFlow Federated, PySyft, Flower – FL Simulators. Project Work: Building a Simple Federated Learning Model – Model Deployment and Evaluation – Future Directions: Split Learning, Hybrid FL, Federated Analytics, FL + AI/ML.
Activities: Ask students to submit an Assignment on applications of FL

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Q. Yang, Y. Liu, T. Chen, and Y. Tong, Federated Learning, PHI Learning Pvt. Ltd., 2021.
2	M. Mohri, A. Rostamizadeh, and A. Talwalkar, Foundations of Machine Learning, 2nd ed., Pearson Education, 2020.
3	K. P. Murphy, Machine Learning: A Probabilistic Perspective, Pearson Education, 2017.
4	C. M. Bishop, Pattern Recognition and Machine Learning, Oxford University Press, 2016.
5	T. Mitchell, Machine Learning, Tata McGraw-Hill Education, 2017.
E-resources:	
1	https://youtu.be/E3Kn5v-vdUc?si=UMnGqSNOB9NjheTS- NPTEL YouTube–Lecture 42: Introduction to Federated Learning
2	https://github.com/adap/flower- Flower Framework GitHu
3	https://github.com/OpenMined/PySyft- PySyft (OpenMined)

Course Outcomes	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and operational principles of federated learning and privacy-preserving machine learning systems.
2	Analyze federated learning algorithms and communication strategies to understand model convergence, privacy, and system performance.
3	Evaluate federated learning frameworks, security mechanisms, and deployment approaches to assess their effectiveness in distributed and sensitive data environments.
4	Design federated learning solutions by selecting appropriate aggregation methods, communication protocols, and privacy techniques for real-world applications.
5	Implement and validate federated learning systems using distributed training frameworks and evaluation metrics to ensure privacy, efficiency, and model performance.

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP920	Deep Learning for Computer Vision	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	This course provides the automatic analysis and understanding of images and videos and Computer Vision. It occupies significant importance in applications including security, healthcare, entertainment, mobility, etc. The recent success of deep learning methods has revolutionized the field of computer vision, making new developments increasingly closer to deployment that benefits end users.

Syllabus

Introduction to Image Fundamentals, Visual Matching and Deep Learning	**9 Hours**

Introduction to Image Formation – Capture and Representation – Linear Filtering – Correlation – Convolution – Edge – Blobs – Corner Detection – Scale Space and Scale Selection – SIFT – SURF– HoG – LBP, Bag-of-words – VLAD – RANSAC – Hough transform – Pyramid Matching – Optical Flow – Review of Deep Learning – Multi-layer Perceptron – Backpropagation.

Activity: Ask the student to present the seminar on the Image Features

Convolutional Neural Networks (CNN)	**9 Hours**

Introduction to CNNs – Evolution of CNN Architectures – AlexNet – ZFNet – VGG – InceptionNets – ResNets – DenseNets – Visualization of Kernels – Backpropagation to image/Deconvolution Methods – Deep Dream – Hallucination – Neural Style Transfer - CAM – Grad – CAM – Grad CAM++ - Recent Methods (IG, Segment-IG, SmoothGrad).

Activity: Create a Quiz to discuss about the basics of Deep Learning

Applications of CNN	**9 Hours**

CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss) – CNNs for Detection: Background of Object Detection – R-CNN – Fast R-CNN – Faster R-CNN – YOLO – SSD – RetinaNet – CNNs for Segmentation: FCN – SegNet – U -Net – Mask-RCNN.

Activity: Ask student to submit assignments on principle behind Hallucination

Recurrent Neural Networks (RNN) and Attention Models	**9 Hours**

Introduction to RNNs – CNN and RNN Models for Video Understanding: Spatio-temporal Models, Action/Activities Recognition – Introduction to Attention Models in Vision – Vision and Language: Image Captioning – Visual QA – Visual Dialog – Spatial Transformers – Transformer Networks.

Activity: Create a Discussion to differentiate R-CNN, Fast R-CNN and Faster R-CNN

Deep Generative Models - Applications and variants of Generative Models in Vision	**9 Hours**

Deep Generative Models: GANs – VAEs – Other Generative Models: PixelRNNs, NADE, Normalizing Flows - Applications: Image Editing – Inpainting – Superresolution - 3D Object Generation – Security - Variants: CycleGANs – Progressive GANs – StackGANs - Pix2Pix. Zero-shot – One-shot – Few-shot Learning – Self-supervised Learning – Reinforcement Learning in Vision – Applications.

Activity: Ask students to prepare a presentation about Transformers.

Total Lecture Periods: 45 Hours

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

References:	
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016, MIT Press
2	Michael Nielsen, Neural Networks and Deep Learning, 2016
3	Yoshua Bengio, Learning Deep Architectures for AI, 2009, Now Publishers
4	Richard Szeliski, Computer Vision: Algorithms and Applications, 2022, Springer Publisher.
5	Simon Prince, Computer Vision: Models, Learning, and Inference, 2012, Cambridge University Press
6	David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002, Pearson Education.
E-Resources:	
1	https://opencv.org/blog/deep-learning-with-computer-vision/
2	https://onlinecourses.nptel.ac.in/noc25_cs93/preview
3	https://cs231n.stanford.edu/

Course Outcomess	
CO No.	**Course Outcomes**
1	Describe the fundamental concepts, architectures, and techniques of deep learning used for computer vision and image understanding tasks.
2	Analyze deep learning–based computer vision models to understand feature learning, performance metrics, and optimization challenges.
3	Evaluate computer vision algorithms and deep learning architectures to assess their effectiveness for various visual recognition and analysis applications.
4	Design computer vision solutions by selecting and integrating suitable deep learning models, datasets, and training strategies for real-world vision problems.
5	Develop and validate computer vision applications using deep learning frameworks, preprocessing pipelines, and evaluation metrics to ensure accuracy and robustness.

CO	PO1	PO2	PO3	PSO1	PSO2
1	1	–	3	2	1
2	2	–	3	3	2
3	3	1	3	3	2
4	2	1	3	3	3
5	3	2	3	3	3
AVG	2.20	0.80	3.00	2.80	2.20

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032

26CSP92	Advanced Compiler Design	T	L	T	P	J	C
			3	0	0	0	3

Course Objectives

1	To analyze the theory and principles of modern compiler design and advanced optimization techniques.
2	To design and implement efficient front-end and back-end compiler components for programming languages.
3	To evaluate code optimization strategies and runtime environment management in contemporary architectures.

Syllabus

Intermediate Representations and Control Flow Analysis — **8 Hours**

Static single assignment (SSA) form- Context-Free Grammer (CFG) construction-dominance relations Intermediate Representation (IR) design for functional and imperative languages-Static single assignment and def-use chains.

Activities:

Convert source code to SSA form using LLVM IR.

Visualize control flow graphs from SSA using LLVM tools.

Program Analysis and Transformations — **8 Hours**

Data flow analysis- live variable analysis- reaching definitions-Alias analysis and dependence analysis-Loop optimizations and transformations.

Activities:

Perform loop unrolling and strength reduction.

Conduct live variable analysis and visualize data flow graphs.

Advanced Optimizations and Polyhedral Compilation — **9 Hours**

Polyhedral model for loop nests-Tiling, skewing, fusion, and vectorization-Profile-guided and feedback-directed optimizations.

Activities:

Implement loop tiling and loop skewing on a matrix multiplication program.

Analyze the effect on loop-intensive code with LLVM optimization flags.

Just-in-Time (JIT) and Machine Learning in Compiler Design — **10 Hours**

JIT compilation models: tracing, method-based-GraalVM architecture, Java HotSpot internals-LLVM JIT and dynamic language support. ML for phase ordering, auto-tuning, and IR prediction-Reinforcement learning for optimization passes-Dataset creation and benchmarking for compiler ML.

Activities:

Develop a basic JIT-enabled interpreter with LLVM or GraalVM.

Implement dynamic dispatch using LLVM JIT API.

Domain-Specific Languages (DSLs) and Compiler Extensions and Security — **10 Hours**

Designing DSLs for AI/ML, DSP, graphics-Code generation for custom accelerators-Integration with TensorFlow XLA and Halide. Secure compilation and type-safe intermediate representations-Compiler fuzzing and formal verification (e.g., CompCert) Quantum compilers, multi-target compilers, and neuromorphic systems.

Activities:

Train an ML model to predict optimization passes.

Use reinforcement learning for pass selection in toy compiler.

Total Lecture Periods: 45 Hours

References:	
1	Cooper, K. D., & Torczon, L. (2023). Engineering a compiler. Morgan Kaufmann.
2	Grune, D., Bal, H. E., Jacobs, C. J. H., & Langendoen, K. G. (2012). Modern compiler design (2nd ed.). Springer.
3	Aho, A. V., Lam, M. S., Sethi, R., & Ullman, J. D. (2006). Compilers: Principles, techniques, and tools (2nd ed.). Pearson.
4	Völter, M. (2013). DSL engineering: Designing, implementing and using domain specific languages. dslbook.org.
5	Sarda, S., & Pandey, M. (2015). LLVM essentials. Packt Publishing.
E-Resources:	
1	Prof. AmeyKarkare, IIT Kanpur, "Advanced Compiler Optimizations" Link: https://www.cse.iitk.ac.in/users/karkare/Courses/cs738/
2	Prof. Santanu Chattopadhyay, "Compiler Design", IIT Kharagpur Link:" https://onlinecourses.nptel.ac.in/noc21_cs07/preview"

Course Outcomes	
CO No.	**Course Outcomes**
1	Explain intermediate control flow techniques in compiler design.
2	Apply program analysis techniques and advanced optimizations for design of compilers.
3	Develop compiler features and machine learning techniques for optimization.
4	Evaluate secure compilation strategies for quantum and multi-target compilation.

CO	PO1	PO2	PO3	PSO1	PSO2
1	**2**	–	**3**	**2**	**1**
2	**3**	–	**3**	**3**	**2**
3	**3**	**1**	**3**	**3**	**2**
4	**2**	**1**	**3**	**3**	**3**
AVG	2.50	0.50	3.00	2.75	2.00

"3"-High, "2" -Medium, "1" – Low, "-" – No Correlation

Chairman - Board of Studies
Department of Computer Science and Engineering
CMS College of Engineering and Technology
(Autonomous)
Kumittipathi, Coimbatore - 641 032