

NANDHA COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University Chennai)

Erode-52

www.nandhatech.org



REGULATIONS – 2026

CURRICULUM AND SYLLABUS

M.E - COMPUTER SCIENCE AND ENGINEERING


Chairman-Board of Studies
Computer Science and Engineering
Nandha College of Technology (Autonomous)
Erode - 638 052.

VISION

- To emerge as a Centre of Excellence in Computer Science by achieving global standards in academics and research to meet the needs of society and industry.

MISSION

- To deliver value-based education in Computer Science and develop innovative, skilled, and competent Computer Engineers capable of fulfilling the increasing needs of society and industry.
- To empower students to enhance their technical skills and engage in research activities through lifelong learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates will be able to:

PEO 1: Pursue higher education, research, and advanced learning in the field of Computer Science and Engineering with strong analytical and problem-solving abilities.

PEO 2: Apply advanced computing knowledge, modern tools, and computational models to design sustainable and scalable solutions for complex real-world problems in industry and society.

PEO 3: Develop innovative and interdisciplinary solutions through research aptitude, technical competence, and entrepreneurial skills in emerging areas of Computer Science and Engineering.

PEO 4: Adapt to evolving technologies through lifelong learning, professional ethics, and continuous skill enhancement to achieve successful careers in academia, research, and industry.

PROGRAMME OUTCOMES

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: 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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Advanced Computing and Problem Solving: Apply advanced algorithms, architectures, and computational models to analyze, design, and implement sustainable and scalable solutions that address complex problems across various domains, meeting the needs of industry and society.

PSO2: Research and Innovation Competence: Conduct independent research and utilize advanced tools and methodologies to develop innovative solutions for real-world and interdisciplinary computing challenges, while exhibiting strong research aptitude.

REGULATIONS 2026
CURRICULUM AND SYLLABUS

SEMESTER - I

S. No.	Course Code	Course Title	Category	Hours/Week				Contact Periods
				L	T	P	C	
Theory Courses								
1	26CPM101	Advanced Mathematical Methods	FC	3	1	0	4	4
2	26CPT101	Research Design and IPR Management	RMC	3	0	0	3	3
3	26CPT102	Advanced Data Structures	PCC	3	0	0	3	3
4	26CPT103	Advanced Database Practices	PCC	3	1	0	4	4
Integrated Courses								
5	26CPI101	Machine Learning	PCC	3	0	2	4	5
Practical Courses								
6	26CPL101	Advanced Data Structures Laboratory	PCC	0	0	4	2	4
7	26CPL102	Technical Term Paper	EEC	0	0	2	1	2
Total				15	2	8	21	25



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SEMESTER - II

S. No.	Course Code	Course Title	Category	Hours/Week				Contact Periods
				L	T	P	C	
Theory Courses								
1	26CPT201	Multicore Architecture	PCC	3	0	0	3	3
2	26CPT202	Block chain Technologies	PCC	3	0	0	3	3
3		Professional Elective I	PEC	3	0	0	3	3
4		Professional Elective II	PEC	3	0	0	3	3
Integrated Courses								
5	26CPI201	Internet of Things	PCC	3	0	2	4	5
6	26CPI202	Deep Learning	PCC	3	0	2	4	5
Practical Course								
7	26CPP201	Miniproject	EEC	0	0	4	2	4
Total				18	0	8	22	26

SEMESTER - III

S. No.	Course Code	Course Title	Category	Hours/Week				Contact Periods
				L	T	P	C	
Theory Courses								
1	26CPT301	Agentic AI	PCC	3	0	0	3	3
2		Professional Elective III	PEC	3	0	0	3	3
3		Professional Elective IV	PEC	3	0	0	3	3
4		Open Elective	OEC	3	0	0	3	3
Practical Course								
5	26CPP301	Project Work I	EEC	0	0	12	6	12
Total				12	0	12	18	24

SEMESTER - IV

S. No.	Course Code	Course Title	Category	Hours/Week				Contact Periods
				L	T	P	C	
Practical Course								
1	26CPP401	Project Work II	EEC	0	0	24	12	24
Total				0	0	24	12	24


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BREAKUP OF CREDITS:

Semester	FC	RMC	PCC	EEC	PEC	OEC	Credits Total
I	4	3	13	1			21
II			14	2	6		22
III			3	6	6	3	18
IV				12			12
Total	4	3	29	22	12	3	73

- Foundation Courses (FC)
- Research Methodology and IPR Courses(RMC)
- Professional Core Courses (PCC)
- Employability Enhancement Courses (EEC)
- Professional Elective Courses (PEC)
- Open Elective Courses(OEC)


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PROFESSIONAL ELECTIVE COURSES (PEC)

S. No.	Course Code	Course Title	Category	Hours/Week				Contact Periods
				L	T	P	C	
Theory Courses								
1.	26CPE201	Text and Speech Processing	PEC	3	0	0	3	3
2.	26CPE202	Cloud and Big Data Analytics	PEC	3	0	0	3	3
3.	26CPE203	Advanced Software Engineering	PEC	3	0	0	3	3
4.	26CPE204	Wireless Communications	PEC	3	0	0	3	3
5.	26CPE205	AI in IoT	PEC	3	0	0	3	3
6.	26CPE206	Quantum Cryptography	PEC	3	0	0	3	3
7.	26CPE207	High Performance Computing for Big Data	PEC	3	0	0	3	3
8.	26CPE208	Web Analytics	PEC	3	0	0	3	3
9.	26CPE209	Advanced Large Language Models	PEC	3	0	0	3	3
10.	26CPE210	Data Visualization	PEC	3	0	0	3	3
11.	26CPE211	Robotics	PEC	3	0	0	3	3
12.	26CPE212	GPU Computing	PEC	3	0	0	3	3
13.	26CPE213	Web 3.0	PEC	3	0	0	3	3
14.	26CPE214	Edge and Fog Computing	PEC	3	0	0	3	3
15.	26CPE215	Devops	PEC	3	0	0	3	3
16.	26CPE216	Embedded Software Development	PEC	3	0	0	3	3
17.	26CPE217	Security Principles and Practice	PEC	3	0	0	3	3
18.	26CPE218	Cognitive Computing	PEC	3	0	0	3	3
19.	26CPE219	Vibe Coding	PEC	3	0	0	3	3
20.	26CPE220	Web of Things	PEC	3	0	0	3	3


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OPEN ELECTIVE COURSE

S. No.	Course Code	Course Title	Category	Hours/Week				Contact Periods
				L	T	P	C	
Theory Courses								
1	26OEC301	Environmental Impact Assessment	OEC	3	0	0	3	3
2	26OEC302	Intellectual Property Rights	OEC	3	0	0	3	3
3	26OEC303	Ethical Management	OEC	3	0	0	3	3
4	26OEC304	Micro and Small Business Management	OEC	3	0	0	3	3
5	26OEC305	IoT for Smart Systems	OEC	3	0	0	3	3
6	26OEC306	Medical Robotics	OEC	3	0	0	3	3



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26CPM101 - ADVANCED MATHEMATICAL METHODS		L	T	P	C
		3	1	0	4
Course Objective	<ul style="list-style-type: none"> Develop an in-depth understanding of advanced concepts in linear algebra, multivariate analysis, and number theory for computer science applications. Apply mathematical tools such as eigenvalue decomposition, SVD, and multivariate statistical methods to real-world computing and data-driven problems. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Understand the fundamental concepts vector Algebra, decomposition				An
CO2	Apply multivariate normal density to population principal components.				Ap
CO3	Understand the concept of elementary number theory				An
CO4	Apply the advanced number theory concept in primality testing algorithms				Ap
CO5	Find the optimum value solving LPP.				Ap

UNIT I - VECTOR ALGEBRA	9+3
Vector spaces, norms, Inner Products, Eigen values using QR transformations, QR factorization, generalized eigenvectors, Canonical forms, singular value decomposition and applications, pseudo inverse, least square approximations.	
UNIT II - MULTIVARIATE ANALYSIS	9+3
Random vectors and matrices, Mean vectors and covariance matrices, Multivariate normal density and its properties, Principal components, Population principal components, Principal components from standardized	
UNIT III - ELEMENTARY NUMBER THEORY	9+3
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.	
UNIT IV - ADVANCED NUMBER THEORY	9+3
Advanced Number Theory, Primality Testing algorithms, Chinese Remainder Theorem, Quadratic Congruence, Discrete Logarithm, Factorization Methods, Side Channel Attacks, Shannon Theory.	
UNIT V - OPTIMIZATION TECHNIQUES	9+3
Linear programming problem, simplex Method, Big-M method, Two-phase method, Game Theory, Transportation problem, Assignment problem.	
TOTAL PERIODS	60

REFERENCES:

1. Gilbert Strang, "Linear Algebra and Its Applications:", 4th Edition, Cengage Learning, 2006.
2. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, 2007.
3. Neal Koblitz, "A Course in Number Theory and Cryptography", 2nd Edition, Springer, 1994.
4. Victor Shoup, "A Computational Introduction to Number Theory and Algebra", 2nd Edition, Cambridge University Press, 2015

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	1	2	2	2
2	3	1	2	2	2
3	3	3	2	3	3
4	2	1	3	1	2
5	2	2	3	1	3
CO (W.A)	2.6	1.6	2.4	1.8	2.4

26CPT101 - Research Design and IPR Management		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand basic research methods, data collection, and how to analyze and present data. To learn the fundamentals of Intellectual Property Rights and patents, including their importance and processes. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Apply appropriate research designs and data collection methods in qualitative and quantitative research.				Ap
CO2	Apply appropriate sampling techniques and data preparation methods to conduct meaningful research analysis.				Ap
CO3	Analyze multivariate data using statistical methods and interpret results in both written and oral formats.				An
CO4	Implement the principles and components of Intellectual Property Rights in real-world contexts, including international IPR practices.				Ap
CO5	Analyze the process of patent filing and licensing, including the roles of patent agents and agencies.				An

UNIT I - RESEARCH DESIGN	9
Introduction to business research, Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.	
UNIT II - DATA COLLECTION AND SOURCES	9
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data Preparation and description, Exploring, examining and displaying data.	
UNIT III - DATA ANALYSIS AND REPORTING	9
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.	
UNIT IV - INTELLECTUAL PROPERTY RIGHTS	9
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.	

UNIT V - PATENTS	9
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.	
TOTAL PERIODS	45

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11th Edition, 2012.
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", 2025.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	1	2	2	2
2	3	1	2	2	2
3	3	3	2	3	3
4	2	1	3	1	2
5	2	2	3	1	3
CO (W.A)	2.6	1.6	2.4	1.8	2.4

26CPT102- ADVANCED DATA STRUCTURES		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand and apply advanced data structures and memory optimization techniques for efficient data storage, retrieval, and processing. To design and analyze algorithms using various paradigms and evaluate their complexity, including approximation and advanced computational methods for solving real-world problems. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Apply advanced linear data structures and memory optimization techniques for efficient data handling.				Ap
CO2	Analyze and implement advanced tree data structures for indexing, searching, and hierarchical data representation.				An
CO3	Design and solve graph problems using appropriate algorithms for traversal, shortest paths, spanning trees, and network flows.				Ap
CO4	Apply various algorithm design paradigms such as divide and conquer, greedy, dynamic programming, and backtracking to solve complex problems.				Ap
CO5	Evaluate computational complexity, apply approximation and heuristic algorithms, and explore advanced topics like randomized, parallel, and streaming algorithms.				Ev

UNIT I – LINEAR DATA STRUCTURES AND MEMORY OPTIMIZATION	9
Advanced arrays: Sparse arrays, dynamic arrays, cache-aware structures. Linked lists: Skip lists, unrolled linked lists, XOR linked lists.- Amortized Analysis .Stacks and Queues: Priority queues, double-ended queues, circular buffers. Hashing: Perfect hashing, cuckoo hashing, extendible hashing.	
UNIT II – ADVANCED TREE DATA STRUCTURES	9
Balanced Trees: AVL trees, Red-Black trees, Splay trees, Treaps. 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.	
UNIT III – GRAPH DATA STRUCTURES AND ALGORITHMS	9
Representation: Adjacency list, adjacency 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, Single-Source Shortest Paths: The Bellman-Ford algorithm. Network Flow Algorithms: Ford-Fulkerson, Edmonds-Karp, Push-Relabel.	

UNIT IV – ALGORITHM DESIGN AND PARADIGMS	9
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.	
UNIT V – COMPUTATIONAL COMPLEXITY AND ADVANCED TOPICS	9
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. Advanced Topics: Monte Carlo algorithms, PRAM model, parallel divide and conquer, load balancing, streaming algorithms, sketching, sampling, frequency moments, suffix arrays, linear-time pattern matching.	
TOTAL PERIODS	45

REFERENCES:

1. S.Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. "Introduction to algorithms". MIT Press, 2009.
3. La Rocca, M. "Advanced algorithms and data structures", Manning Publications, 2021.
4. Goodrich, M. T., Tamassia, R., & Mount, D. M. "Data structures and algorithms in C++", John Wiley & Sons, Inc, 2011.
5. Weiss, M. A. "Data structures and algorithm analysis in C++", Pearson Education, 2014.
6. Drozdek, A. "Data structures and algorithms in C++", Cengage Publications, 2013.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	-	-	2
2	3	3	2	2	2
3	3	3	3	2	2
4	3	3	2	2	2
5	3	3	2	2	3
CO (W.A)	3.0	2.8	2.6	2.0	2.6

26CPT103 – ADVANCED DATABASE PRACTICES		L	T	P	C
		3	1	0	3
Course Objective	<ul style="list-style-type: none"> To provide advanced knowledge in relational, distributed, and NoSQL database systems with emphasis on secure and scalable database design. To enable learners to develop modern database applications using SQL, PL/SQL, XML, JSON, and emerging database technologies for enterprise-level solutions. 				
Course Outcomes: The student will be able to		Cognitive Level			
CO1	Design advanced relational database schemas and implement optimized SQL queries for enterprise applications.	Ap			
CO2	Analyze and implement distributed and XML database systems for scalable data management.	An			
CO3	Apply NoSQL database techniques and Big Data storage concepts for handling semi-structured and unstructured data.	Ap			
CO4	Implement database security, backup, recovery, and cloud database solutions for secure data management.	Ap			
CO5	Develop advanced database applications using PL/SQL, JSON, and modern database technologies.	C			

UNIT I - ADVANCED RELATIONAL DATABASE DESIGN AND SQL PRACTICES	9+3
Relational Model – ER Modeling – Enhanced ER Model – Mapping ER Model to Relational Model – Relational Algebra – Structured Query Language (SQL) – Advanced SQL Queries – Joins and Nested Queries – Views – Constraints and Assertions – Triggers and Stored Procedures – Query Optimization Concepts.	
UNIT II - DISTRIBUTED, ACTIVE AND XML DATABASES	9+3
Distributed Database Concepts – Distributed Database Design – Fragmentation and Replication – Distributed Transactions – Concurrency Control in Distributed Databases – Active Database Concepts and Triggers – XML Databases – XML Schema – XML Query (XQuery) – XML Applications in Data Exchange.	
UNIT III - NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS	9+3
Need for NoSQL Databases – Types of NoSQL Databases – Key-Value Stores – Column-Oriented Databases – Document-Oriented Databases – Graph Databases – CAP Theorem – MongoDB Architecture – CRUD Operations in MongoDB – Aggregation Framework – Introduction to Big Data Storage Concepts.	
UNIT IV - DATABASE SECURITY, RECOVERY AND CLOUD DATABASES	9+3
Database Security Requirements – Access Control and Authorization – Role-Based Access Control – Encryption Techniques – SQL Injection and Database Attacks – Backup and Recovery Techniques – Transaction Recovery – Cloud Databases – Database as a Service (DBaaS) Concepts – Multi-tenant Databases.	

UNIT V - ADVANCED DATABASE APPLICATIONS AND EMERGING TRENDS	9+3
PL/SQL Programming – Functions, Procedures, Packages and Cursors – JSON Data Model and JSON Queries – Integration of Databases with Web Applications – Data Warehousing Concepts – Introduction to Data Analytics using Databases – Emerging Trends in Database Technologies.	
TOTAL PERIODS	60

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.
2. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
3. Carlos Coronel, Steven Morris, "Database Systems: Design, Implementation and Management", Fourteenth Edition, Cengage Learning, 2023.
4. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	1	3	3	1
2	3	1	3	3	2
3	2	1	3	3	2
4	2	1	3	3	2
5	3	2	3	3	3
CO (W.A)	2.4	1.2	3.0	3.0	2.0

26CPI101 -MACHINE LEARNING		L	T	P	C
		3	0	2	4
Course Objective:	<ul style="list-style-type: none"> To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning. To understand the basic concepts of neural networks and deep learning. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Understand and outline problems for each type of machine learning	An			
CO2	Design a Decision tree and Random forest for an application	Ap			
CO3	Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.	Ap			
CO4	Use a tool to implement typical Clustering algorithms for different types of applications.	E			
CO5	Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.	C			

UNIT I - INTRODUCTION AND MATHEMATICAL FOUNDATIONS	9
What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory.	
UNIT II - SUPERVISED LEARNING	9
Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms.	
UNIT III - UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING	9
Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning.	
UNIT IV - PROBABILISTIC METHODS FOR LEARNING	9
Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models.	

UNIT V - NEURAL NETWORKS AND DEEP LEARNING	9
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.	
TOTAL PERIODS	45
List of Experiments	
<ol style="list-style-type: none"> 1. Implement Linear Regression using a real-world dataset. Experiment with different feature combinations and tune model hyperparameters. 2. Implement a Binary Classification model using the California Housing Dataset to classify houses above or below a selected price threshold. Analyze the effect of varying classification thresholds and evaluate the model using different classification metrics. 3. Implement K-Nearest Neighbors (KNN) Classification using the California Housing Dataset. Perform training, validation, and testing using different K values and analyze model performance. 4. Perform training, validation, and testing using separate datasets. Analyze overfitting and underfitting by comparing training and validation results, and apply suitable techniques to improve model performance. 5. Implement the K-Means Clustering algorithm using the Codon Usage Dataset from the UCI Machine Learning Repository. 6. Implement the Naïve Bayes Classifier using the Gait Classification Dataset from the UCI Machine Learning Repository. 7. Develop a mini project implementing one or more machine learning algorithms on a real-world dataset. 	
Suggested Mini Project Topics	
<ol style="list-style-type: none"> 1. Sentiment Analysis of Product Reviews 2. Stock Price Prediction 3. Sales Forecasting 4. Music Recommendation System 5. Handwritten Digit Classification 6. Fake News Detection 7. Sports Prediction 8. Object Detection 9. Disease Prediction 	
HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:	
HARDWARE REQUIRED:	
<ul style="list-style-type: none"> • Processor: Intel Core i5 Processor or above • RAM: Minimum 8 GB • Storage: Minimum 256 GB 	

SOFTWARE REQUIRED:

- Operating System: Windows 10 / Windows 11
- Programming Language & Frameworks: Python, PyTorch, Hugging Face Transformers, Keras, YOLOv8
- IDE / Development Tools: Jupyter Notebook / Google Colab / Visual Studio Code

TOTAL PERIODS**30****TEXT BOOK:**

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014.

REFERENCES:

1. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
3. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	2	3	3	1
3	2	2	3	3	2
4	2	2	3	3	2
5	2	3	3	3	3
CO (W.A)	2.2	2.2	2.6	2.8	1.8



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26CPL101- ADVANCED DATA STRUCTURES LABORATORY		L	T	P	C
		0	0	4	2
Course Objective	<ul style="list-style-type: none"> To provide practical exposure to advanced data structures and algorithms through implementation and performance analysis in real-world scenarios. To develop the ability to design, analyze, and evaluate efficient algorithms, including randomized, parallel, approximation, and heuristic approaches. 				
Course Outcomes : The Student will be able to					Cognitive Level
CO1	Implement advanced data structures such as skip lists, B+ trees, and suffix trees for efficient data storage and retrieval.				Ap
CO2	Analyze memory utilization and performance of data structures, including cache-aware and optimized implementations.				An
CO3	Apply graph algorithms and network flow techniques to solve real-world problems such as routing and shortest path computation.				Ap
CO4	Design and implement algorithms using paradigms such as divide and conquer, randomized, and approximation methods.				Ap
CO5	Evaluate computational complexity and develop heuristic, parallel, and streaming solutions for large-scale and NP-hard problems.				Ev

List of Experiments:

1. Implement skip lists and measure performance compared with balanced BST.
2. Experiment with cache-aware data structures and analyze memory utilization.
3. Implement B+ tree for database indexing use-case.
4. Design a suffix tree-based algorithm for DNA sequence matching.
5. Implement Johnson's algorithm for sparse graph shortest paths.
6. Demonstration of Maximum flow in traffic or network routing simulation
7. Implement Strassen's algorithm and compare with naive matrix multiplication.
8. Develop a randomized algorithm for primality testing (Miller-Rabin).
9. Implement approximation algorithm for vertex cover.
10. Complexity analysis of a chosen NP-hard problem and implement a heuristic.
11. Implement randomized and streaming algorithms on real-world datasets.
12. Design of parallel and distributed algorithms.

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:**Hardware Requirements**

- **Computer Systems:** 30 Nos. (one per student) or minimum 15 systems (1:2 sharing)
- **Processor:** Intel i5 / AMD Ryzen 5 or higher
- **RAM:** Minimum 8 GB
- **Storage:** 500 GB HDD / 256 GB SSD
- **Network:** LAN/Wi-Fi connectivity
- **Server (Optional):** 1 No. for distributed/parallel computing experiments

Software Requirements

- **Operating System:** Windows / Linux (Ubuntu preferred)
- **Programming Languages:** C / C++ / Python
- **Compilers/IDE:** GCC, Visual Studio Code, Code::Blocks
- **Libraries/Tools:**
 - Graph libraries (Boost Graph Library / NetworkX)
 - Parallel computing tools (OpenMP / MPI)
 - Data analysis tools (NumPy, Pandas)
- **Database Tools (Optional):** MySQL / SQLite (for B+ tree indexing use case)

TOTAL PERIODS**60****Mapping of COs with POs / PSOs**

COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	2	3	3	1
3	2	2	3	3	2
4	2	2	3	3	2
5	2	3	3	3	3
CO (W.A)	2.2	2.2	2.6	2.8	1.8



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26CPL102 – TECHNICAL TERM PAPER		L	T	P	C
		0	0	2	1
Course Objective	<ul style="list-style-type: none"> To develop the ability to identify research problems, review literature, and prepare a well-structured technical paper with proper citations.. To enhance skills in academic writing and effectively communicate research findings through oral presentations. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Identify and formulate a relevant research problem within a selected technical domain.	An			
CO2	Collect and review current literature using academic databases, journals, and conference proceedings.	An			
CO3	Organize and synthesize research information into a coherent technical report with appropriate citations and structure.	C			
CO4	Present research findings effectively using professional oral presentation tools and techniques.	Ap			
CO5	Demonstrate the ability to write a well-structured term paper that adheres to academic and ethical standards of research.	C			

METHODOLOGY

- 1. Faculty Assignment:** Each student will be assigned a Supervisor from the department by the Head of the Department (HOD). This Supervisor will guide the student throughout the research project.
- 2. Topic Selection:** Through mutual discussions between the student and the supervisor, a suitable research topic will be chosen. This topic should be relevant to the student's area of study or interest within the subject domain.
- 3. Literature Review:** The student is required to conduct a thorough literature review by accessing academic journals, conference proceedings, and other scholarly sources. The focus should be on collecting at least 20 research papers published within the last five years to ensure the research is up-to-date and relevant.
- 4. Presentation:** The student will prepare and deliver two presentations during the semester:
 - The first presentation will be a progress update, scheduled around the middle of the semester.
 - The second presentation will be the final presentation, near the end of the semester.
 - Each presentation should last 15 to 20 minutes, followed by a 10-minute discussion session where the student answers questions and receives feedback.
- 5. Technical Report:** Alongside the presentations, the student must prepare a detailed technical report of approximately 30 to 50 pages. This report should include:
 - Title Page
 - Abstract (1 page): A concise summary of the research objectives, methods, and key findings.

- Review of Literature: A critical analysis of the collected research papers organized under appropriate subheadings to clearly explain different themes or areas within the topic.
- Concluding Remarks: Summary of insights gained, research gaps identified, and potential directions for future research.
- References: A comprehensive list of all sources cited, following a consistent citation style.
- The technical report must be submitted to the HOD one week before the final presentation, after obtaining approval from the faculty guide.

Weightage for Continuous Assessment

Component	Weightage
Review 1	10%
Review 2	20%
Review 3	30%
Report Evaluation – Supervisor & Internal Examiner	20%
Viva-Voce – Supervisor & Internal Examiner	20%
Total	100%

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	1	2	2	3
2	3	1	2	1	3
3	2	3	3	1	3
4	1	3	2	1	2
5	2	3	3	1	3
CO (W.A)	2.2	2.2	2.4	1.2	2.8

26CPT201- MULTICORE ARCHITECTURE		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand parallel programming models, tools, and techniques for both shared and distributed memory systems. To implement and evaluate the performance of parallel applications using frameworks such as OpenMP and MPI. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain the fundamentals of multicore systems, architectures, memory models, and cache coherence mechanisms.				Ap
CO2	Apply thread management and synchronization techniques to solve issues such as data races, deadlocks, and inter-thread communication.				Ap
CO3	Develop parallel programs using OpenMP directives and shared memory techniques for efficient computation.				Ap
CO4	Implement distributed parallel programs using MPI with point-to-point and collective communication				An
CO5	Analyze and evaluate the performance and scalability of parallel programs using profiling tools and apply parallel algorithms to real-world problems.				Ev

UNIT I – MULTICORE SYSTEMS AND ARCHITECTURES	9
Evolution from single-core to multicore systems – SIMD vs MIMD architectures – Shared and distributed memory systems – Cache coherence – Memory consistency models.	
UNIT II – THREAD MANAGEMENT AND SYNCHRONIZATION TECHNIQUES	9
Thread management – Synchronization primitives: Mutex, Locks, Semaphores – Data races and deadlocks – Inter-thread communication: Condition variables, Pipes.	
UNIT III – PARALLEL PROGRAMMING USING OPENMP	9
OpenMP architecture and memory model – Directives and work-sharing constructs – Parallelizing loops – Task management – Performance optimization techniques.	
UNIT IV – MESSAGE PASSING PROGRAMMING WITH MPI	9
MPI programming concepts – Point-to-point communication – Collective communication – Derived data types – Synchronization – Performance tuning.	
UNIT V – PERFORMANCE EVALUATION AND ADVANCED APPLICATIONS	9
Scalability metrics - Use of Profiling Tools for Performance Bottlenecks. Performance measurement and analysis – Scalability metrics – Profiling tools (gprof, perf) – Case studies: Tree search, N-body simulation, graph algorithms – Comparative analysis of OpenMP and MPI – Trends in multicore and manycore processors.	
TOTAL PERIODS	45

REFERENCES:

1. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", CRC Press, 2015.
2. MichaelJ. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw- Hill, 2004.
3. Victor Alessandrini, "Shared Memory Application Programming", Morgan Kaufmann, 2015.
4. Rohit Chandraetal., "Parallel Programming in OpenMP", Morgan Kaufmann, 2000.
5. Gerassimos Barlas, "Multicore and GPU Programming", Morgan Kaufmann, 2014.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	3	2	2	2
3	2	2	3	3	2
4	2	3	3	3	3
5	3	3	2	2	3
CO (W.A)	2.6	2.2	2.4	2.8	2.6


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26CPT202 - BLOCK CHAIN TECHNOLOGIES		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand blockchain fundamentals, cryptocurrency mechanisms, Ethereum, smart contracts, and distributed ledger technologies. To analyze and develop secure blockchain-based applications using Ethereum, Solidity, Hyperledger, and modern decentralized technologies. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain the fundamentals of cryptography, blockchain architecture, and cryptocurrency concepts.				U
CO2	Illustrate the working principles of Bitcoin, Ethereum, and blockchain consensus mechanisms.				U
CO3	Apply Ethereum and Solidity programming concepts to develop smart contracts and decentralized applications.				Ap
CO4	Analyze Hyperledger frameworks, distributed ledger technologies, and blockchain security challenges.				An
CO5	Design blockchain-based solutions for real-world applications such as IoT, healthcare, DeFi, and supply chain systems.				C

UNIT I – INTRODUCTION TO CRYPTOGRAPHY AND BLOCKCHAIN	9
Introduction to Blockchain – Blockchain Technology Mechanisms and Networks – Blockchain Origins – Objectives of Blockchain – Challenges in Blockchain – Transactions and Blocks – Peer-to-Peer Systems – Keys as Identity – Digital Signatures – Hashing – Public Key Cryptosystems – Private vs Public Blockchain – Introduction to Web3 – Decentralized Identity (DID) Basics.	
UNIT II – BITCOIN AND CRYPTOCURRENCY	9
Introduction to Bitcoin – Bitcoin Network – Bitcoin Mining Process – Mining Developments – Bitcoin Wallets – Decentralization and Hard Forks – Ethereum Virtual Machine (EVM) – Merkle Tree – Double-Spend Problem – Blockchain and Digital Currency – Transactional Blocks – Stablecoins and Central Bank Digital Currency (CBDC) – Impact of Blockchain Technology on Cryptocurrency.	
UNIT III – INTRODUCTION TO ETHEREUM	9
Introduction to Ethereum – Consensus Mechanisms – Proof of Stake (PoS) – MetaMask Setup – Ethereum Accounts – Transactions – Receiving Ethers – Smart Contracts – Gas Fees and Optimization.	
UNIT IV – INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING	9
Introduction to Hyperledger – Distributed Ledger Technology and its Challenges – Hyperledger Fabric – Hyperledger Composer – Solidity Programming – Installing Solidity and Ethereum Wallet – Basics of Solidity – Structure of Smart Contracts – General Value Types – Smart Contract Security Basics – Introduction to Layer-2 Scaling Solutions.	

UNIT V – BLOCKCHAIN APPLICATIONS	9
Blockchain Applications in Internet of Things – Medical Record Management System – Blockchain in Supply Chain Management – NFT and Digital Asset Applications – Decentralized Finance (DeFi) – Domain Name Service – Future of Blockchain.	
TOTAL PERIODS	45

REFERENCES:

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Apress, 2nd Edition, 2020.
2. Mastering Blockchain, Packt Publishing, 4th Edition, 2023.
3. Introducing Ethereum and Solidity, Apress, 2nd Edition, 2022.
4. Hands-On Blockchain with Hyperledger, Packt Publishing, 2020.
5. Blockchain Technology, Universities Press, 2021.
6. Blockchain Revolution, Penguin Random House, 2018.
7. Mastering Ethereum, O'Reilly Media, 2019.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	-	2	-
2	3	2	1	2	1
3	2	3	3	3	3
4	2	3	2	2	3
5	2	2	3	3	3
CO (W.A)	2.4	2.4	1.8	2.4	2.0


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26CPI201 - INTERNET OF THINGS		L	T	P	C
		3	0	2	4
Course Objective	<ul style="list-style-type: none"> To understand the fundamentals of IoT, its architecture, communication models, and enabling technologies. To develop skills in IoT protocols, cloud integration, and building real-time IoT applications using Raspberry Pi. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Apply IoT concepts, architecture, and communication models to design and implement basic IoT systems				Ap
CO2	Analyze IoT architectures and generations for real-world applications..				An
CO3	Apply IoT protocols and hardware technologies in system design.				Ap
CO4	Demonstrate cloud computing concepts for IoT data management				Ap
CO5	Analyze IoT applications using Raspberry Pi with cloud and edge integration				An

UNIT I - INTRODUCTION TO IoT	9
Definition, Characteristics and Applications – IoT Architecture and Functional Blocks – IoT vs M2M Communication – Sensors and Actuators for IoT Applications – IoT Communication Models – Introduction to Cloud in IoT (Basic Concepts)	
UNIT II - IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS	9
IETF Architecture for IoT – IoT Reference Architecture – IoT Generations: First Generation – Description and Characteristics – Advanced Generation – Description and Characteristics.	
UNIT III - IoT PROTOCOLS AND HARDWARE TECHNOLOGIES	9
SCADA and RFID Protocols – BACnet Protocol – Zigbee Architecture – 6LoWPAN and CoAP – MQTT Protocol (Message Queuing Telemetry Transport) – Wireless Sensor Node Structure: Energy Storage Module, Power Management Module, RF Module, Sensing Module.	
UNIT IV - CLOUD ARCHITECTURE BASICS	9
Cloud Types: IaaS, PaaS, SaaS – Development Platforms: Amazon, Azure, Google Cloud – Serverless Computing (AWS Lambda Basics).	

UNIT V - IOT PROJECTS ON RASPBERRY PI	9
Building IoT with Raspberry Pi – Preparing Raspberry Pi – Creating Sensor-Based Projects – Hardware Interfacing and Interaction – Internal and External Representation of Sensor Data – Data Persistence and Exporting.	
TOTAL PERIODS	45
LIST OF EXPERIMENTS:	
<ol style="list-style-type: none"> 1. Interfacing basic sensors and actuators (temperature/light, LED/buzzer). 2. Implementation of IoT communication models (Device-to-Device / Device-to-Cloud). 3. Implementation of MQTT/CoAP protocol using IoT tools/software. 4. Study and configuration of Zigbee communication (simulation/hardware). 5. Creating and exploring cloud platforms (AWS/Azure/Google Cloud). 6. Developing a Raspberry Pi based sensor application. 7. Sending sensor data to cloud using MQTT/HTTP protocol. 	
HARDWARE / SOFTWARE REQUIRED:	
HARDWARE REQUIRED:	
<ul style="list-style-type: none"> • Raspberry Pi (any recent version, e.g., Pi 3/4) • Micro SD Card (16GB or above) • Power Supply for Raspberry Pi • Breadboard and Jumper Wires • Sensors (Temperature, Light/LDR) • Actuators (LED, Buzzer) • Resistors (220Ω, 330Ω) • Zigbee Module (optional, for experiment 4) • RFID Module and Tags (for protocol study, optional) • Internet Connectivity (Wi-Fi/Ethernet) 	
SOFTWARE REQUIRED:	
<ul style="list-style-type: none"> • Raspberry Pi OS • Python (with libraries like GPIO, sensor libraries) • MQTT Broker (e.g., Mosquitto) • IoT Development Tools (Node-RED / Arduino IDE optional) • Cloud Platforms (AWS / Microsoft Azure / Google Cloud) • Web Browser (for dashboards and cloud access) • Simulation Tools (optional: Cisco Packet Tracer / any IoT simulator) 	
TOTAL PERIODS	30

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), "Architecting the Internet of Things", Springer, 2011.
3. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015.
4. Ovidiu Vermesan, Peter Friess, "Internet of Things – From Research and Innovation to Market Deployment", River Publishers, 2014.
5. N. Ida, Sensors, "Actuators and Their Interfaces: A Multidisciplinary Introduction", 2nd Edition, Scitech Publishers, 2014.
6. Reese, G., "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", O'Reilly Media, 2009.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	2	3	2
2	2	2	3	3	2
3	3	2	2	3	2
4	2	3	2	2	2
5	3	2	3	3	3
CO (W.A)	2.6	2.2	2.4	2.8	2.6

26CPI202 - DEEP LEARNING		L	T	P	C
		3	0	2	4
Course Objective:	<ul style="list-style-type: none"> To Develop and Train Deep Neural Networks. Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition. To Build and train RNNs, work with NLP and Word Embeddings The internal structure of LSTM and GRU and the differences between them The Auto Encoders for Image Processing. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Perform feature extraction techniques from image and video data for computer vision applications.	An			
CO2	Design and implement image segmentation and instance segmentation techniques for image analysis applications.	Ap			
CO3	Implement image recognition and image classification models using pretrained deep learning networks through transfer learning.	Ap			
CO4	Analyze traffic-related information from Twitter data using data analytics and machine learning techniques.	E			
CO5	Design and implement Autoencoders for feature extraction and classification tasks in deep learning applications.	C			

UNIT I - DEEP LEARNING CONCEPTS	9
Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.	
UNIT II - NEURAL NETWORKS	9
About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyper parameters.	
UNIT III - CONVOLUTIONAL NEURAL NETWORK	9
About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO	

UNIT IV - NATURAL LANGUAGE PROCESSING USING RNN	9
About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co occurrence Statistics-based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.	
UNIT V - DEEP REINFORCEMENT & UNSUPERVISED LEARNING	9
About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders.	
TOTAL PERIODS	45
LIST OF EXPERIMENTS:	
<ol style="list-style-type: none"> 1. Perform feature selection and feature extraction from image and video data using suitable techniques. 2. Implement image and video recognition using deep learning models. 3. Perform image colorization using convolutional neural networks. 4. Implement aspect-oriented topic detection and sentiment analysis on text data. 5. Develop an object detection system using autoencoders. 6. Apply transfer learning techniques for image classification using pretrained models. 7. Design and implement a complete pipeline combining feature extraction, model training, and evaluation for a real-world image/video or text dataset. 	
HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:	
HARDWARE REQUIRED:	
<ul style="list-style-type: none"> • Processor: Intel Core i5 Processor or above • RAM: Minimum 8 GB • Storage: Minimum 256 GB HDD/SSD 	
SOFTWARE REQUIRED:	
<ul style="list-style-type: none"> • Operating System: Windows 10 / Windows 11 • Programming Language: Python • Development Environment: Anaconda Distribution • Libraries / Frameworks: OpenCV, Scikit-Learn, Hugging Face Transformers 	
TOTAL PERIODS	30

REFERENCES:

1. Josh Patterson and Adam Gibson, "Deep Learning A Practitioner's Approach", O'Reilly Media, Inc.2017
2. Jojo Moolayil, "Learn Keras for Deep Neural Networks", Apress, 2018.
3. Vinita Silaparasetty, "Deep Learning Projects Using TensorFlow", Apress, 2020.
4. Francois Chollet, "Deep Learning with Python", Manning Shelter Island, 2017.
5. Santanu Pattanayak, "Pro Deep Learning with TensorFlow", Apress, 2017.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	2	2	1	2
2	2	3	3	2	2
3	2	3	3	2	2
4	3	2	2	3	3
5	2	3	3	3	2
CO (W.A)	2.4	2.2	2.6	2.6	2.2

26CPP201 – MINI PROJECT		L	T	P	C
		0	0	4	2
Course Objective	<ul style="list-style-type: none"> To apply theoretical knowledge to design and develop a solution for a real-world problem using appropriate tools and techniques. To develop skills in problem-solving, teamwork, documentation, and effective presentation of project outcomes. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Identify and define a technical problem by analyzing requirements and clearly stating objectives and scope.				An
CO2	Design and implement an effective solution using appropriate methods and programming practices.				C
CO3	Use suitable tools, frameworks, and technologies for development, testing, and validation.				Ap
CO4	Apply problem-solving and critical thinking skills to analyze issues and improve the solution.				An
CO5	Present the project outcomes clearly through structured documentation and effective oral presentation.				Ap

METHODOLOGY	
<ol style="list-style-type: none"> <u>Faculty Assignment:</u> <ul style="list-style-type: none"> Each student will be assigned a Supervisor from the department by the Head of the Department (HOD). This Supervisor will guide the student throughout the mini project. <u>Project Planning and Ideation</u> <ul style="list-style-type: none"> Problem identification and domain selection. Literature survey and requirement gathering. Finalizing tools/technologies to be used. <u>System Design</u> <ul style="list-style-type: none"> System architecture and UML diagrams. Proposed System Modules Database and UI design (if applicable). <u>Implementation Phase</u> <ul style="list-style-type: none"> Module-wise development. Use of version control (e.g., Git). Integration and testing of modules. Regular progress reviews. <u>Testing and Evaluation</u> <ul style="list-style-type: none"> Unit testing, integration testing, and system testing. Bug fixing and performance optimization. Final validation with project Supervisor. 	

6. Report Preparation and Presentation

- Preparation of mini project report.
- Technical presentation with demo.

**Weightage for Continuous Assessment & End-Semester Examination for
MiniProject Work**

Component	Weightage
Continuous Assessment (60%)	
Review 1	10%
Review 2	20%
Review 3	30%
End-Semester Examination (40%)	
Mini Project Report Evaluation – Supervisor	10%
Project Thesis Report Evaluation – External Examiner	10%
Viva-Voce – External Examiner	10%
Viva-Voce – Internal Examiner	10%
Total	100%

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	1	2	2	3
2	3	2	3	3	3
3	2	1	2	3	2
4	3	1	2	2	3
5	1	3	2	1	2
CO (W.A)	2.4	1.6	2.2	2.2	2.6

26CPT301 – Agentic AI		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To learn the foundations of Agentic AI, including intelligent agent design, decision-making under uncertainty, and reinforcement learning. To explore multi-agent systems, language-based AI agents, and ethical considerations in deploying agentic AI. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain the principles of intelligent agents, environments, and core agent architectures.				U
CO2	Apply planning, probabilistic reasoning, and decision-making techniques to design rational agents.				Ap
CO3	Implement reinforcement learning algorithms for adaptive agent behavior.				Ap
CO4	Analyze coordination, communication, and negotiation mechanisms in multi-agent systems.				An
CO5	Develop language-based agentic AI systems with attention to ethical and societal impact.				Ap

UNIT I - FOUNDATIONS OF INTELLIGENT AGENTS	9
Introduction to Agentic AI: Definition – The Foundation AI – The History of AI – The State of the Art – Risk and Benefits of AI – Intelligent Agents: Agent and Environments – Good Behavior: The Concept of Rationality – The Nature of Environments – The Structure of Agents – Problem-Solving Agents – Example Problems – Architectures: Reactive, Deliberative, Hybrid, Subsumption.	
UNIT II - AGENT PLANNING AND DECISION-MAKING	9
Automated Planning: Definition of Classical Planning – Algorithms for Classical Planning. Quantifying Uncertainty: Bayes' Rule and Its Use. Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain – The Semantics of Bayesian Networks. Making Simple Decisions: The Basis of Utility Theory – Utility Functions. Making Complex Decisions: Sequential Decision Problems – Algorithms for MDPs. Multiagent Decision Making: Non-Cooperative Game Theory.	
UNIT III - REINFORCEMENT LEARNING IN AGENTIC SYSTEMS	9
Learning from Rewards – Passive and Active Reinforcement Learning – Temporal-Difference Learning: SARSA, Q-Learning – Generalization in Reinforcement Learning – Deep Reinforcement Learning: Deep Q-Networks – Policy Gradient Methods – Actor-Critic Methods – Applications of Reinforcement Learning.	
UNIT IV - MULTI-AGENT SYSTEMS	9
Multi-Agent Coordination: Cooperation and Competition – Cooperative Distributed Problem Solving – Agent Communication: Speech Acts and Communication Languages – Negotiation: Game-Theoretic and Auction-Based – Distributed Constraint Satisfaction – Multi-Agent Applications.	

UNIT V - LLM AGENTS AND ETHICS IN AGENTIC AI	9
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 – Ethics and Applications of Agentic AI: AI Alignment, Fairness, Explainability – Social and Environmental Implications – Case Studies: Autonomous Vehicles, Conversational Agents.	
TOTAL PERIODS	45

REFERENCES:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT Press, Second Edition, 2018.
2. Michael Wooldridge, "An Introduction to MultiAgent Systems", John Wiley & Sons, Second Edition, 2009.
3. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, Forth Edition, 2021.
4. Yoav Shoham and Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations", Cambridge University Press, 2009.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	3	1
2	3	3	2	3	2
3	2	3	3	3	3
4	2	3	3	3	3
5	2	3	3	3	3
CO (W.A)	2.4	2.8	2.4	3.0	2.4

26CPE201 - TEXT AND SPEECH PROCESSING		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand the fundamental concepts of Natural Language Processing and Speech Processing, including text preprocessing, language modeling, speech signal analysis, speech recognition and speech synthesis techniques. To design and develop intelligent text and speech-based applications using NLP methods, conversational AI, deep learning models, Transformer and Large Language Models while addressing multilingual and ethical considerations. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Apply the fundamental concepts and techniques of text and speech processing in language and speech-based applications.				Ap
CO2	Analyze text processing and speech processing algorithms for various language and speech applications.				An
CO3	Evaluate NLP and speech processing models based on their performance, accuracy and suitability for real-world applications.				E
CO4	Design text and speech processing solutions by integrating appropriate techniques, features and models.				C
CO5	Develop intelligent language and speech-based applications using deep learning, Transformer architectures and Large Language Models.				C

UNIT I – INTRODUCTION TO TEXT AND SPEECH PROCESSING	9
Introduction to NLP and Speech Processing – NLP Pipeline – Applications of NLP and Speech Technologies – Human Speech Production and Acoustic Phonetics – Text Normalization: Tokenization, Stop-word Removal, Stemming and Lemmatization – Speech Signal Fundamentals: Sampling, Quantization, Frequency, Spectrum and Noise – Speech Corpora and Datasets.	
UNIT II – TEXT PROCESSING TECHNIQUES	9
Part-of-Speech Tagging – Syntactic Parsing – Context Free Grammar – Dependency Parsing – Named Entity Recognition – Chunking – Information Extraction – Statistical Language Models – N-gram Models – Smoothing Techniques – Word Embeddings: Word2Vec and GloVe.	
UNIT III – SPEECH SIGNAL PROCESSING AND RECOGNITION	9
Speech Feature Extraction – MFCC – LPC – PLP – Acoustic Modeling – Hidden Markov Models (HMM) – Gaussian Mixture Models (GMM) – Automatic Speech Recognition (ASR) – Pronunciation Models – Language Models – End-to-End Speech Recognition Systems	
UNIT IV – SPEECH SYNTHESIS AND CONVERSATIONAL AI	9
Text-to-Speech Systems – Speech Databases and Corpora – Evaluation Metrics: WER, CER and MOS – Voice Assistants – Dictation Systems – Conversational AI – Voice Bots – Open Source Speech Processing Frameworks.	

UNIT V – MODERN NLP AND SPEECH APPLICATIONS	9
Sentiment Analysis – Chatbots and Dialogue Systems – Multilingual and Low-Resource NLP – Ethics, Bias and Privacy in Language Technologies – Recurrent Neural Networks (RNN) – Long Short-Term Memory Networks (LSTM) – Transformer Architecture – Large Language Models (LLMs) – Encoder-only, Decoder-only and Encoder-Decoder Models – Prompt Engineering Fundamentals.	
TOTAL PERIODS	45

REFERENCES:
<ol style="list-style-type: none"> 1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd Edition, Pearson, 2025. 2. Fundamentals of Speech Recognition, Pearson Education, 2011. 3. Natural Language Processing with Transformers, O'Reilly Media, 2022. 4. Introduction to Natural Language Processing, MIT Press, 2019.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	3	3	2	3	2
3	2	3	3	2	3
4	2	3	3	3	2
5	3	3	3	3	3
CO (W.A)	2.6	2.8	2.4	2.6	2.2

26CPE202 - CLOUD AND BIG DATA ANALYTICS		L	T	P	C
		3	0	0	3
Course Objective:	<ul style="list-style-type: none"> To apply cloud computing paradigms, distributed data processing frameworks, and modern data storage techniques for managing and analyzing large-scale data in scalable environments To design, evaluate, and deploy secure cloud-based big data analytics solutions using advanced tools, real-time processing frameworks, and modern deployment models for real-world applications. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Apply cloud computing models, virtualization techniques, and containerization tools to configure and deploy basic cloud-based services.	Ap			
CO2	Analyze big data characteristics and evaluate distributed processing frameworks such as Hadoop and data lakes for scalability and performance.	An			
CO3	Design data storage solutions using NoSQL databases and construct ETL pipelines for efficient data processing.	C			
CO4	Evaluate advanced big data analytics frameworks including Spark, streaming systems, and machine learning models for real-time applications.	E			
CO5	Develop secure and scalable cloud-based big data applications using modern deployment models such as serverless computing.	C			

UNIT I – CLOUD COMPUTING FUNDAMENTALS	9
Introduction to Cloud Computing – Service Models: IaaS, PaaS, SaaS – Deployment Models: Public, Private, Hybrid, Community – Virtualization: Hypervisors, VM Provisioning – Cloud Providers: Amazon Web Services, Microsoft Azure, Google Cloud Platform-Containerization using Docker.	
UNIT II – BIG DATA ECOSYSTEM & HADOOP	9
Big Data Characteristics (5Vs) – Challenges in Big Data – Hadoop Architecture – HDFS – MapReduce Programming Model – YARN – Data Lakes.	
UNIT III – DATA STORAGE & PROCESSING	9
NoSQL Databases: MongoDB, Apache Cassandra, HBase – Data Ingestion: Sqoop, Flume – Hive Architecture and Querying – Data Cleaning and Preparation – ETL Process.	
UNIT IV – ADVANCED BIG DATA ANALYTICS	9
Introduction to Apache Spark – Spark vs MapReduce – Spark SQL, DataFrames, RDDs – Machine Learning using Spark MLlib – Real-time Processing using Apache Kafka and Spark Streaming – Introduction to Deep Learning with Big Data.	

UNIT V – CLOUD INTEGRATION AND SECURITY	9
Data on Cloud – Storage and Compute Services – Data Security and Privacy – Cloud-based Data Analytics Use Cases – Cloud Native vs Traditional Applications – Serverless Computing (AWS Lambda / Azure Functions) - Case Study: Smart Cities / Healthcare Analytics.	
TOTAL PERIODS	45

REFERENCES:

1. Kai Hwang and Min Chen, "Big Data Analytics for Cloud, IoT and Cognitive Computing", Wiley, 1st Edition, 2017.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 1st Edition, 2011.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
4. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, 1st Edition, 2013.
5. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", Cambridge University Press, 2nd Edition, 2014.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	-	3	2	-
2	3	-	3	3	2
3	3	2	3	3	-
4	3	-	3	3	2
5	3	3	3	3	2
CO (W.A)	2.8	2.5	3.0	2.8	2.0

26CPE203 - ADVANCED SOFTWARE ENGINEERING		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand software development process models, the importance of architectural design, and the key dimensions of software dependability such as availability, reliability, safety, security, and resilience. To understand the fundamentals of web services, including standards and service-oriented architecture, along with the various stages of software testing during system development. 				
Course Outcomes : The Student will be able to					Cognitive Level
CO1	Critically evaluate and select appropriate software process models based on diverse project requirements and constraints.				Ap
CO2	Analyze and justify the role of software architecture in achieving system quality attributes and overall project success.				Ap
CO3	Assess and model the key dimensions of software dependability—availability, reliability, safety, security, and resilience—in complex systems.				Ap
CO4	Examine and design web service solutions using standard protocols and service-oriented architecture (SOA) principles.				An
CO5	Design and evaluate comprehensive software testing strategies across multiple levels to ensure system quality and reliability.				Ap

UNIT I - SOFTWARE PROCESS & MODELING	9
Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – Behavioural Modelling.	
UNIT II - SOFTWARE DESIGN	9
Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – PatternBased Design.	
UNIT III - SYSTEM DEPENDABILITY AND SECURITY	9
Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement.	

UNIT IV - SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING	9
Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.	
UNIT V - SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT	9
Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing – Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.	
TOTAL PERIODS	45

REFERENCES:

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3 rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018.
4. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018.
5. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd, 2018.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	3	2	2	1
2	3	3	3	3	2
3	3	3	2	3	2
4	3	2	3	3	3
5	3	3	3	2	2
CO (W.A)	3.0	2.8	2.6	2.6	2.0

26CPE204 – WIRELESS COMMUNICATIONS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand the fundamental concepts of cellular communication, wireless channel characteristics, and the impact of digital modulation techniques in fading environments. To analyze and apply diversity techniques and multicarrier systems for improving performance in wireless communication systems. 				
Course Outcomes : The Student will be able to					Cognitive Level
CO1	Design and develop efficient solutions for cellular communication systems by considering coverage, capacity, and quality of service requirements.				Ap
CO2	Analyze and determine the capacity of wireless channels using appropriate theoretical models under varying noise and interference conditions.				Ap
CO3	Evaluate the performance of digital modulation techniques in fading channels using analytical and simulation-based approaches.				Ap
CO4	Apply and assess various diversity techniques to mitigate fading effects and enhance the reliability of wireless communication systems.				An
CO5	Design and optimize multicarrier communication systems (such as OFDM) for high data rate transmission in wireless environments.				Ap

UNIT I - CELLULAR CONCEPTS	9
Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- SectoringRepeaters for Range Extension-Microcell Zone Concept.	
UNIT II - THE WIRELESS CHANNEL	9
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity comparisons – Capacity of Frequency Selective Fading channels.	
UNIT III - PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS	9
Performance of flat fading and frequency selective fading – Impact on digital modulation techniques – Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.	

UNIT IV - DIVERSITY TECHNIQUES	9
Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combining – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.	
UNIT V - MULTICARRIER MODULATION	9
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.	
TOTAL PERIODS	45

REFERENCES:

1. Theodore.S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2010.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Wiley Series in Telecommunications, Cambridge University Press, 2005.
4. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies" CRC press – 2019.
5. Keith Q. T. Zhang, "Wireless Communications: Principles, Theory and Methodology" 1st Edition, John Wiley & Sons, 2016.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	3	3	2	3	2
3	2	3	3	2	3
4	2	3	3	3	2
5	3	3	3	3	3
CO (W.A)	2.6	2.8	2.4	2.6	2.2

26CPE205 - AI IN IOT		L	T	P	C
		3	0	0	3
Course Objective:	<ul style="list-style-type: none"> To understand the integration of Artificial Intelligence techniques with IoT architectures for building intelligent and connected systems. To design, evaluate, and deploy AI-enabled IoT applications using machine learning, edge intelligence, and secure data-driven decision-making approaches. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Apply the concepts, architectures, and AI techniques in developing intelligent IoT systems for real-world applications.	Ap			
CO2	Analyze IoT sensor data processing techniques and AI-based analytics methods used in intelligent connected environments.	An			
CO3	Apply machine learning and deep learning models for classification, anomaly detection, and decision-making in IoT applications.	Ap			
CO4	Evaluate Edge AI deployment strategies, security mechanisms, and privacy-preserving approaches for IoT systems.	E			
CO5	Design scalable and sustainable AI-enabled IoT solutions for real-world industrial and smart city applications.	C			

UNIT I – FOUNDATIONS OF AI IN IOT	9
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.	
UNIT II – DATA ACQUISITION AND AI-BASED IOT ANALYTICS	9
Sensor Data Collection and Processing – AI-Based Data Normalization, Filtering and Feature Engineering – Challenges in Data Handling and Storage for AI Models – Cloud-Based IoT Data Analytics – Ethical Considerations in AI-Driven Data Processing – Case Study: Predictive Maintenance in Smart Factories.	
UNIT III – AI MODELS FOR INTELLIGENT IOT SYSTEMS	9
Supervised and Unsupervised AI Models in IoT – Classification, Clustering and Anomaly Detection – Deep Learning Models for IoT: CNNs and RNNs – Federated Learning for IoT Systems – Performance Metrics and Model Optimization – Case Study: AI-Driven Traffic Monitoring System.	
UNIT IV – EDGE AI AND SECURE IOT DEPLOYMENT	9
Edge AI Deployment Strategies – Edge AI for Real-Time Decision-Making – Deploying AI Models in Resource-Constrained IoT Devices – AI-Powered Security and Intrusion Detection in IoT Networks – Blockchain for Secure IoT Data Sharing – Ethical Implications and Privacy Concerns – Case Study: AI-Based Intrusion Detection in Healthcare IoT Networks.	

UNIT V – AI IN IOT: INDUSTRY TRENDS AND FUTURE DIRECTIONS	9
Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.	
TOTAL PERIODS	45

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. uyya 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 and Peter Norvig, Artificial Intelligence: A Modern Approach (4th Edition), Pearson, 2020.
10. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach (2nd Edition), Universities Press, 2016.

Web References:

<https://www.opensourceforu.com/2025/02/open-source-ai-frameworks-integrating-ai- with-iot/>
<https://www.springer.com/gp/campaign/artificial-intelligence/artificial-intelligence-in-iot>
<https://iotworldmagazine.com/2025/01/16/2675/list-of-top-50-best-ai-automation tools- in-2025>

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	-	-	2	-
2	3	-	-	3	-
3	3	2	-	3	2
4	2	2	3	2	2
5	2	3	3	3	3
CO (W.A)	2.6	2.3	3.0	2.6	2.3


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 Computer Science and Engineering
 Nandha College of Technology (Autonomous)
 Erode - 638 052.

26CPE206 - QUANTUM CRYPTOGRAPHY		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To introduce quantum information, computation, and algorithms for secure communication. To develop understanding of post-quantum and advanced quantum cryptographic techniques for real-world applications. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Describe the fundamental concepts of quantum information, quantum computation, and quantum gates used in quantum systems.				C
CO2	Analyze quantum algorithms to understand their computational advantages and problem-solving capabilities.				An
CO3	Evaluate the impact of quantum algorithms on classical cryptographic systems and analyze their vulnerabilities.				E
CO4	Apply post-quantum cryptographic techniques to design secure encryption schemes resistant to quantum attacks.				Ap
CO5	Design and implement advanced quantum cryptographic protocols for secure communication in practical and emerging systems.				C

UNIT I - QUANTUM INFORMATION AND COMPUTATION	9
Qubit: Single and multiple qubits - Mathematical model of quantum mechanics - Quantum measurements Quantum computation and No-cloning theorem - Quantum operations: Phase shift, Bit flips, Hadamard transform - Entanglement - Quantum gates and circuits: CNOT, CCNOT, reversible gates, universal gates - Quantum parallelism.	
UNIT II - QUANTUM ALGORITHMS	9
Deutsch's Algorithm - Phase Kickback - Deutsch-Jozsa Algorithm - Simon's Algorithm - Quantum Fourier Transform (QFT) - Grover's Algorithm - Shor's Algorithm.	
UNIT III - QUANTUM CRYPTANALYSIS	9
Quantum order finding and factoring - Discrete logarithms - Hidden Subgroup Problems (HSP) - Diffie-Hellman problems (Computational & Decisional) - IND-CPA security - Applications in RSA and ElGamal encryption	
UNIT IV - POST-QUANTUM CRYPTOGRAPHY	9
Introduction to lattices, codes, and isogenies - Lattice problems: LWE and SIS - Connection to hidden-subgroup problems - Public Key Encryption from LWE - Fully Homomorphic Encryption (FHE)	

UNIT V - ADVANCED QUANTUM CRYPTOGRAPHY	9
Quantum Key Distribution (QKD) – BB84 - Bit commitment and Random Oracles - Quantum One-Time Pad and Quantum Encryption - Quantum PKE and Quantum FHE - Quantum in differentiability and Quantum money - Device-independent QKD and IoT-based QKD systems	
TOTAL PERIODS	45

REFERENCES:

1. Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", 10th Edition, Cambridge University Press, 2021.
2. Quantum Computation and Quantum Information, M. A. Nielsen and I. Chuang, Cambridge University Press, 2012.
3. Quantum Computing from the Ground Up, Riley Tipton Perry, World Scientific Publishing Ltd., 2012.
4. Quantum algorithms via linear Algebra Primer, Richard J. Lipton Kenneth W. Regan, The MIT Press Cambridge, 2014.
5. Quantum Computing: An Applied Approach, Jack D. Hidary, 1st Edition, Springer, 2019.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	-	1	2	-
2	3	-	2	3	1
3	3	-	2	-	3
4	2	2	-	3	2
5	2	3	3	2	3
CO (W.A)	2.4	1.0	1.6	2.0	1.8

26CPE207 - HIGH PERFORMANCE COMPUTING FOR BIG DATA		L	T	P	C
		3	0	0	3
Course Objective:	<ul style="list-style-type: none"> To analyze and apply high performance computing paradigms, network infrastructures, and distributed systems for efficient big data processing and real-time analytics. To design and evaluate secure, scalable, and high-performance big data solutions using advanced computing architectures and emerging applications. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Apply HPC paradigms and computing models to solve large-scale data processing problems.	Ap			
CO2	Analyze network and storage infrastructures for optimizing high-performance big data systems.	An			
CO3	Evaluate real-time analytics frameworks and HPC architectures for scalable data processing.	E			
CO4	Design secure big data systems using advanced security models and distributed computing techniques.	C			
CO5	Develop high-performance big data applications using modern accelerators and AI-driven computing platforms.	C			

UNIT I – INTRODUCTION	9
Emerging IT Trends – IoT/IoE – Big Data Analytics concepts – HPC paradigms – Cluster Computing – Grid Computing – Cloud Computing – Heterogeneous Computing – Supercomputing for BDA – Appliances for BDA – GPU Computing for HPC.	
UNIT II – NETWORK & SOFTWARE INFRASTRUCTURE	9
Design of Network Infrastructure – Network Virtualization – Software Defined Networking (SDN) – Network Functions Virtualization (NFV) – WAN Optimization – Storage Infrastructure – SAN, NAS – Distributed File Systems – Cloud Storage – Edge Computing for Data Processing	
UNIT III – REAL-TIME ANALYTICS USING HPC	9
Real-time Analytics Technologies – MOA – GPFS – Machine Data Analytics – Operational Analytics – HPC Architecture Models – In-database Analytics – In-memory Analytics – Stream Processing Frameworks (Apache Spark Streaming)	
UNIT IV – SECURITY AND TECHNOLOGIES	9
Security, Privacy and Trust – Big Data Security Challenges – IoT Data Security – End-to-End Security Framework – Clustering in Big Data – Blockchain for Data Security in HPC	

UNIT V – EMERGING BIG DATA APPLICATIONS	9
Deep Learning Accelerators – Accelerators for Clustering and Classification – Big Data Genome Sequencing – AI Accelerators (TPUs and Edge AI).	
TOTAL PERIODS	45

REFERENCES:

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj, Siddhartha Duggirala, "High-Performance Big-Data Analytics: Computing Systems and Approaches", Springer, 1st Edition, 2015.
2. Kuan-Ching Li, Hai Jiang, Albert Y. Zomaya, "Big Data Management and Processing", CRC Press, 1st Edition, 2017.
3. Chao Wang, "High Performance Computing for Big Data: Methodologies and Applications", CRC Press, 1st Edition, 2018.
4. Khosrow Hassibi, "High Performance Data Mining and Big Data Analytics", CreateSpace Independent Publishing Platform, 1st Edition, 2014.
5. Thomas Sterling, Matthew Anderson, "High Performance Computing: Modern Systems and Practices", Morgan Kaufmann, 1st Edition, 2017.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	-	3	2	-
2	3	-	3	3	2
3	3	-	3	3	2
4	3	2	3	3	2
5	3	3	3	3	2
CO (W.A)	2.8	2.5	3.0	2.8	2.0

26CPE208 - WEB ANALYTICS		L	T	P	C
		3	0	0	3
Course Objective:	<ul style="list-style-type: none"> To analyze web analytics platforms, data collection mechanisms, and web metrics for understanding user behavior and optimizing digital applications. To design and evaluate modern web analytics solutions using KPI frameworks, competitive intelligence, and advanced analytics tools for data-driven decision making. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Analyze web analytics concepts, platforms, and digital traffic sources for effective online business monitoring.	An			
CO2	Apply data collection and clickstream analysis techniques to capture and process web usage data.	Ap			
CO3	Evaluate qualitative analysis methods and UX analytics techniques for improving website usability and user engagement.	E			
CO4	Analyze web metrics, KPI frameworks, and conversion analytics for optimizing web performance and decision-making.	An			
CO5	Design intelligent web analytics solutions using competitive intelligence, predictive analytics, and AI-based tools.	C			

UNIT I – INTRODUCTION TO WEB ANALYTICS	9
Definition, Process, Key Terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, Onsite web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations – Digital Marketing Analytics Concepts.	
UNIT II – DATA COLLECTION	9
Clickstream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data – Social Media Analytics Data Sources.	
UNIT III – QUALITATIVE ANALYSIS	9
Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.	

UNIT IV – WEB METRICS	9
Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.	
UNIT V – WEB ANALYTICS 2.0	9
Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.	
TOTAL PERIODS	45

REFERENCES:

1. Avinash Kaushik, "Web Analytics: An Hour a Day", Wiley Publishing, 1st Edition, 2007.
2. Brian Clifton, "Advanced Web Metrics with Google Analytics", Wiley Publishing, 3rd Edition, 2012.
3. Kaushik A., "Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity", Wiley Publishing, Inc., 1st Edition, 2010.
4. Jason Burby and Shane Atchison, "Actionable Web Analytics: Using Data to Make Smart Business Decisions", Wiley Publishing, 1st Edition, 2007.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	-	3	2	-
2	3	-	3	3	2
3	3	2	3	2	2
4	3	2	3	3	2
5	3	3	3	3	3
CO (W.A)	2.8	2.5	3.0	2.8	2.0

26CPE209 - ADVANCED LARGE LANGUAGE MODELS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand the architectures, training methodologies and capabilities of Large Language Models for natural language understanding and generation. To design and deploy LLM-based applications using prompting, fine-tuning, retrieval augmentation and responsible AI practices. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Apply transformer-based architectures for language understanding and generation tasks.				Ap
CO2	Analyze the training and adaptation techniques used in modern LLMs.				An
CO3	Evaluate the performance, limitations and ethical implications of LLMs.				E
CO4	Design LLM-powered applications using prompt engineering and retrieval mechanisms.				C
CO5	Develop domain-specific generative AI solutions using fine-tuned and open-source LLMs.				C

UNIT I – FOUNDATIONS OF LARGE LANGUAGE MODELS	9
Evolution of NLP – Statistical NLP to Deep Learning – Word Embeddings – RNN, LSTM and Attention Mechanism – Transformer Architecture – Self-Attention – Multi-Head Attention – Positional Encoding – Encoder and Decoder Architectures – Scaling Laws of LLMs.	
UNIT II – PRETRAINING AND FOUNDATION MODELS	9
Language Modeling Objectives – Autoregressive Models – Masked Language Models – Foundation Models – GPT Family – BERT Family – T5 and FLAN Models – Tokenization Techniques – Training Data Preparation – Distributed Training Concepts.	
UNIT III – ADAPTATION AND FINE-TUNING OF LLMs	9
Prompt Engineering – In-Context Learning – Zero-Shot Learning – Few-Shot Learning – Fine-Tuning Strategies – Parameter Efficient Fine Tuning (PEFT) – LoRA – QLoRA – Instruction Tuning – Reinforcement Learning from Human Feedback (RLHF).	
UNIT IV – RETRIEVAL AUGMENTED GENERATION AND AGENTIC AI	9
Vector Databases – Embedding Models – Semantic Search – Retrieval Augmented Generation (RAG) – Knowledge Grounding – AI Agents – Tool Calling – Multi-Agent Systems – Memory Mechanisms – LLM Application Frameworks.	

UNIT V – LLM APPLICATIONS, EVALUATION AND RESPONSIBLE AI	9
Text Generation – Question Answering – Summarization – Code Generation – Multimodal LLMs – Benchmarking and Evaluation – Hallucination Detection – Bias and Fairness – Explainability – Privacy and Security – Responsible AI Governance.	
TOTAL PERIODS	45

REFERENCES:

1. Hands-On Large Language Models, O'Reilly Media, 2024.
1. Generative AI with Large Language Models, O'Reilly Media, 2024.
2. Natural Language Processing with Transformers, O'Reilly Media, 2022.
3. Build a Large Language Model From Scratch, Manning Publications, 2024

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	3	2	3	2
3	2	2	3	2	3
4	2	3	3	3	2
5	3	3	3	3	3
CO (W.A)	2.4	2.6	2.4	2.6	2.2


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26CPE210 - DATA VISUALIZATION		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To apply principles of visual perception, visual encoding, and data representation for effective communication and exploration of data. To design interactive visualizations, dashboards, and visual analytics solutions for large-scale and real-world datasets using modern visualization tools and techniques. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Apply visualization principles and techniques for representing different types of data.				Ap
CO2	Analyze visual encoding methods and interactive visualization techniques for data exploration.				An
CO3	Evaluate the effectiveness and usability of visualization systems and dashboards.				E
CO4	Design visual analytics solutions using suitable visualization models and tools.				C
CO5	Develop interactive dashboards and storytelling applications for real-world datasets.				C

UNIT I – FUNDAMENTALS OF DATA VISUALIZATION	9
Introduction to Data Visualization – Importance and Applications – Data Types: Categorical, Ordinal, Quantitative, Temporal and Spatial Data – Visualization Pipeline – Exploratory Data Analysis – Human Perception and Cognition – Visual Variables: Position, Size, Shape, Color and Texture – Design Principles and Best Practices – Avoiding Misleading Visualizations.	
UNIT II – VISUAL REPRESENTATION TECHNIQUES	9
Statistical Graphics – Bar Charts, Histograms, Pie Charts, Box Plots, Scatter Plots and Heat Maps – Time Series Visualization – Multivariate Visualization – Network and Graph Visualization – Tree Maps – Geospatial Visualization – Color Theory and Visual Encoding Techniques.	
UNIT III – INTERACTIVE VISUALIZATION AND DASHBOARDS	9
Interactive Visualization Concepts – Filtering, Aggregation and Drill-Down Operations – Multiple Coordinated Views – Dashboard Design Principles – Storytelling with Data – User-Centered Visualization Design – Visual Analytics Frameworks – Dashboard Evaluation Metrics.	
UNIT IV – VISUALIZATION TOOLS AND TECHNOLOGIES	9
Data Preparation and Cleaning for Visualization – Visualization using Python Libraries: Matplotlib, Seaborn, Plotly – Tableau Fundamentals – Power BI Fundamentals – Web-based Visualization using D3.js – Real-Time Visualization Concepts – Building Interactive Dashboards.	

UNIT V – ADVANCED VISUAL ANALYTICS	9
Big Data Visualization – Visualization for Machine Learning Models – Explainable AI Visualization – Text and Social Media Visualization – Visualizing High-Dimensional Data – Visual Analytics for Decision Support Systems – Ethics and Accessibility in Data Visualization – Emerging Trends in Visualization.	
TOTAL PERIODS	45

REFERENCES:

1. Visualization Analysis and Design, CRC Press, 2nd Edition, 2024.
1. Storytelling with Data, Wiley, 2nd Edition, 2025.
2. Fundamentals of Data Visualization, O'Reilly Media, 2020.
3. Interactive Data Visualization for the Web, O'Reilly Media, 3rd Edition, 2023.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	3	2	3	2
3	2	2	3	2	3
4	2	3	3	3	2
5	3	3	3	3	3
CO (W.A)	2.4	2.6	2.4	2.6	2.2


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26CPE211 - ROBOTICS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To gain knowledge on the history, classification, structure, components, kinematics, dynamics, control techniques, and artificial intelligence in robotics. To gain practical knowledge in. To provide practical exposure to work cell design, robot safety, flexible manufacturing systems (FMS), and human-robot collaboration for industrial applications. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Analyze basic robotics concepts including structure, components, joints, DOF, reference frames, sensors, and software.				An
CO2	Analyze and model robot kinematics and dynamics using transformations, DH parameters, kinematics, Jacobian, and dynamic methods.				An
CO3	Apply control techniques such as PID, PD gravity, computed torque, state-space, and impedance control.				Ap
CO4	Apply AI techniques like search methods, logic, robot learning, and task planning in robotics.				Ap
CO5	Analyze the design, coordination, safety, and efficiency of industrial robotic systems, including work cells, FMS, and cobots.				An

UNIT I – INTRODUCTION TO ROBOTICS	9
Robotics -History - Classification and Structure of Robotic Systems - Basic components -Degrees of freedom - Robot joints coordinates- Reference frames - workspace- Robot languages- Robotic sensors- proximity and range sensors, ultrasonic sensor, touch and slip sensor.	
UNIT II – ROBOT KINEMATICS AND DYNAMICS	9
Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.	
UNIT III - ROBOTICS CONTROL	9
Control of robot manipulator -State equations - Linear feedback systems - Controllability and observability (state-space control) - Single-axis PID control - PD gravity control - Computed torque control - Variable structure control - Impedance control.	
UNIT IV - ROBOT INTELLIGENCE AND TASK PLANNING	9
Artificial Intelligence - techniques - search problem reduction - predicate logic means and end analysis - problem solving -robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics	



UNIT V - INDUSTRIAL ROBOTICS	9
Robot cell design and control - Cell layouts and work cell design - Multiple robots and machine interference Work cell control and interlocks - Error detection, deduction, and recovery -Work cell controller -Robot cycle time analysis -Safety in robotics -Flexible Manufacturing Systems (FMS) - Human-robot collaboration (cobots) - Applications of robots and future scope	
TOTAL PERIODS	45

REFERENCES:

1. "Introduction to Robotics: Mechanics and Control "– John J. Craig, 3rd Edition, Pearson Education, 2004.
2. Robotics: Control, Sensing, Vision, and Intelligence – K. S. Fu, R. C. Gonzalez, C. S. G. Lee, 1st Edition, McGraw-Hill, 1987.
3. Robot Modeling and Control – Mark W. Spong, Seth Hutchinson, M. Vidyasagar, 1st Edition, Wiley, 2005.
4. Industrial Robotics: Technology, Programming, and Applications – Mikell P. Groover, 1st Edition, McGraw-Hill, 1986.

Mapping of COs with POs / PSOs					
COs	Pos			PSOs	
	1	2	3	1	2
1	2	1	2	2	1
2	3	1	3	3	2
3	3	1	3	3	3
4	2	2	3	3	3
5	3	3	3	3	3
CO (W.A)	2.6	1.6	2.8	2.8	2.4



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26CPE212 – GPU COMPUTING		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand the architecture of GPUs and develop efficient programs using CUDA, including memory handling, multi-GPU solutions, optimization, and debugging of common programming issues. To introduce different GPU programming models such as OpenCL and apply parallel patterns to design efficient algorithms for heterogeneous computing platforms. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Describe GPU Architecture.	U			
CO2	Write programs using CUDA, identify issues and debug them.	Ap			
CO3	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication.	Ap			
CO4	Write simple programs using OpenCL.	Ap			
CO5	Identify efficient parallel programming patterns to solve problems.	An			

UNIT I - GPU ARCHITECTURE	9
Evolution of GPU architectures – Understanding Parallelism with GPUs – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Block Scheduling – Memory Handling with CUDA: Shared Memory – Global Memory – Constant Memory – Texture Memory.	
UNIT II - CUDA PROGRAMMING	9
Using CUDA in Practice – Multi-CPU and Multi-GPU Solutions – Optimizing CUDA Applications: Parallel/Serial GPU/CPU Problem Breakdown – Memory Considerations – Transfers – Thread Usage, Calculations, and Divergence – Algorithms – Resource Contentions – Self-Tuning Applications.	
UNIT III - PROGRAMMING ISSUES	9
Common Problems, Causes and Solutions: Errors with CUDA Directives – Parallel Programming Issues – Algorithmic Issues – Finding and Avoiding Errors – Developing for Future GPUs.	
UNIT IV - OPENCL BASICS	9
OpenCL Standard – The OpenCL Specification – Kernels and the OpenCL Execution Model – Platform and Devices – The Execution Environment – Memory Model – Writing Kernels – Basic OpenCL Examples.	

UNIT V - ALGORITHMS ON GPU	9
Parallel Patterns: Convolution – Prefix Sum – Sparse Matrix – Vector Multiplication – Programming Heterogeneous Cluster.	
TOTAL PERIODS	45

REFERENCES:

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison-Wesley, Second Edition, 2020.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison-Wesley, First Edition, 2010.
3. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", Morgan Kaufmann, First Edition, 2013.
4. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous Computing with OpenCL", Morgan Kaufmann, Third Edition, 2015.
5. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", Morgan Kaufmann, Forth Edition, 2022.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	2	3	3	1
3	2	2	3	3	2
4	2	2	3	3	2
5	2	3	3	3	3
CO (W.A)	2.2	2.2	2.6	2.8	1.8

26CPE213 - WEB 3.0		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand the evolution of Web technologies and develop skills in blockchain, smart contracts, and decentralized application (dApp) design for building secure and scalable Web 3.0 systems. To implement NFT, digital identity, and decentralized storage solutions while integrating AI, IoT, and Semantic Web technologies, and evaluate governance and regulatory challenges in Web 3.0. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain the evolution, principles, and layered architecture of Web 3.0 technologies.	C			
CO2	Summarize blockchain architectures and consensus mechanisms, highlighting their advantages and limitations.	An			
CO3	Implement smart contracts and develop decentralized applications by integrating block chain with front-end technologies.	Ap			
CO4	Analyze NFT models and decentralized storage systems for interoperability and scalability in Web 3.0.	An			
CO5	Evaluate decentralized governance models, security mechanisms, and technology integrations to propose effective Web 3.0 solutions.	E			

UNIT I - EVOLUTION AND FUNDAMENTALS OF WEB 3.0	9
Evolution: Web 1.0 → Web 2.0 → Web 3.0 - Core concepts and principles of Web 3.0 – Decentralization and Semantic Interoperability - Layered architecture: Blockchain, P2P networks, decentralized storage - Introduction to Semantic Web protocols.	
UNIT II - BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGIES	9
Blockchain architecture and components - Consensus mechanisms: PoW, PoS, Hybrid models - Directed Acyclic Graphs (DAGs) - RESTful APIs and open standards in blockchain systems - Comparative analysis of consensus mechanisms.	
UNIT III - SMART CONTRACTS AND DECENTRALIZED APPLICATIONS	9
Smart contract design and deployment - dApp architecture and lifecycle - Blockchain integration with front-end technologies - HTML5, Semantic HTML, ARIA/WCAG accessibility.	
UNIT IV - TOKENIZATION AND DECENTRALIZED STORAGE	9
Digital asset tokenization and NFTs - ERC-721 and ERC-1155 standards - Metadata structuring using JSON-LD - Oracle services and real-time data - Decentralized storage: IPFS, Filecoin.	

UNIT V - SECURITY, GOVERNANCE, AND TECHNOLOGY INTEGRATION	9
Security, scalability, interoperability challenges - Decentralized Identity (DIDs) and W3C standards - Peer-to-peer networking - DAOs and token-based governance - Integration with AI, IoT, and Semantic Web (RDF, OWL, SPARQL) - Regulatory and economic frameworks.	
TOTAL PERIODS	45

REFERENCES:

1. Andreas M. Antonopoulos, Gavin Wood, "Mastering Ethereum", 2nd Edition, O'Reilly Media, 2018.
2. Alex Tapscott, "Web3: Charting the Internet's Next Economic and Cultural Frontier, Portfolio", 2023.
3. Imran Bashir, "Mastering Blockchain: Unlocking the World of Cryptocurrencies", Latest Edition, Packt Publishing, 2023.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	-	1	2	-
2	2	-	2	2	1
3	3	2	2	3	2
4	3	-	2	3	2
5	3	3	3	2	3
CO (W.A)	2.4	1.0	2.0	2.4	1.6

26CPE214 - EDGE AND FOG COMPUTING		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To gain knowledge on cloud-fog-edge computing paradigms, IoT architecture, offloading strategies, resource management, network slicing, virtualization, and middleware design in distributed edge environments. To gain knowledge on edge intelligence, machine learning-based optimization, security and privacy mechanisms, and emerging technologies such as Edge AI, 6G, and advanced distributed computing models. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Analyze cloud, fog, and edge computing paradigms and architectures.				An
CO2	Apply edge offloading and optimization techniques.				Ap
CO3	Analyze resource federation and network slicing.				An
CO4	Apply middleware solutions to edge systems to manage changes at the application level.				Ap
CO5	Analyze edge intelligence and emerging technologies and their impact on system performance and decision-making.				An

UNIT I - CLOUD TO EDGE COMPUTING PARADIGMS	9
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 – Introduction to C2F2T Integration.	
UNIT II - EDGE OFFLOADING AND SYSTEM OPTIMIZATION	9
Edge Offloading Strategies and Placement Issues – Latency, Energy, QoS, and Privacy Challenges – Queuing Theory and System Performance Metrics – Optimization using Machine Learning – Basic Heuristic and Scheduling Algorithms.	
UNIT III - RESOURCE FEDERATION AND NETWORK SLICING	9
C2F2T Integration – Network Slicing for 5G/6G – Slice Types and Lifecycle – Resource Virtualization using SDN and NFV – Container-Based Federation – Modeling and Simulation – Introduction to OpenFlow (SDN basics).	
UNIT IV MIDDLEWARE FOR EDGE SYSTEMS	9
Middleware Design Goals – Service Orchestration – Docker and Kubernetes on Edge Devices – Edge Cluster Formation – Communication Protocols: MQTT, CoAP, Microservices – Distributed Storage and Fault Recovery – Edge Monitoring and Resource Discovery.	

UNIT V - EDGE INTELLIGENCE, SECURITY AND FUTURE DIRECTIONS	9
Data Management (Caching, Placement, Lifecycle) – Federated Learning and Distributed ML – Stream Processing and Real-Time Analytics – Use Cases: Smart Cities, Healthcare, Smart Homes – Security Challenges and ML-based Threat Detection – Privacy Techniques – Blockchain for Edge Security – Software-defined Edge Networks – Green Computing – Edge AI and TinyML – 6G Vision – Digital Twins, Serverless Edge, Cognitive Networks.	
TOTAL PERIODS	45

REFERENCES:

1. "Fog Computing and Its Role in the Internet of Things", ACM MCC, 2012.
2. "A Survey of Fog Computing: Concepts, Applications and Issues", ACM, 2015.
3. "SDN: Software Defined Networks", O'Reilly Media, 2013
4. "Kubernetes: Up and Running, O'Reilly Media", 2nd Edition, 2019.
5. "Building Microservices", O'Reilly Media, 2nd Edition, 2021.
6. "TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers", O'Reilly Media, 2019.
7. "Cloud Computing: Concepts, Technology & Architecture", Springer, 2018.
8. "Perry Lea, IoT and Edge Computing for Architects", Packt Publishing, 2nd Edition, 2020.
9. Assad Abbas, Samee U. Khan, Albert Y. Zomaya, "Fog Computing: Theory and Practice", Wiley, 2018.
10. Rajkumar Buyya, Satish Narayana Srirama, "Fog and Edge Computing: Principles and Paradigms", Wiley, 2019.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	-	2	3	2
2	3	-	2	3	2
3	2	-	3	3	2
4	3	2	3	3	2
5	2	3	3	2	3
CO (W.A)	2.6	2.5	2.6	2.5	2.2

26CPE215 – DEVOPS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To learn the fundamentals of DevOps, its platform, and supporting cloud services. To build, deploy, monitor, and govern modern applications using DevOps tools and MLOps practices. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain DevOps principles, software process models, and barriers to adoption.				U
CO2	Utilize cloud platform and operations service concepts to support DevOps practices.				Ap
CO3	Design a microservice-based deployment pipeline with automated build and testing.				Ap
CO4	Analyze monitoring and security mechanisms for reliable DevOps systems.				An
CO5	Implement an MLOps workflow covering model development, deployment, and governance.				Ap

UNIT I – INTRODUCTION	9
Software Engineering – Traditional and Agile process models – DevOps: Definition – Need for DevOps – DevOps Perspective – DevOps and Agile – Team Structure – Coordination – Barriers.	
UNIT II - DEVOPS PLATFORM AND SERVICES	9
Cloud as a Platform: Features of the Cloud – DevOps Consequences of the Unique Cloud Features – Operations: Operation Services – Service Operation Functions – Continual Service Improvement – Operations and DevOps.	
UNIT III - THE DEPLOYMENT PIPELINE	9
Overall Architecture: Need for Architectural Change – Overall Architecture Structure – Quality Discussion of Microservice Architecture – Amazon's Rules for Teams – Microservice Adoption for Existing Systems – Building and Testing: Moving a System Through the Deployment Pipeline – Crosscutting Aspects – Development and Pre-commit Testing – Build and Integration Testing – UAT/Staging/Performance Testing – Deployment: Strategies for Managing a Deployment – Logical Consistency – Packaging – Deploying to Multiple Environments – Partial Deployment – Rollback – Tools.	
UNIT IV - CROSSCUTTING CONCERNS	9
Monitoring: What to Monitor – How to Monitor – When to Change the Monitoring Configuration – Interpreting Monitoring Data – Challenges – Tools – Diagnosing an Anomaly from Monitoring Data – Security and Security Audits: Security – Threats – Resources to Be Protected – Security Roles and Activities – Identity Management – Access Control – Detection, Auditing, and Denial of Service –	

Development – Auditors – Application Design Considerations – Deployment Pipeline Design Considerations – Other Illities – Business Considerations.	
UNIT V - MLOPS	9
MLOps – Definition – Challenges – Developing Models – Deploying to Production – Model Governance – Real-world Examples.	
TOTAL PERIODS	45

REFERENCES:	
<ol style="list-style-type: none"> 1. Joakim Verona, “Practical DevOps”, Packet Publishing, Second Edition, 2018. 2. Viktor Farcic, “The DevOps 2.5 Toolkit: Monitoring, Logging, and Auto-Scaling Kubernetes”, Packet Publishing, 2019. 3. Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect’s Perspective”, Pearson Education, First Edition, 2016. 4. Mark Treveil and the Dataiku Team, “Introducing MLOps”, O’Reilly Media, First Edition, 2020. 	

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	3	1
2	3	2	2	3	3
3	3	3	3	3	3
4	2	3	3	3	3
5	2	3	3	3	3
CO (W.A)	2.6	2.6	2.4	3.0	2.6


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26CPE216 - EMBEDDED SOFTWARE DEVELOPMENT		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand modern embedded system architectures, interfacing techniques, embedded networking, and real-time operating system concepts. To analyze, design, and develop secure IoT-enabled smart embedded applications using modern embedded platforms and Industry 4.0 technologies. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Explain the architecture and operation of modern embedded processors, embedded platforms, and peripheral interfacing techniques.	U			
CO2	Apply embedded programming and interfacing methods to develop real-time and IoT-based embedded applications.	Ap			
CO3	Analyze embedded communication protocols, networking architectures, and system performance in distributed embedded environments.	An			
CO4	Examine real-time scheduling algorithms and RTOS concepts for efficient embedded system design.	An			
CO5	Design secure and intelligent embedded solutions for Industry 4.0 and Edge AI applications using modern system design methodologies.	C			

UNIT I – EMBEDDED PROCESSORS	9
Embedded Computers – Characteristics of Embedded Computing Applications – Challenges in Embedded Computing System Design – Embedded System Design Process – Formalism for System Design – Structural Description – Behavioural Description – ARM Cortex Processor – RISC-V Processor Architecture – Basics of Edge Computing – Introduction to Embedded AI Processors.	
UNIT II – EMBEDDED COMPUTING PLATFORM	9
CPU Bus Configuration – Memory Devices and Interfacing – Input/Output Devices and Interfacing – IoT Sensor and Actuator Interfacing – ESP32 and STM32 Development Boards – Embedded Linux Basics – System Design – Development and Debugging – Simulator – JTAG Design Example – Alarm Clock – Analysis and Optimization of Performance – Low Power Embedded Design – Power and Program Size.	
UNIT III – EMBEDDED NETWORK ENVIRONMENT	9
Distributed Embedded Architecture – Hardware and Software Architectures – Networks for Embedded Systems – I2C – CAN Bus – Ethernet – Internet – MQTT Protocol – Wireless Sensor Networks – Bluetooth Low Energy (BLE) – Zigbee – LoRaWAN – Embedded System Security Basics – Network-based Design – Communication Analysis – System Performance Analysis – Hardware Platform Design – Allocation and Scheduling – Design Example – Elevator Controller.	

UNIT IV – REAL-TIME CHARACTERISTICS	9
Clock Driven Approach – Weighted Round Robin Approach – Priority Driven Approach – Dynamic versus Static Systems – Effective Release Times and Deadlines – Earliest Deadline First (EDF) Algorithm – Challenges in Validating Timing Constraints in Priority Driven Systems – Off-Line versus On-Line Scheduling – FreeRTOS Basics – Zephyr RTOS Basics – Multithreading Concepts – Real-Time IoT Applications – Introduction to TinyML in Embedded Systems.	
UNIT V – SYSTEM DESIGN TECHNIQUES	9
Design Methodologies – Requirement Analysis – Specification – System Analysis and Architecture Design – Quality Assurance – Embedded Cybersecurity – Smart Embedded Systems – Industry 4.0 Applications – Edge AI Applications – Design Examples – Smart Healthcare Systems – Smart Agriculture Systems – Inkjet Printer – Set-Top Boxes.	
TOTAL PERIODS	45

REFERENCES:

1. “Embedded Systems Design, Springer”, 3rd Edition, 2021.
2. “Embedded Systems: Introduction to ARM Cortex-M Microcontrollers”, CreateSpace Independent Publishing, 5th Edition, 2020.
3. “Real-Time Concepts for Embedded Systems”, CMP Books, 2017.
4. “Internet of Things: A Hands-On Approach”, Universities Press, 2019.
5. “Practical Embedded Security”, Elsevier, 2nd Edition, 2021.
6. “Embedded System Design: A Unified Hardware/Software Introduction”, Wiley India, 2nd Edition, 2019.
7. “ARM System Developer’s Guide”, Elsevier, 2018.
8. “Mastering Embedded Linux Programming”, Packt Publishing, 3rd Edition, 2021.
9. “TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers”, O’Reilly Media, 2020.
10. “Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed”, Wiley, 2018.
11. “Embedded Networking with CAN and CANopen”, Copperhill Technologies, 2019.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	-	2	-
2	3	3	2	3	2
3	2	3	2	3	2
4	2	3	2	2	3
5	2	2	3	3	3
CO (W.A)	2.4	2.6	1.8	2.6	2.0


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26CPE217 – SECURITY PRINCIPLES AND PRACTICES		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand and analyze core and advanced concepts of system, network, web, cyber, cloud, and forensic security. To apply security techniques and implement management, governance, risk, privacy, and storage security strategies in modern IT environments. 				
Course Outcomes: The student will be able to					Cognitive Level
CO1	Explain system security models and mechanisms.				U
CO2	Apply security techniques in network and wireless systems.				Ap
CO3	Implement security management and governance practices.				Ap
CO4	Analyze cyber forensics and cloud security fundamentals.				An
CO5	Evaluate privacy, storage security, and risk issues.				E

UNIT I - SYSTEM SECURITY	9
Model of Network Security - Security Attacks, Services, and Mechanisms - OSI Security Architecture - Cryptography: Encryption and Decryption - Intrusion Detection Systems (IDS) - Intrusion Prevention Systems (IPS) - Security in Web Applications - Introduction to Secure Software Development Lifecycle (SSDLC) Case Study: OWASP Top 10 Web Application Security Risks	
UNIT II - NETWORK SECURITY	9
Internet Security - Intranet Security - Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security - Cellular Network Security - Mobile Security - IoT Security Case Study: Kali Linux	
UNIT III - SECURITY MANAGEMENT	9
Information Security Essentials for IT Managers - Security Management Systems - Policy Driven Security Management - IT Security - Online Identity and User Management System - Security Governance Frameworks (ISO 27001 concepts) – Case Study: Metasploit	
UNIT IV - CYBER SECURITY AND CLOUD SECURITY	9
Cyber Forensics - Disk Forensics - Network Forensics - Wireless Forensics - Database Forensics - Malware Forensics - Mobile Forensics - Email Forensics - Best Practices for Automated Security - Cloud Security (IaaS, PaaS, SaaS) - Case Study: DVWA	

UNIT V - PRIVACY AND STORAGE SECURITY	9
Privacy on the Internet - Privacy Enhancing Technologies - Personal Privacy Policies - Detection of Conflicts in Security Policies - Storage and Security in Network Devices - Storage Area Network Security - Risk Management - Physical Security Essentials - Data Privacy Regulations (GDPR concepts)	
TOTAL PERIODS	45

REFERENCES:

1. William Stallings, Lawrie Brown "Computer Security: Principles and Practice", Pearson ,4th Edition, 2018.
2. William Stallings, "Cryptography and Network Security: Principles and Practice" Pearson, 8th Edition, 2023.
3. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", Cengage Learning, 7th Edition ,2023.
4. Dafydd Stuttard and Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaw"s, Wiley, 2nd Edition, 2011.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	1	2	2	1
2	3	1	2	3	2
3	3	2	3	3	2
4	3	2	3	3	3
5	2	2	3	2	2
CO (W.A)	2.6	1.6	2.6	2.6	2.0

26CPE218 - COGNITIVE COMPUTING		L	T	P	C
		3	0	0	3
Course Objective:	<ul style="list-style-type: none"> To introduce the fundamentals of cognitive computing, artificial intelligence, and human cognition, and to develop the ability to model intelligent systems for solving real-world problems. To explore machine learning, natural language processing, cognitive architectures, and modern AI applications to design scalable, ethical, and human-centric solutions. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain cognitive computing concepts and AI foundations for intelligent systems.	U			
CO2	Apply machine learning and reasoning techniques in cognitive systems.	Ap			
CO3	Analyze NLP techniques and semantic models for real-world applications.	An			
CO4	Evaluate cognitive agents, decision systems, and ethical implications.	An			
CO5	Design cognitive computing applications using modern tools and frameworks.	C			

UNIT I – FOUNDATIONS OF COGNITIVE COMPUTING	9
Human cognition – Introduction to Cognitive Computing – Elements of Cognitive Systems – Artificial Intelligence overview (ML, NLP) – Computational thinking for intelligent systems – Real-world problem mapping.	
UNIT II - COGNITIVE ARCHITECTURES AND LEARNING MODELS	9
Cognitive Architectures: ACT-R, Soar – Knowledge Representation and Reasoning – Machine Learning models (Supervised, Unsupervised) – Reinforcement Learning basics – Decision-making models.	
UNIT III – NATURAL LANGUAGE PROCESSING AND SEMANTICS	9
NLP pipeline: Tokenization, POS tagging, NER – Sentiment Analysis – Question Answering Systems – Semantic Web – Ontologies – Knowledge Graphs – Real-world NLP applications.	
UNIT IV - COGNITIVE AGENTS AND HUMAN-AI INTERACTION	9
Cognitive Agents – Rule-based and Learning Agents – Decision Support Systems – Emotion-aware computing – Human-Computer Interaction – Cognitive bias and ethics in AI.	

UNIT V - COGNITIVE APPLICATIONS AND EMERGING TRENDS	9
Cognitive applications in Healthcare, Finance, Education – Cognitive Cloud – Cognitive IoT – Chatbots and Conversational AI – Neuromorphic computing – Building cognitive applications (IBM Watson overview).	
TOTAL PERIODS	45

REFERENCES:

1. Peteringar, "Cognitive Computing: A Brief Guide for Game Changers", Meghan Kiffer, 2015.
2. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009.
3. Addy Osmani, "Beyond Vibe Coding", O'Reilly Media, 1st Edition, 2025.
4. Velankar, Mahalle & Shinde, "Cognitive Computing for Machine Thinking", CRC Press, 2024.
5. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive Computing and Big Data Analytics", Wiley, 2015.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	-	3	1
2	3	2	2	3	2
3	2	2	3	2	3
4	2	3	2	2	2
5	3	3	2	3	3
CO (W.A)	2.6	2.4	1.8	2.6	2.2


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26CPE219-VIBE CODING		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To equip learners with the ability to design, develop, and deploy AI-assisted software systems using modern tools, prompt engineering, and collaborative workflows. To enable critical evaluation of AI-generated code, ensuring quality, security, ethics, and adaptability for industry, research, entrepreneurship, and competitive environments. 				
Course Outcomes: The Student will be able to		Cognitive Level			
CO1	Describe the concepts of vibe coding, AI tools, and human-AI collaboration in software development.	U			
CO2	Apply AI-assisted tools and workflows to develop basic and intermediate applications.	Ap			
CO3	Analyze prompt strategies, debugging techniques, and optimization methods in AI-generated code.	An			
CO4	Evaluate code quality, security, ethical practices, and AI usage in real-world scenarios.	E			
CO5	Design and deploy AI-driven software solutions for industry, startups, and research applications.	C			

UNIT I – FOUNDATIONS OF VIBE CODING AND COMPUTATIONAL THINKING	9
Introduction to Vibe Coding – Evolution of AI in Software Development – Human-AI Collaboration Models – Computational Thinking for AI-Assisted Development – Basics of Prompting for Coding Tasks – Roles: Developer, Prompt Engineer, AI Assistant – Problem-Solving using AI Tools.	
UNIT II - AI TOOLS, PLATFORMS, AND RAPID APPLICATION DEVELOPMENT	9
Overview of AI Coding Tools (Cursor, v0, Replit, etc.) – Features and Use Cases – Setup and Navigation – Rapid Prototyping using AI – Building Simple Applications (Web/Desktop) – Workflow Design using AI Tools – Version Control Basics with AI Assistance.	
UNIT III – PROMPT ENGINEERING, OPTIMIZATION, AND DEBUGGING	9
Prompt Design Principles – Context Handling and Prompt Optimization – AI Code Debugging Techniques – Code Refactoring and Optimization – Error Analysis – Testing Strategies in AI-Generated Code – Competitive Coding with AI Support.	
UNIT IV - CODE QUALITY, SECURITY, ETHICS, AND CAREER READINESS	9
Code Quality and Maintainability – Secure Coding Practices – Ethical Issues in AI Coding – Bias and Accountability – Documentation Standards – Interview Preparation using AI – Resume Building and Portfolio Development – AI in Competitive Exams and Research.	


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UNIT V - AI-DRIVEN PRODUCT DEVELOPMENT AND DEPLOYMENT	9
End-to-End Project Development – AI-Based Application Design – Integration of Frontend, Backend, and AI – Deployment Strategies – Startup and Business Model Basics – Government and Industry Use Cases – Continuous Learning and Upskilling in AI.	
TOTAL PERIODS	45

REFERENCES:

1. Ted Winston, "Mastering Vibe Coding: Build, Debug, and Ship Software with AI Assistants like Cursor, Replit, and GPT", Independently Published (Kindle Direct Publishing), Kindle Edition, 2025.
2. Gene Kim, Steve Yegge, "Vibe Coding: Building Production-grade Software With GenAI, Chat, Agents, and Beyond", IT Revolution Press, 1st Edition, 2025.
3. 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", Independently Published (Kindle Direct Publishing), Kindle Edition, 2025.
4. Amit Iyer, "Beginner's Guide to Vibe Coding: Exploring Features, Use Cases and Understanding Vibe Coding", Notion Press, 1st Edition, 2025.
5. Addy Osmani, "Beyond Vibe Coding", O'Reilly Media, 1st Edition, 2025.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	–	–	–	–
2	3	2	–	3	3
3	–	2	3	–	2
4	–	–	3	–	2
5	–	3	3	3	3
CO (W.A)	3.0	2.3	3.0	3.0	2.5


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26CPE220 - WEB OF THINGS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To understand the concepts, architecture, standards, and technologies of the Web of Things (WoT). To learn WoT frameworks, Thing Descriptions, communication protocols, and Servient implementation. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Explain the concepts, architecture, standards, and enabling technologies of the Web of Things.				U
CO2	Analyze Thing Descriptions, semantic models, and WoT standards for interoperable smart devices.				An
CO3	Develop WoT applications using Servients, Node-WoT framework, and communication protocols.				Ap
CO4	Evaluate interoperability, security, privacy, and trust mechanisms in Web of Things ecosystems.				E
CO5	Design and implement WoT-enabled solutions integrating embedded systems for smart applications.				C

UNIT I - INTRODUCTION TO WEB OF THINGS AND ARCHITECTURE	9
Introduction to IoT and Web of Things – Evolution from IoT to WoT – WoT Architecture – WoT Building Blocks – Things, Consumers and Producers – Resources and Services – RESTful Web Services – Semantic Web Technologies – Resource Description Framework (RDF) – Linked Data Principles – WoT Use Cases and Applications.	
UNIT II - WOT STANDARDS AND THING DESCRIPTION	9
W3C WoT Standards – WoT Architecture and Building Blocks – Thing Description (TD) Concepts – TD Syntax and Vocabulary – JSON-LD Format – Metadata Representation – TD Schema Validation – TD Interpretation – Semantic Annotation in TD – Discovery Mechanisms.	
UNIT III - IMPLEMENTATION OF WOT SERVIENTS	9
WoT Servient Architecture – Exposed Things and Consumed Things – WoT Runtime Environment – Node-WoT Framework – WoT Scripting API – Event Handling – Protocol Bindings – HTTP Binding – MQTT Binding – CoAP Binding – Application Development using Node-WoT.	
UNIT IV - INTEROPERABILITY, SECURITY AND PRIVACY IN WOT	9
Interoperability Challenges – Cross-platform Integration – Semantic Interoperability – Security Requirements in WoT – HTTPS Security – OAuth 2.0 Authentication – Access Control Models – Privacy Preservation – Data Anonymization – Trust Management – Identity Management in WoT Ecosystems.	

UNIT V - WOT APPLICATIONS AND EMBEDDED SYSTEM INTEGRATION	9
Applications of WoT in Smart Cities, Smart Homes, e-Health, Industrial IoT (IIoT) – Cloud and Edge Integration – AI and Data Analytics in WoT – Digital Twins – Metaverse Integration – Arduino to WoT Integration – BeagleBone to WoT Integration – Intel Boards and Other Embedded Systems Integration – Future Trends in WoT.	
TOTAL PERIODS	45

REFERENCES:

1. Dom Guinard and Vlad Trifa, Building the Web of Things, Manning Publications, 2016.
2. Michael Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, Morgan Kaufmann, 2010.
3. Hakima 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.
6. Dieter Uckelmann, Mark Harrison and Florian Michahelles, Architecting the Internet of Things, Springer, 2011.
7. Vijay Madisetti and Arshdeep Bahga, Internet of Things: A Hands-on Approach, Universities Press, 2014.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	1		2	
2	3	2	1	3	1
3	2	3	2	3	2
4	2	2	3	2	3
5	1	3	3	3	3
CO (W.A)	2.2	2.2	1.8	2.6	1.8

26OEC301 - ENVIRONMENTAL IMPACT ASSESSMENT		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To provide knowledge of Environmental Impact Assessment principles, regulatory frameworks, environmental clearance procedures, and impact assessment methodologies for sustainable project planning. To develop skills in evaluating environmental and socio-economic impacts, preparing Environmental Management Plans (EMPs), and applying EIA techniques to real-world development projects. 				
Course Outcomes : The Student will be able to		Cognitive Level			
CO1	Analyze Environmental Impact Assessment (EIA) principles, regulatory requirements, environmental clearance procedures, and stages of the EIA process for effective environmental decision-making.	An			
CO2	Apply impact identification and prediction methods to assess environmental consequences of developmental projects.	Ap			
CO3	Analyze socio-economic impacts and prepare appropriate rehabilitation and resettlement strategies.	An			
CO4	Develop Environmental Management Plans and EIA reports incorporating mitigation, monitoring, and audit requirements.	Ap			
CO5	Examine real-world industrial and infrastructure projects using EIA methodologies for sustainable decision-making.	An			

UNIT I - INTRODUCTION	9
Historical development of Environmental Impact Assessment (EIA). Environmental Clearance EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process- screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.	
UNIT II - IMPACT IDENTIFICATION AND PREDICTION	9
Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological – cumulative impact assessment.	
UNIT III - SOCIO-ECONOMIC IMPACT ASSESSMENT	9
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. Rehabilitation and Resettlement plan.	
UNIT IV - EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN	9
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.	

UNIT V - CASE STUDIES	9
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.	
TOTAL PERIODS	45

REFERENCES:

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India.
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India.
3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996.
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003.
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey.
6. World Bank –Source book on EIA ,1999.
7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	1	3	1	1
2	3	1	3	2	2
3	2	2	3	1	2
4	3	3	3	2	2
5	3	2	3	2	3
CO (W.A)	2.6	1.8	3.0	1.6	2.0

26OEC302 - INTELLECTUAL PROPERTY RIGHTS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To provide comprehensive knowledge of Intellectual Property Rights and their role in fostering innovation, research, and technological development. To enable students to protect, manage, commercialize, and strategically utilize intellectual assets in computing and emerging technology domains. 				
Course Outcomes : The Student will be able to		Cognitive Level			
CO1	Explain the concepts, principles, and legal frameworks governing Intellectual Property Rights.	U			
CO2	Apply copyright, trademark, and industrial design protection mechanisms to technology-based products and services.	Ap			
CO3	Analyze patentability, conduct patent searches, and understand patent filing and management processes.	An			
CO4	Evaluate IPR issues associated with software, artificial intelligence, and emerging computing technologies.	An			
CO5	Develop IP strategies for innovation, technology transfer, entrepreneurship, and commercialization of research outcomes.	Ap			

UNIT I – FUNDAMENTALS OF INTELLECTUAL PROPERTY RIGHTS	9
Introduction to Intellectual Property Rights (IPR) – Meaning, need and significance of IPR – Types of Intellectual Property – Intellectual Property as a strategic resource – IPR and innovation ecosystem – National and international perspectives of IPR – Challenges in the digital era.	
UNIT II – COPYRIGHTS, TRADEMARKS AND INDUSTRIAL DESIGNS	9
Copyright: Concepts, ownership, registration and protection – Copyright issues in software, databases and digital content – Trademarks: Features, registration process, infringement and remedies – Industrial Designs: Registration, protection and enforcement – Case studies on copyright and trademark disputes in the IT industry.	
UNIT III – PATENTS AND PATENT MANAGEMENT	9
Patent system and patentability criteria – Novelty, Industrial applicability – Patent search techniques and databases – Patent specification drafting – Patent filing procedures and examination process – Grant, opposition and revocation of patents – Patent portfolio management and commercialization.	
UNIT IV – IPR IN COMPUTING AND EMERGING TECHNOLOGIES	9
IPR issues in Software Engineering – Open Source Software and Licensing Models – Software patents and legal concerns – Protection of Artificial Intelligence, Machine Learning and Data-driven innovations – Cloud Computing, Blockchain and Cyber security-related IP issues – Technology transfer and commercialization of research outputs.	

UNIT V – IPR LAWS, POLICIES AND TECHNOLOGY ENTREPRENEURSHIP	9
International IPR framework – TRIPS Agreement – Role of WIPO and WTO in IPR governance – Indian Intellectual Property Laws and recent developments – IPR valuation and technology licensing – Startup innovations and IP strategy – Entrepreneurship, innovation management and case studies in technology-based enterprises.	
TOTAL PERIODS	45

REFERENCES:

1. Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, Latest Edition.
2. Intellectual Property: Patents, Copyrights, Trademarks and Allied Rights, Universal Law Publishing, Latest Edition.
3. Law Relating to Intellectual Property Rights, LexisNexis, Latest Edition.
4. Intellectual Property Rights, PHI Learning, Latest Edition.
5. Intellectual Property Rights in the Global Economy, Institute for International Economics.
6. Patent Searching: Tools and Techniques, Wiley.
7. Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall.
8. Intellectual Property Rights in the Information Age, Aspen Publishers.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	1	1	2	1	1
2	2	3	2	2	1
3	3	2	3	2	3
4	2	2	3	3	2
5	3	3	3	2	3
CO (W.A)	2.2	2.2	2.6	2.0	2.0

26OEC303 – ETHICAL MANAGEMENT		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To develop students' understanding of ethical principles, values, and responsibilities in organizational and professional environments. To enhance students' ability to apply ethical management practices and make effective decisions in organizational contexts. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Understand the importance of ethical leadership and professional culture in computing and technology environments.				Un
CO2	Demonstrate ethical principles and professional standards in the development and management of computing systems.				Ap
CO3	Apply stakeholder management concepts in technology-driven decision-making and project execution.				Ap
CO4	Analyze ethical issues, security concerns, and crisis situations in computing environments to determine appropriate actions.				An
CO5	Analyze complex organizational and technological challenges by considering ethical, managerial, and stakeholder perspectives.				Ap

UNIT I - ETHICS AND SOCIETY	9
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society's expectations- Individual and organizational responsibility to society and the community.	
UNIT II - ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS	9
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.	
UNIT III - STAKEHOLDERS IN ETHICAL MANAGEMENT	9
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).	
UNIT IV - INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT	9
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision making and management.	

UNIT V - PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS	9
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.	
TOTAL PERIODS	45

REFERENCES:

1. Linda K. Treviño and Katherine A. Nelson, Managing Business Ethics: Straight Talk About How to Do It Right, 8th Edition, Wiley, 2021.
2. Laura P. Hartman, Joseph Des Jardins and Chris MacDonald, Business Ethics: Decision Making for Personal Integrity and Social Responsibility, 6th Edition, McGraw-Hill Education, 2023.
3. Archie B. Carroll, Jill Brown and Ann K. Buchholtz, Business and Society: Ethics, Sustainability and Stakeholder Management, 11th Edition, Cengage Learning, 2022.
4. Muel Kaptein, The Effective Manager: Achieving Success through Ethical Management, Routledge, 2020.
5. Mark S. Schwartz, Corporate Social Responsibility: An Ethical Approach, Broadview Press, 2021.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	2	-	3	-	2
2	2	1	3	1	2
3	2	1	3	1	2
4	2	1	3	2	2
5	2	2	3	2	2
CO (W.A)	2.0	1.3	3.0	1.5	2.0

26OEC304 - MICRO AND SMALL BUSINESS MANAGEMENT		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To familiarize students with the theory and practice of small business management. To learn the legal issues faced by small business and how they impact operations. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Familiarize the students with the concept of small business.				R
CO2	In-depth knowledge on small business opportunities and challenges.				An
CO3	Ability to devise plans for small business by building the right skills and marketing strategies.				An
CO4	Identify the funding source for small start ups.				Ap
CO5	Business evaluation for buying and selling of small firms.				E

UNIT I - INTRODUCTION TO SMALL BUSINESS	9
Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.	
UNIT II - SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN	9
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm – importance of strategy formulation – Business Model Canvas – management skills for small business creation and development.	
UNIT III - BUILDING THE RIGHT TEAM AND MARKETING STRATEGY	9
Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance sales management and strategy - the marketing mix and marketing strategy.	
UNIT IV - FINANCING SMALL BUSINESS	9
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.	

UNIT V - VALUING SMALL BUSINESS AND CRISIS MANAGEMENT	9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.	
TOTAL PERIODS	45

REFERENCES:

1. Hankinson,A. "The key factors in the profile of small firm owner-managers that influence business performance". The South Coast Small Firms Survey, 1997-2000. Industrial and Commercial Training 32(3):94-98, 2000.
2. Parker,R. "Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia." Australian Journal of Political Science 35(2):239-253, 2000.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	2	1	2	1
2	2	3	2	2	1
3	2	2	3	3	2
4	2	2	3	3	2
5	2	3	3	3	3
CO (W.A)	2.2	2.4	2.4	2.6	1.8


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26OEC305 - IoT FOR SMART SYSTEMS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To study Internet of Things (IoT) technologies, infrastructure, platforms, attributes, and their role in real-time applications. To understand IoT hardware and communication components, including embedded processors, sensors, accessories, and communication techniques required for IoT systems. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Analyze the concepts of IoT and its present developments.	An			
CO2	Compare and contrast different platforms and infrastructures available for IoT	An			
CO3	Apply different IoT protocols and communication technologies to design and implement IoT-based applications	Ap			
CO4	Analyze the big data analytic and programming of IoT.	An			
CO5	Implement IoT solutions for smart applications	Ap			

UNIT I INTRODUCTION TO INTERNET OF THINGS	9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications. IoT Security, Privacy, and Trust Management.	
UNIT II IOT ARCHITECTURE	9
IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.	
UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT	9
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.	
UNIT IV IOT PROCESSORS	9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT: Introduction to Python programming -Building IOT with RASPBERRY PI and Arduino.	

UNIT V CASE STUDIES	9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense.	
TOTAL PERIODS	45

REFERENCES:

1. ArshdeepBahga and VijaiMadiseti:A Hands-on Approach "Internet of Things", Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi "The Internet of Things", Wiley,2016.
3. Samuel Greengard, "The Internet of Things", The MIT press, 2015.
4. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014.
5. Jean- Philippe Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP: The Next Internet" Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
7. Lingyang Song, DusitNiyato, Zhu Han, Ekram Hossain, "Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8. Ovidiu Vermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
9. Vijay Madiseti , Arshdeep Bahga, "Internet of Things (A Hands on-Approach)", 2014.
10. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
12. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, "Smart Grid Technology and Applications", Wiley, 2015.
13. Upena Dalal, "Wireless Communications & Networks, Oxford, 2015.



Mapping of COs with POs / PSOs					
COs	Pos			PSOs	
	1	2	3	1	2
1	3	1	3	2	1
2	3	2	3	3	1
3	3	1	3	3	1
4	3	2	3	3	2
5	3	3	3	3	3
CO (W.A)	3.0	1.8	3.0	2.8	1.6


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26OEC306 - MEDICAL ROBOTICS		L	T	P	C
		3	0	0	3
Course Objective	<ul style="list-style-type: none"> To explain the basic concepts of robots and types of robots and to discuss the designing procedure of manipulators, actuators and grippers. To explore various applications of Robots in Medicine and to impart knowledge on wearable robots and their sensors. 				
Course Outcomes: The Student will be able to					Cognitive Level
CO1	Describe the configuration, applications of robots and the concept of grippers and actuators.				U
CO2	Apply manipulator functions and basic kinematic concepts in the analysis of robotic motion and positioning.				Ap
CO3	Apply the principles of robotic surgery in selected medical procedures.				Ap
CO4	Design and analyze the robotic systems for rehabilitation.				An
CO5	Design the wearable robots.				Ap

UNIT I - INTRODUCTION TO ROBOTICS	9
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization Sensors and Actuators Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models.	
UNIT II - MANIPULATORS & BASIC KINEMATICS	9
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems Navigation and Treatment Planning Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor.	
UNIT III - SURGICAL ROBOTS	9
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study.	
UNIT IV - REHABILITATION AND ASSISTIVE ROBOTS	9
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study.	

B. S. F. A.

UNIT V - WEARABLE ROBOTS	9
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human-robot cognitive interaction (cHRI), Human robot physical interaction (pHRI), Wearable Robotic Communication - Case study.	
TOTAL PERIODS	45

REFERENCES:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw Hill, 1st Edition, 2003.
1. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, 1st Edition, 2008.
2. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, "Robotics, control, sensing, Vision and Intelligence", Tata McGraw Hill International, 1st Edition, 2008.
3. Bruno Siciliano, Oussama Khatib, "Springer Handbook of Robotics", 1st Edition, Springer, 2008.

Mapping of COs with POs / PSOs					
COs	POs			PSOs	
	1	2	3	1	2
1	3	1	-	2	1
2	3	3	1	2	2
3	2	1	2	3	2
4	2	3	3	3	3
5	2	2	3	2	3
CO (W.A)	2.4	2.0	2.3	2.4	2.2


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