PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH,
COIMBATORE - 641 062
(Autonomous college affiliated to Anna University)

R2025

Courses of Study, Scheme of Assessment and Syllabi for All Semesters

for

M.E. Computer Science and Engineering

M.E. COMPUTER SCIENCE AND ENGINEERING

(Minimum No. of credits to be earned: 70)

Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER I									
MA25102	Linear Algebra, Statistical Methods and Optimization Techniques	3	1	0	4	40	60	100	PC
CS25101	Advanced Data Structures and Algorithms	3	1	0	4	40	60	100	PC
CS25102	Advanced Database Management Systems	3	0	0	3	40	60	100	PC
CS25103	Machine Learning and its Applications	3	1	0	4	40	60	100	PC
CS25104	Advanced Operating Systems	3	0	0	3	40	60	100	PC
SE25105	Research Methodology and IPR	2	0	0	2	40	60	100	RMC
SE25A__	Audit Course I	2	0	0	Grade	100	0	100	MC
CS25111	Advanced Data Structures and Algorithms Laboratory	0	0	4	2	60	40	100	PC
CS25112	Machine Learning Laboratory	0	0	4	2	60	40	100	PC
	Total 30 periods	**19**	**3**	**8**	**24**	**460**	**440**	**900**	
SEMESTER II									
CS25201	Next Generation Computer Networks	3	0	0	3	40	60	100	PC
CS25202	Analysis and Design of Software Systems	3	1	0	4	40	60	100	PC
CS25203	Deep Learning Techniques	3	0	0	3	40	60	100	PC
CS25P__	Professional Elective I	3	0	0	3	40	60	100	PE
CS25P__	Professional Elective II	3	0	0	3	40	60	100	PE
SE25A__	Audit Course II	2	0	0	Grade	100	0	100	MC
CS25211	Advanced Computer Networks Laboratory	0	0	4	2	60	40	100	PC
CS25212	Deep Learning Laboratory	0	0	4	2	60	40	100	PC
CS25213	Industrial Visit and Technical Seminar	0	0	4	2	60	40	100	EEC
	Total 30 periods	**17**	**1**	**12**	**22**	**480**	**420**	**900**	
SEMESTER III									
CS25P__	Professional Elective III	3	0	0	3	40	60	100	PE
CS25P__	Professional Elective IV	3	0	0	3	40	60	100	PE
CS25311	Project Work I	0	0	12	6	60	40	100	EEC
	Total 18 periods	**6**	**0**	**12**	**12**	**140**	**160**	**300**	
SEMESTER IV									
CS25411	Project Work II	0	0	24	12	60	40	100	EEC
	Total 24 periods	**0**	**0**	**24**	**12**	**60**	**40**	**100**	

CAT – Category; PC – Professional Core; PE - Professional Elective; RMC- Research Methodology and IPR; EEC – Employability Enhancement Course; MC - Mandatory Course; Grade – Completed / Not Complete

SUMMARY OF CREDIT DISTRIBUTION

M.E. COMPUTER SCIENCE AND ENGINEERING						Total Credits
S. No	Course Category	Credits Per Semester				
		I	II	III	IV	
1	PC	22	14	0	0	36
2	RMC	2	0	0	0	02
3	PE	0	6	6	0	12
4	EEC	0	2	6	12	20
5	MC	-	-	-	-	-
Total		**24**	**22**	**12**	**12**	**70**

PROFESSIONAL ELECTIVE THEORY COURSES (Four to be opted)

S. No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
1	CS25P01	Internet of Things	3	0	0	3	40	60	100	PE
2	CS25P02	Blockchain and Distributed Ledger Technology	3	0	0	3	40	60	100	PE
3	CS25P03	Cloud Computing	3	0	0	3	40	60	100	PE
4	CS25P04	Computer Vision	3	0	0	3	40	60	100	PE
5	CS25P05	GPU Computing	3	0	0	3	40	60	100	PE
6	CS25P06	Edge Computing	3	0	0	3	40	60	100	PE
7	CS25P07	Reinforcement Learning	3	0	0	3	40	60	100	PE
8	CS25P08	Quantum Computing	3	0	0	3	40	60	100	PE
9	CS25P09	Data Intensive Computing Systems	3	0	0	3	40	60	100	PE
10	CS25P10	Cognitive Computing	3	0	0	3	40	60	100	PE
11	CS25P11	Natural Language Processing	3	0	0	3	40	60	100	PE
12	CS25P12	Data Analytics	3	0	0	3	40	60	100	PE
13	CS25P13	Text and Speech Analysis	3	0	0	3	40	60	100	PE
14	CS25P14	Soft Computing	3	0	0	3	40	60	100	PE
15	CS25P15	Recommender Systems	3	0	0	3	40	60	100	PE
16	CS25P16	Expert Systems	3	0	0	3	40	60	100	PE
17	CS25P17	Generative AI	3	0	0	3	40	60	100	PE
18	CS25P18	Agentic AI	3	0	0	3	40	60	100	PE
19	CS25P19	Drone Technologies	3	0	0	3	40	60	100	PE
20	CS25P20	Data Security	3	0	0	3	40	60	100	PE

List of Audit Courses

S. No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
1	SE25A01	Sustainable Development Goals	2	0	0	Grade	100	0	100	MC
2	SE25A02	English for Research Paper Writing	2	0	0	Grade	100	0	100	MC
3	SE25A03	Disaster Management	2	0	0	Grade	100	0	100	MC
4	SE25A04	Constitution of India	2	0	0	Grade	100	0	100	MC
5	SE25A05	Building Communication Skills	2	0	0	Grade	100	0	100	MC

MA25102 LINEAR ALGEBRA, STATISTICAL METHODS AND OPTIMIZATION TECHNIQUES

3 1 0 4

VECTOR SPACES: Real vector spaces, subspaces, – linear dependence, bases and dimension of a vector space – rank – row space, column space, null space, inner product space, Gram-Schmidt process, QR decomposition – Linear transformations – Matrix transformation. **(12+4)**

EIGENANALYSIS AND OPTIMIZATION TECHNIQUES: Eigenvalues and eigenvectors – diagonalization – orthogonal diagonalization, discrete dynamical systems, iterative estimates for eigenvalues, singular value decomposition. Unconstrained minimization Problems – Decent Methods – Gradient decent methods – Steepest decent methods. **(11+3)**

ESTIMATION AND TESTING OF HYPOTHESES: Estimation – Point estimation, Maximum Likelihood Estimation, Bayesian estimation of parameters, interval estimates and confidence interval. Sampling, sampling distribution. Testing of Statistical Hypothesis: Large sample tests – inference concerning means, variances and proportions, Small sample tests – inference concerning means and variances, goodness of fit and independence of attributes. **(10+4)**

MULTIVARIATE ANALYSIS: Random vectors and Matrices – Mean vectors and covariance matrices – Multivariate Normal distribution and its properties – principal components: population principal components – principal components from standardized variables. **(12+4)**

Total L: 45 + T: 15 = 60 Periods

REFERENCES

1. David C. L., '*Linear Algebra and its Applications*'. Pearson Education, New Delhi, 2022.
2. Douglas C. M. and George C. R., *'Applied Statistics and Probability for Engineers'*. Wiley India, New Delhi, 2020.
3. Gilbert Strang, *'Linear Algebra and its Applications'*. Cengage Learning, New Delhi, 2023.
4. Howard A. and Chris Rorres, *'Elementary Linear Algebra: Applications Version'*. Wiley India, New Delhi, 2019.
5. Richard A. J. and Dean W. W., *'Applied Multivariate Statistical Analysis'*. Pearson Education, New Delhi, 2019.
6. S. Boyd and L. Vandenberghe. *'Convex Optimization'*. Cambridge University Press, 2004.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts of vector spaces, subspaces, basis, dimension, linear transformations, matrix factorizations, eigenvalues, eigenvectors, and multivariate statistical foundations including covariance and probability distributions.	**K2**
CO2	Apply eigenvalue techniques, diagonalization, singular value decomposition, optimization methods for nonlinear systems, and statistical inference procedures including estimation, confidence intervals, and hypothesis testing.	**K3**
CO3	Analyze linear systems and multivariate data using matrix decomposition techniques, covariance structures, multivariate normal models, and principal component analysis to interpret real-world engineering problems.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1					
CO2	3				
CO3					
	3				

1-low, 2-medium, 3-high

CS25101 ADVANCED DATA STRUCTURES AND ALGORITHMS

3 1 0 4

ALGORITHM ANALYSIS AND LINEAR DATA STRUCTURES: Analysis of iterative and recursive algorithms – Recurrence relation – Asymptotic notations – Arrays – Linked lists – Stacks – Queues – Applications. **(12+4)**

TREES: Search trees – Balanced search trees – AVL trees– Red black trees – Splay Trees. Heaps: Double ended heap – Leftist heaps – Binomial heaps – Fibonacci heaps – Skew heaps – Multi-dimensional data structure: k-D tree. **(11+4)**

GRAPHS AND HASHING: Representation – Shortest path algorithms: Unweighted shortest path, Dijkstra's algorithm, Graphs with negative edge costs, All pairs shortest path – Network Flow problems – Activity Networks– DFS applications: Bi-connectivity, Euler Circuits. Hashing: Static hashing – Dynamic hashing - Overflow handling: Open Hashing, Closed Hashing – Linear probing, Quadratic probing. **(11+4)**

ALGORITHM DESIGN TECHNIQUES: General method - Dynamic programming - Greedy algorithms – Backtracking - Branch and bound - NP and NP-Complete problems - Knapsack problem – Applications. **(11+3)**

Total L: 45 + T: 15 = 60 Periods

REFERENCES

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, '*Introduction to Algorithms*'. Fourth edition, The MIT Press, 2022.
2. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, '*Algorithms*'. McGraw Hill, 2023.
3. Mark Allen Weiss, '*Data structures and Algorithm Analysis in C*'. Pearson Education, 2020.
4. Peter Brass, '*Advanced Data Structures*'. Cambridge University Press, New York, 2019.
5. Anany Levitin, '*Introduction to the design and analysis of Algorithms'*. Third edition, Pearson Education, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe data structures and implement algorithmic solutions for complex computational problems.	**K2**
CO2	Analyze the time complexity and efficiency of algorithms for various computing problems.	**K3**
CO3	Evaluate algorithmic techniques and data structures to determine their suitability for different applications.	**K4**
CO4	Design optimized solutions for real-world problems using appropriate algorithms and data structures.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1					
CO2	3			3	3
CO3			3	3	3
CO4		1		1	1
	3	**1**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25102 ADVANCED DATABASE MANAGEMENT SYSTEMS

3 0 0 3

RELATIONAL DATABASE: Relational database design – ER and EER diagrams, Reduction to relational schemas, Normalization – Functional dependencies, Normal forms, Overview of SQL, Relational algebra. **(12)**

ORDBMS AND XML DATABASES: Database design for ORDBMS – UDT and Complex structures, Nested relations and collections. XML databases: XML data model – DTD – XML schema – XML querying: Xpath and Xquery – Web databases – Open database connectivity. **(10)**

PARALLEL AND DISTRIBUTED DATABASES: Introduction – Architecture – Parallel query evaluation; Parallelizing individual operations, Sorting, Joins. Distributed Database Design: Concepts, Data fragmentation, Replication and Allocation techniques – Distributed query processing – Commit protocols – Concurrency control. **(12)**

NOSQL DATABASES: Introduction to NoSQL databases – Key-Value stores – Columnar stores – Document stores, Graph database – The Power of graph databases – Options for storing connected data – Data modeling with document database – Building a document database application, Case studies. **(11)**

Total L: 45 periods

REFERENCES

1. R. Elmarsi, S. B. Navathe, '*Fundamentals of Database Systems*'. Seventh edition, Pearson Education, 2017.
2. Raghu Ramakrishnan and Johannes Gehrke, '*Database Management Systems*'. Third edition, McGraw Hill, New Delhi, 2022.
3. Stefano Ceri, '*Distributed Database Principles & Systems*'. Visionas, 2018.
4. Seema Acharya, '*Demystifying NoSQL*'. Wiley, 2020.
5. Andreas Meier and Michael Edward Kaufmann, '*SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management*'. Springer, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe various data modeling approaches for developing efficient and consistent database systems.	**K2**
CO2	Apply data management techniques to ensure efficient storage and retrieval of diverse data.	**K3**
CO3	Assess database system architectures and query processing methods for optimizing performance and scalability.	**K4**
CO4	Evaluate scalable and robust database solutions to manage complex, distributed, and large-scale data applications.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		3		3	3
CO4			2	2	2
	3	**3**	**2**	**3**	**3**

1-low, 2-medium, 3-high

CS25103 MACHINE LEARNING AND ITS APPLICATIONS

3 1 0 4

MACHINE LEARNING FUNDAMENTALS: Machine learning, Types of machine learning: Supervised learning – Unsupervised learning, Machine learning process, Model evaluation and testing, Parametric vs non-parametric models, Basics of learning theory: Concept learning – Hypothesis space – Bias-variance tradeoffs, Mathematical basics for machine learning: Bayes' theorem – Conditional probability and basic statistics, Introduction to probability distributions, Decision theory, Information theory. **(10+3)**

SUPERVISED LEARNING METHODS: Regression: Introduction – Linear regression – Least squares – Under fitting and overfitting – Cross validation – Lasso regression – Logistic regression, Classification: linear and non-linear models – Support vector machines – Kernel methods – K-Nearest neighbors, Learning with trees: Constructing decision tree using ID3 – Classification and Regression Trees (CART), Decision by committee : Ensemble methods – Bagging – Boosting – Random forest, Evaluation of classification algorithms. **(13+4)**

UNSUPERVISED AND REINFORCEMENT LEARNING: Clustering – K-means – Mixtures of gaussians – Vector quantization – The self-organizing feature map, Dimensionality reduction: Linear discriminant analysis – Principal components analysis – Independent components analysis, Reinforcement learning : Q learning – Deterministic and nondeterministic rewards and actions – Temporal difference learning – Markov decision process. **(11+4)**

PROBABILISTIC GRAPHICAL MODELS: Introduction to graphs, Inference in graphical models, Bayesian belief networks, Markov chain, Markov model, Hidden Markov Models (HMM), Inference, Learning, Generalization, Undirected graphical models – Markov random fields, Conditional independence: Properties, Conditional random fields, Applications of machine learning: Natural Language Processing (NLP) Applications – Computer vision – Recommender systems – Time series forecasting applications –Healthcare applications, Deployment and challenges in real-world ML applications. **(11+4)**

Total L: 45 + T: 15 = 60 Periods

REFERENCES

1. Tom M. Mitchell, '*Machine Learning'.* Affiliated East-West Press Pvt. Ltd., 2025.
2. Ethem Alpaydin, '*Introduction to Machine Learning*'. Third edition, Prentice Hall of India, 2005.
3. Stephen Marsland, '*Machine Learning – An Algorithmic Perspective*'. Chapman and Hall, CRC Press, 2015.
4. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, '*Mathematics for Machine Learning*'. Cambridge University Press, 2020.
5. Kevin P. Murphy, '*Machine Learning: A Probabilistic Perspective*'. MIT Press, 2012.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts and theoretical foundations underlying intelligent learning systems.	**K2**
CO2	Implement appropriate computational models to solve predictive and decision-making problems using data-driven approaches.	**K3**
CO3	Analyze the performance of learning models using suitable validation techniques.	**K4**
CO4	Evaluate the suitability of intelligent solutions for complex problem domains considering performance, limitations, and practical constraints.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				1	1
CO2			3	3	3
CO3			3	3	3
CO4	2			2	2
	2		**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25104 ADVANCED OPERATING SYSTEMS

3 0 0 3

PROCESS SCHEDULING AND SYNCHRONIZATION: Process scheduling, Operations on processes, Inter-process communication, Process scheduling criteria, Process scheduling algorithms. Process Synchronization: Background, Hardware Support to Process Synchronization, Semaphores, Monitors. Case study: process scheduling in Linux **(9)**

MEMORY MANAGEMENT, FILE SYSTEM AND INTRODUCTION TO DISTRIBUTED OPERATING SYSTEM: Virtual Memory –Implementation in Linux System– Windows File System Vs Linux File System. Issues in Distributed Operating System - Architecture – Communication Primitives – Lamport's Logical clocks – Vector Logical clocks – Causal Ordering of Messages, Distributed File System. Case Study: Remote Procedure Call in Distributed Computing Environment, HDFS. **(12)**

DISTRIBUTED RESOURCE MANAGEMENT: Introduction to Scheduling and Load Balancing in Distributed Systems - Classification of Mutual Exclusion and Associated algorithms – Deadlock handling strategies in distributed systems – Issues in deadlock detection and resolution – Centralized and Distributed Deadlock Detection Algorithms - Virtualization-based resource management and Kubernetes for distributed scheduling and load balancing. **(12)**

REAL TIME AND MOBILE OPERATING SYSTEMS: Basic Model of Real Time Systems - Characteristics - Applications of Real Time Systems – Real Time Task Scheduling- Handling Resource Sharing - Mobile Operating Systems – Microkernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File System – Case Study – VxWorks, iOS and Android. **(12)**

Total L: 45 periods

REFERENCES

1. William Stallings, '*Operating Systems – Operating System: Internals and Design Principles*'. Ninth edition, Pearson, 2021.
2. Mukesh Singhal, Niranjan Shivaratri, '*Advanced Concepts in Operating Systems*'. First edition, McGraw-Hill, 2017.
3. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, '*Distributed Systems – Concepts and Design*'. Fifth edition, Pearson, 2022.
4. C.M. Krishna, K.G.Shin, '*Real-Time Systems'.* McGraw-Hill, 2017.
5. Dawn Griffiths, David Griffiths, '*Head First Android Development: A Brain-Friendly Guide'.* Second edition, O'Reilly Media, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of Operating Systems	**K2**
CO2	Apply the Operating System Services for the given application	**K3**
CO3	Analyze the given operating system relevant algorithms, and arrive at suitable conclusions	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			2	2	2
CO2	3			3	3
CO3		3		3	3
	3	**3**	**2**	**3**	**3**

1-low, 2-medium, 3-high

SE25105 RESEARCH METHODOLOGY AND IPR

2 0 0 2

RESEARCH PROBLEM FORMULATION: Objectives of research, types of research, research process, approaches to research; conducting literature review – information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap. **(4)**

RESEARCH DESIGN AND DATA COLLECTION: Statistical design of experiments types and principles; data types & classification; data collection – methods and tools. **(6)**

DATA ANALYSIS, INTERPRETATION AND REPORTING: Sampling, sampling error, measures of central tendency and variation; test of hypothesis- concepts; data presentation types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research. **(10)**

INTELLECTUAL PROPERTY RIGHTS AND PATENTS: Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, copy rights, applicability of these IPR; IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance. Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process – patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents. **(10)**

Total L: 30 periods

REFERENCES

1. Cooper Donald R., Schindler Pamela S. and Sharma J. K., ‘*Business Research Methods’.* Eleventh edition, Tata McGraw Hill Education, 2012.
2. Soumitro Banerjee, ‘*Research methodology for natural sciences*. IISc Press, Kolkata, 2022.
3. Catherine J. Holland, ‘*Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*’. Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, ‘*Patent searching: tools & techniques’*. Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, ‘*Professional Programme Intellectual Property Rights, Law and practice*’. September 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Outline the principles of research problem formulation, research design, data collection, the basic features and significance of IPR	**K2**
CO2	Utilize research methodology principles to develop a research plan, conduct literature reviews, analyze data using appropriate statistical methods, and prepare structured research reports or proposals following ethical guidelines.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3				
CO2		3			
	3	**3**			

1-low, 2-medium, 3-high

CS25111 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY

0 0 4 2

1. Decomposition, Pattern Recognition, Abstraction and Algorithm
2. Search algorithms
3. Sorting algorithms
4. Algorithm Analysis
5. Balanced Search Trees
6. Graphs
7. Hashing
8. Algorithm Design Techniques

Total P: 60 periods

REFERENCES

1. Thomas H. Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein. ‘*Introduction to Algorithms*’, Fourth edition, The MIT Press, 2022.
2. John Guttag, ‘*Introduction to Computation and Programming Using Python*’. Third edition, The MIT Press, 2021.
3. Peter Denning, Matti Tedre, ‘*Computational Thinking’*. MIT Press, 2019.
4. Mark Allen Weiss, ‘*Data structures and Algorithm Analysis in C++*’. Pearson Education, New Delhi, 2013.
5. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, ‘*Algorithms*’. McGraw Hill, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply appropriate algorithms and data structures to implement solutions for computational problems.	**K3**
CO2	Analyze the performance of implemented algorithms by assessing their time and space complexity	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	3			3	3
CO2			3	3	3
	3		**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25112 MACHINE LEARNING LABORATORY

0 0 4 2

1. Implement basic statistical measures, conditional probability, and visualize data to understand distributions.
2. Build linear and logistic regression model for making predictions from any practical dataset and calculate performance metrics.
3. Implement logistic regression and apply it to a binary classification task. Evaluate the model using accuracy and confusion matrix.
4. Implement the K-Nearest Neighbors (KNN) algorithm and analyze the impact of the hyperparameter K (the number of neighbors) on the model's performance metrics.
5. Implement an SVM classifier on a non-linearly separable dataset. Experiment with different kernel methods.
6. Implement and compare single decision tree models with various ensemble methods.
7. Apply K-means clustering to segment a dataset. Use the elbow method to determine the optimal 'K'.
8. Application of dimensionality reduction techniques for numeric and text data.
9. Implement sequential learning using Hidden Markov Model (HMM).
10. Mini project.

Total P: 60 periods

REFERENCES

1. Andreas C. Muller and Sarah Guido, '*Introduction to Machine Learning with Python*'. O'Reilly Media, 2016.
2. Pradhan Manaranjan, '*Machine Learning Using Python*'. Wiley India Pvt. Ltd, 2019.
3. Scikit-learn Documentation: https://scikit-learn.org/stable/

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply statistical and machine learning techniques to develop models for data analysis and predictive tasks.	**K3**
CO2	Compare the performance of different learning models for applied problem contexts based on experimental validation.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1			3	3	3
CO2	3	3		3	3
	3	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25201 NEXT GENERATION COMPUTER NETWORKS

3 0 0 3

INTERNET ROUTING, QOS ANALYSIS AND MULTICASTING: Internet architecture – IP service model – Routing domains and Autonomous Systems – Intra domain routing algorithms – Inter Domain Routing: BGP – BGP Traffic – Routing convergence, Need for QoS: End to End QoS – QoS levels, Performance measures: Bandwidth – Delay and Jitter – Packet Loss – Throughput, Routing overheads – Multicast: Address Assignments – Multicast Routing – DVMRP – Protocol Independent Multicasting. **(10)**

TCP PERFORMANCE MODELING: TCP segment format – TCP sliding windows – Congestion control and queuing – TCP congestion control – Analysis of TCP: Buffer sizing – Throughput – Fairness, Random early detection gateways for congestion avoidance – Congestion control for high bandwidth – Delay product networks – Variations of TCP. **(12)**

CELLULAR AND WIRELESS NETWORKS: Introduction – UMTS – UTRAN – UMTS security – IEEE 802.16 and WiMAX – Security – Advanced functionalities – WLAN configuration and security – IEEE 802.11e and subsets. LTE – Network architecture and interfaces – FDD Air interface and radio networks – LTE security architecture. **(12)**

5G NETWORKS AND Virtualization: Introduction to 5G - Architecture – 4G Vs 5G – Transition from 5G to 6G – Software Defined Networks: Centralized and distributed control, Services – Data center networking – Network virtualization – Network function virtualization. **(11)**

Total L: 45 periods

REFERENCES

1. James F Kurose, Keith W Ross, '*Computer Networking - A Top-Down Approach Featuring the Internet*'. Pearson Education, India, Ninth edition, 2025.
2. Larry L Peterson and Bruce S Davie, '*Computer Networks: A systems approach*'. Morgan Kaufmann Publishers Burlington, USA, Sixth edition, 2021.
3. Martin Sauter, '*From GSM to LTE-Advanced: An Introduction to Mobile Networks and Mobile Broadband*'. Wiley, Fourth edition, 2021.
4. Abdulrahman Yarali, '*From 5G to 6G: Technologies, Architecture, AI, and Security*'. Wiley, 2023.
5. Peterson, Cascone, O'Connor, Vachuska, and Davie, '*Software-Defined Networks: A Systems Approach*'. Systems Approach LLC, Second edition, 2021.
6. Deke Guo, '*Data Center Networking*'. Springer, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental principles and operational aspects of next generation computer networks.	**K2**
CO2	Apply appropriate techniques to address issues related to reliability, efficiency, and security in networks.	**K3**
CO3	Analyze network behavior and performance under different operational conditions.	**K4**
CO4	Evaluate complex networking problems and propose effective solutions based on given requirements.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				1	1
CO2	3			3	3
CO3			3	3	3
CO4		1		1	1
	3	**1**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25202 ANALYSIS AND DESIGN OF SOFTWARE SYSTEMS

3 1 0 4

SOFTWARE ENGINEERING CONCEPTS: Software characteristics – Software myths – Software life cycle models – Linear sequential model – Incremental model – RAD model – Evolutionary software process models – The Prototyping model – Spiral model – Agile methods – Requirement engineering – Requirement engineering tasks. **(12+3)**

SYSTEM ANALYSIS: Requirement analysis – Analysis modelling approaches – Data flow-oriented modelling – Context diagram, Data flow diagrams – Elements of analysis model – Data modeling – Objects and Classes – Object identification – Relationship among objects – Classification. **(11+4)**

UML MODELING: Unified software development process – Scenario based modeling – Class based modeling – Behavioral model – Computer aided software engineering tools. **(11+4)**

SYSTEM DESIGN: Design process – Design concepts – Modularity – Functional independence - Modular design – Coupling – Cohesion – Refactoring – Design model – Architectural design –Component level design element – Deployment level design – Architectural styles and patterns – IEEE Standard for software design descriptions. **(11+4)**

Total L: 45 + T: 15 = 60 Periods

REFERENCES

1. Roger S. Pressman and Bruce Maxim, '*Software Engineering - A Practitioner 's Approach'*. Ninth edition, McGraw Hill International, Singapore, 2023.
2. James Rumbaugh and Michael Blaha, '*Object-Oriented Modeling and Design with UML'*. Third edition, Prentice Hall, Upper Saddle River, New Jersey, 2017.
3. Ian Sommerville, '*Software Engineering'*. Tenth edition, Pearson Education, Global edition, Boston, Massachusetts, 2026.
4. Booch G., Maksimchuk R. A., Engel M W, Young B. J., Conallen J, Houston K. A., '*Object Oriented Analysis and Design with Applications*'. Third edition, Addison-Wesley, USA, 2007.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply appropriate software engineering principles, process models, and requirement engineering techniques for systematic software development.	**K3**
CO2	Analyze system requirements and construct analysis models using structured and object-oriented modeling approaches.	**K4**
CO3	Evaluate software engineering practices, methodologies, and design solutions based on quality attributes, standards, and development needs.	**K5**
CO4	Design software systems using UML diagrams, architectural styles, and design principles for modular and maintainable solutions.	**K6**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	2			2	2
CO2		3		3	3
CO3					
CO4			3	3	3
	2	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25203 DEEP LEARNING TECHNIQUES

3 0 0 3

DEEP LEARNING FOUNDATIONS: AI, Machine learning, Representation learning and deep learning – ML Algorithms – Challenges and motivation for deep learning – Deep feedforward networks – Cost functions – Output units – Hidden units – Architecture design – Regularization for deep learning – Optimization for training deep models. **(12)**

CONVOLUTIONAL NEURAL NETWORKS: Convolution operation – Motivation – Pooling – Convolution variants – Down sampling, stride and padding – Local, convolution, tiled and full connections – CNN training – Structured outputs – Data types – Efficient convolution algorithms – Random or unsupervised features – Neuro scientific basis of CNN. **(11)**

RECURRENT NEURAL NETWORKS: Recurrent networks – Unfolding computational graphs – RNN design patterns – Backpropagation through time – Teacher forcing – Gradient computation – RNN as directed graphical models – Modeling sequences conditioned on context – Bidirectional RNN – Encoder Decoder Sequence-to-Sequence architectures – Deep recurrent networks – Recursive Neural Networks – Challenge of long-term dependencies – Strategies for multiple time scales – LSTM and GRU – Optimization for long-term dependencies – Explicit memory. **(11)**

AUTOENCODERS, GENERATIVE MODELS AND APPLICATIONS: Autoencoders (AE) – AE variants - Undercomplete AE – Regularized AE – Overcomplete AE – Sparse AE – Denoising AE – Learning Manifolds with autoencoders – Contractive AE – Variational AE – Representation learning – Greedy pre-training – Transfer learning and domain adaptation – Restricted Boltzmann Machine – Generative Adversarial Networks – Practical methodology – Monte Carlo methods – Gibbs sampling – Deep learning applications. **(11)**

Total L: 45 periods

REFERENCES

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *'Deep Learning'*. MIT Press, 2016.
2. John D. Kelleher, *'Deep Learning (The MIT Press Essential Knowledge series)'*, MIT Press, 2019.
3. François Chollet, '*Deep Learning with Python'*. Second edition, Manning Publications, 2017.
4. Eugene Charniak, '*Introduction to Deep Learning'*. MIT Press, 2018.
5. David Foster, *'Generative Deep Learning'*. O'Reilly Media, 2019.
6. Christopher M. Bishop, *'Deep Learning: Foundations and Concepts'*. Springer, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the principles of intelligent data-driven models used in modern engineering applications.	**K2**
CO2	Apply computational models to solve problems using appropriate learning strategies.	**K3**
CO3	Analyze model performance and data patterns to improve solution effectiveness.	**K4**
CO4	Evaluate different modeling approaches to select suitable solutions for complex engineering problems.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				3	3
CO2	3			3	3
CO3		3		3	3
CO4			2	2	2
	3	**3**	**2**	**3**	**3**

1-low, 2-medium, 3-high

CS25211 ADVANCED COMPUTER NETWORKS LABORATORY

0 0 4 2

1. Configure and compare RIP and OSPF routing protocols.
2. Implement eBGP between Autonomous Systems and analyze route selection.
3. Implement queuing mechanisms and measure delay, jitter, throughput and packet loss.
4. Implement PIM and study multicast address assignment and routing behavior.
5. Capture packets and study TCP window size, acknowledgements and retransmissions.
6. Generate TCP traffic and analyze congestion control behavior.
7. Configure WLAN, SSID, WPA2 security and analyze wireless performance.
8. Study of LTE/5G architecture, handover and throughput using a network simulator.
9. Study of centralized vs distributed control and virtualization using logical topology.
10. Design of a virtual network using Mininet/OpenFlow and implementation of basic NFV functions.

Total P: 60 periods

REFERENCES

1. James F. Kurose, Keith W Ross, '*Computer Networking - A Top-Down Approach Featuring the Internet*'. Pearson Education, India, Ninth edition, 2025.
2. Larry L. Peterson and Bruce S Davie, '*Computer Networks: A systems approach*'. Morgan Kaufmann Publishers Burlington, USA, Sixth edition, 2021.
3. Anand Nayyar, Bhawna Singla, Preeti Nagrath, '*Software Defined Networks: Architecture and Applications'*. John Wiley & Sons, First edition, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply appropriate tools and techniques to implement and test networking solutions.	**K3**
CO2	Analyze experimental results to assess network performance and behavior.	**K4**
CO3	Evaluate advanced networking solutions for complex networking challenges	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2			2	2
CO2		3		3	3
CO3			1	1	1
	2	**3**	**1**	**3**	**3**

1-low, 2-medium, 3-high

CS25212 DEEP LEARNING LABORATORY

0 0 4 2

1. Setting up the Spyder IDE environment and executing a python program.
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them.
3. Applying the Convolution Neural Network on computer vision problems.
4. Image classification on MNIST dataset (CNN model with fully connected layer).
5. Applying the deep learning models in the field of Natural Language Processing.
6. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes.
7. Applying the Autoencoder algorithms for encoding the real-world data.
8. Applying Generative Adversarial Networks for image generation and unsupervised tasks.

Total P: 60 periods

REFERENCES

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *'Deep Learning'*. MIT Press, 2016.
2. Francois Chollet, *'Deep Learning with Python'*. Manning Publications, second edition, 2021.
3. TensorFlow, https://www.tensorflow.org
4. PyTorch, https://pytorch.org/docs
5. Spyder IDE, https://docs.spyder-ide.org

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply modern computational tools to develop models for solving engineering problems.	**K3**
CO2	Analyze the performance of developed models and interpret results for different application domains.	**K4**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3			3	3
CO2		2		2	2
	3	**2**		**3**	**3**

1-low, 2-medium, 3-high

CS25213 INDUSTRIAL VISIT & TECHNICAL SEMINAR

0 0 4 2

The student will make at least four one-and-a-half-day industry visits and technical presentations. The same will be assessed by the committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his / her presentations together with the observation in industry visits. A quiz covering the above will be held at the end of the semester.

Total L: 60 periods

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Summarize and present insights gained through industry visits and technical observations using effective communication.	**K2**

CS25311 PROJECT WORK I

0 0 12 6

The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply theoretical and practical knowledge to solve problems, conduct literature reviews, develop methodology, identify research gaps with key parameters, and effectively present findings.	**K5**

CS25411 PROJECT WORK II

0 0 24 12

The student should continue the phase I work on the selected topic as per the formulated methodology / Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explore research in Computer Science and Engineering, apply theoretical and practical knowledge creatively, represent data clearly, derive meaningful conclusions, and effectively report findings with structured presentation.	**K5**

CS25P01 INTERNET OF THINGS

3 0 0 3

IOT MIDDLEWARE: Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT architecture – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart objects and connecting smart objects – Middleware technologies for IoT system – Middleware architecture of RFID, WSN, SCADA, M2M – Challenges introduced by 5G in IoT Middleware – perspectives and a middleware approach toward 5G. **(11)**

COMMUNICATION AND NETWORKING PROTOCOLS: IoT access technologies: Physical and MAC layers, Topology and security of IEEE 802.15.4 and LoRaWAN – Zigbee architecture – Zigbee protocol stack - Zigbee networking – Zigbee clusters and profiles – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over low power and lossy networks – Application layer protocols: CoAP and MQTT – Data aggregation and dissemination **(12)**

DEVICE-TO-CLOUD IOT: Connecting to the physical world – Data simulation: Simulating sensors and actuators – Data management – Data translation in the constrained device app and gateway device app – MQTT integration – Installing and configuring MQTT broker – CoAP client and server integration – Edge integration – Connecting to the cloud. **(11)**

CASE STUDIES: Real world design constraints – Home automation – Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health and life style – Role of AI and Big data analytics in Industry 4.0. **(11)**

Total L: 45 periods

REFERENCES

1. Pethuru Raj and Anupama C. Raman, '*The Internet of Things: Enabling Technologies, Platforms, and Use Cases'*. CRC Press, 2017.
2. Arshdeep Bagha, Vijay Madisetti, *'Internet of Things: A Hands- on Approach'*. Universities Press, 2015.
3. Andy King., '*Programming the Internet of Things: An introduction to building integrated, device-to-cloud IoT Solutions*'. O'Reilly Media, 2021.
4. Honbo Zhou, '*The Internet of Things in the Cloud: A Middleware Perspective'*. CRC Press, 2012.
5. C.Wang et al., '*Zigbee Networking Protocols and Applications*'. CRC Press, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts, architecture, and components of Internet of Things systems.	**K2**
CO2	Apply appropriate technologies and methods to build IoT-based solutions.	**K3**
CO3	Analyze the performance, communication, and integration aspects of IoT systems.	**K4**
CO4	Design and develop efficient end-to-end IoT solutions for diverse application domains.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		1		1	1
CO4			2	2	2
	3	**1**	**2**	**3**	**3**

1-low, 2-medium, 3-high

CS25P02 BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY

3 0 0 3

INTRODUCTION: Blockchain – Distributed ledger – Cryptographic basics for cryptocurrency – Signature schemes, Hashing and elliptic curve cryptography CAP theorem – Categories of blockchain: Public blockchain, Private blockchain, Permissioned ledger, Tokenized blockchain, Tokenless blockchain, and Sidechains. Understanding cryptocurrency, Digital identification and wallets – Decentralized network – Permissioned distributed ledger – Blockchain data structure – Double spending – Network consensus – Sybil attacks – Block rewards and miners – Forks and consensus chain – Finality in blockchain consensus – Limitation of proof of-work – Alternatives to proof of work. **(12)**

DISTRIBUTED LEDGER TECHNOLOGY (DLT): Working of DLT- Key features of DLT – Relation between DLT and blockchain in digital currency – Open vs Permissioned digital ledger – Advantages – Challenges and risks related to DLT Blockchain and full ecosystem decentralization: Smart contract, Decentralized autonomous organization (DAO), Decentralized applications - Platforms for decentralization. **(12)**

BLOCKCHAIN PLATFORMS: Open source platforms: Architecture, identities and policies, Membership and access control, Channels, Transaction validation, Writing smart contract, Blockchain application development using blockchain platforms. **(11)**

BLOCKCHAIN CHALLENGES: Blockchain governance challenges: Bitcoin block size debate, The Ethereum DAO Fork, Ethereum's move to PoS and scaling challenges – Blockchain technical challenges: Denial-of-Service Attacks, Security in smart contracts, Scaling. **(10)**

Total L: 45 periods

REFERENCES

1. Imran Bashir, '*Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks*'. Packt Publishing Limited, 2017.
2. Rogen Wattenhofer, '*Blockchain Science:Distributed Ledger Technologies*'. Inverted Forest Publishing, 2019.
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, '*Bitcoin and cryptocurrency technologies: a comprehensive introduction'*. Princeton University Press, 2020.
4. Bina Ramamurthy, '*Blockchain in Action'.* Manning Publications, First edition, 2020.
5. Josh Thompson, '*Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming'*. Create Space Independent Publishing Platform, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental principles, architecture and operational concepts of blockchain and distributed ledger technologies.	**K2**
CO2	Apply blockchain frameworks and development tools to implement decentralized applications and smart contract–based solutions.	**K3**
CO3	Analyze blockchain networks and distributed ledger systems to identify security issues, consensus mechanisms, governance challenges and performance limitations.	**K4**
CO4	Evaluate blockchain platforms and consensus models based on criteria such as security, scalability, efficiency and suitability	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				3	2
CO2	3		3	3	2
CO3				3	3
CO4		3	3	3	3
	3	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P03 CLOUD COMPUTING

3 0 0 3

INTRODUCTION TO CLOUD COMPUTING: The vision of cloud computing – Defining a cloud – A cloud computing reference model – Cloud deployment models: Public, Private, Community, Hybrid clouds – Cloud delivery models: IaaS, PaaS, SaaS characteristics and benefits – Challenges ahead – Historical developments – Computing platforms and technologies. **(10)**

VIRTUALIZATION: Introduction – Hypervisors – Challenges of X86 Architecture – Main categories of virtualization: Full, Para - Levels of virtualization: Hardware, Programming language, Application, Operating system, Storage, Network, Desktop, Application Server – Benefits of virtualization – Cost of virtualization – Virtualization drawbacks – Xen – KVM – Cloud container: Docker. **(12)**

CLOUD ARCHITECTURE AND TECHNOLOGIES: Infrastructure as a service: Amazon EC2 – Platform as Service: Google App Engine, Microsoft Azure Amazon AWS, Aneka – Software as a service: RESTful Web Services – SLA– Resource management – Scheduling. **(12)**

CLOUD SECURITY: Infrastructure Security: Network level, Host level and application level –Data security – Identity and access management: Architecture and practices – Security management in the cloud – Federation in cloud – Cloud storage – Edge computing. **(11)**

Total L: 45 periods

REFERENCES

1. Rajkumar Buyya, Christian Vecchiola and Thamarai SelviS, '*Mastering Cloud Computing'*. Tata McGraw Hill Education Private Limited, New Delhi,2013.
2. Chen, Lei, Le-Khac, Nhien-An, Takabi, Hassan, *'Security, privacy and digital forensics in the cloud*'. John Wiley & Sons, 2019.
3. Sébastien Goasguen, '*Docker in the Cloud -Recipes for AWS, Azure, Google, and More'*. O'Reilly Media, 2016.
4. Tim Mather, Subra Kumarasamy and Shahed Latif, '*Cloud Security and Privacy: An Enterprise Perspective on Risks and Complainace*'. O'Reilly, USA,2011.
5. Raj Samani; Jim Reavis; Brian Honan, *'CSA Guide to Cloud Computing: Implementing Cloud Privacy and Security*'. Syngress, 2014.
6. Jim Smith, Ravi Nair, '*Virtual Machines: Versatile Platforms for Systems and Processes*'. Morgan Kaufmann Publisher, 2005.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamental concepts behind delivering computing services on demand and their relevance to different user needs.	**K2**
CO2	Apply abstraction techniques to create isolated execution environments and improve efficient utilization of physical resources.	**K3**
CO3	Demonstrate the use of service-based frameworks to deploy, manage, and execute applications in distributed environments.	**K4**
CO4	Evaluate system scenarios to assess protection and control mechanisms for secure data handling and reliable service operation.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		3		3	3
CO4			2	2	2
	3	**3**	**2**	**3**	**3**

1-low, 2-medium, 3-high

CS25P04 COMPUTER VISION

3 0 0 3

IMAGE PROCESSING: Basics of image formation, Colour spaces – Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier transform – Linear filtering – Image enhancement – Restoration – Histogram processing. **(11)**

FEATURE EXTRACTION AND SEGMENTATION: Feature detectors – Feature descriptors – Feature matching- Edge detection – Contour detection – Lines and vanishing points – Feature Segmentation – Graph-Cut, Mean-shift, Normalized-cuts. **(11)**

MOTION ESTIMATION: Translational alignment – Parametric motion – spline flow motion – Optical flow – Multi frame motion estimation – Layered motion – Video object segmentation – Video object tracking. **(12)**

DEPTH ESTIMATION: Pose estimation algorithms – Multi frame structure from motion – Simultaneous localization and mapping (SLAM) – Epipolar geometry – 3D curves and profiles – Local methods. **(11)**

Total L: 45 periods

REFERENCES

1. Szeliski R., '*Computer Vision: Algorithms and Applications*'. Second edition. Springer 2022.
2. Forysth D. A. et al, '*Computer Vision - A Modern Approach'*. Second edition. Prentice Hall, 2015.
3. Davies E. R.,'*Computer Vision: Principles, Algorithms, Applications Learning'*. Fifth edition, Academic Press, 2017.
4. Gonzalez R. C. and Woods R. E., '*Digital Image Processing'*. Fourth edition,Pearson. 2022.
5. Steve Holden, '*Computer Vision: Advanced Techniques and Applications'*. Clanrye International, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe computational methods for structured visual input analysis in practical applications.	**K2**
CO2	Implement techniques for effective interpretation of spatial and temporal data.	**K3**
CO3	Analyze mathematical and algorithmic approaches for meaningful pattern extraction from input data.	**K4**
CO4	Assess proficiency in application-based problem solving involving visual information.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	2			2	2
CO3		3		3	3
CO4			3	3	3
	2	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P05 GPU COMPUTING

3 0 0 3

GPU ARCHITECTURE: Evolution of GPU architectures – Understanding parallelism with GPU – Typical GPU Architecture – CUDA Hardware overview – Threads, Blocks, Grids, Warps, Scheduling – Memory handling with CUDA: Shared memory, Global memory, Constant memory and Texture memory. **(11)**

CUDA PROGRAMMING: Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread usage, Resource Contentions. **(12)**

OPENCL BASICS: OpenCL Standard – Kernels – Host Device Interaction – Execution environment – Memory model – Basic OpenCL examples – Demonstration. **(11)**

APPLICATIONS: Video and Image processing – Experiences on Image and Video Processing with CUDA and OpenCL, Signal and audio Processing – Efficient automatic speech recognition on the GPU – Emerging data – Intensive applications – Large scale Machine Learning. **(11)**

Total L: 45 periods

REFERENCES

1. Shane Cook, '*CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs*'. Morgan Kaufmann, 2013.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, '*Heterogeneous computing with OpenCL*'. Third edition, Morgan Kauffman, 2015.
3. Wen – mei W. Hwu, '*GPU Computing Gems'*. Emerald Edition. A volume in Applications of GPU Computing Series, Morgan Kauffman, 2011.
4. Tolga Soyata, '*GPU Parallel Program Development Using CUD'*. CRC Press, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		Bloom's Level
CO1	Explain the evolution and internal organization of high – performance computing units used for data – intensive tasks.	**K2**
CO2	Apply concurrent execution techniques to develop programs that efficiently process large computational workloads.	**K3**
CO3	Analyze processing scenarios to identify performance limitations and select suitable improvement strategies.	**K4**
CO4	Evaluate different implementation approaches for executing applications across heterogeneous computing resources.	**K5**

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		3		3	3
CO4			2	2	2
	3	**3**	**2**	**3**	**3**

1 – low,2 – medium,3 – high

CS25P06 EDGE COMPUTING

3 0 0 3

EDGE ARCHITECTURE: Multi-Tier cloud computing framework; Data services with clouds at home; Leveraging mobile devices to provide cloud service at the edge; Fast, scalable and secure onloading of edge functions – The cloud-edge interplay in off – Loading services. **(11)**

NETWORKING FOR EDGE & FOG: Integrating IoT, Fog and Cloud Infrastructures: System modeling and research challenges, Management and orchestration of network slices in 5G, Fog, Edge, and Clouds. **(11)**

SYSTEM DESIGN: Optimization problems in fog and edge computing, Middleware for fog and edge Computing: Design issues, A Lightweight container middleware for edge cloud architectures – Edge analytics tools - Open source edge computing simulation platforms: Case studies, Data Processing: Data management in fog computing, Using machine learning for protecting the security and privacy of Internet of Things (IoT) systems, Edge Computing realization for Big data analytics, designing Edge Analytics solutions for different business applications. **(12)**

EDGE COMPUTING MODELS: Case Studies: Cloud Gaming, Smart Manufacturing, Smart City applications, Smart Surveillance and Video Stream Processing, Smart Transportation applications. **(11)**

Total L: 45 periods

REFERENCES

1. Buyya, S.N. Srirama, *'Fog and Edge computing: Principles and Paradigms'*. Wiley Blackwell, 2019.
2. Perry Lea, '*IoT and Edge Computing for Architects*'. Packt Publishing, Second edition, 2020.
3. Wei Chang, Jie Wu, *'Fog/Edge Computing For Security, Privacy, and Applications'*. Springer, 2021.
4. Rajiv Misra, Yashwant Patel, *'Cloud and Distributed Computing: Algorithms and Systems'*. Wiley, 2020.
5. Pethuru Raj, Anupama C. Raman, *'The Internet of Things Enabling Technologies, Platforms, and Use Cases'*. Taylor & Francis, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts, architectures, and principles of edge computing systems.	**K2**
CO2	Apply appropriate methods and tools to implement edge-enabled computing solutions.	**K3**
CO3	Analyze performance, optimization, and security aspects of edge computing environments.	**K4**
CO4	Prepare a report and present case studies demonstrating the application of edge computing solutions in various domains.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1				2	2
CO2	3			3	3
CO3			2	2	2
CO4		1		1	1
	3	**1**	**2**	**3**	**3**

1-low, 2-medium, 3-high

CS25P07 REINFORCEMENT LEARNING

3 0 0 3

BASIC CONCEPTS: Reinforcement learning – Limitations and scope – A grid world example – State and action – State transition – Policy – Reward – Trajectories, returns, and episodes. Markov decision processes – The Agent – Environment interface – Goals and rewards – Returns and episodes – Unified notation for episodic and continuing tasks – Policies and value functions – Optimal policies and optimal value functions. **(8)**

DYNAMIC PROGRAMMING AND MONTE CARLO ALGORITHMS: Policy evaluation (prediction) – Policy improvement – Policy iteration – Value iteration – Generalized policy iteration – Monte Carlo prediction – Monte Carlo estimation of action values – Monte Carlo control – Monte Carlo control without exploring starts. **(13)**

TEMPORAL-DIFFERENCE METHODS AND TABULAR METHODS: TD prediction – Advantages of TD prediction methods – Optimality of TD. Sarsa: On-policy TD control – Q-learning: Off-policy TD control – Expected Sarsa – Maximization bias and double learning – Planning and learning with tabular methods – Models and planning – Dyna: Integrated planning, Acting, and Learning – Incorrect models – Prioritized sweeping – Expected vs. sample update. **(16)**

VALUE-FUNCTION APPROXIMATION METHODS: On-policy prediction with approximation: Value-function approximation – The prediction objective – Stochastic-gradient and Semi-gradient methods – On-policy control with approximation: Episodic semi-gradient control – Average reward **(8)**

Total L: 45 periods

REFERENCES

1. Richard S. Sutton and Andrew G. Barto, '*Reinforcement Learning: An Introduction*'. Second edition, The MIT Press, 2020.
2. Uwe Lorenz, '*Reinforcement Learning from scratch*'. Springer Nature Switzerland, 2022.
3. Dimitri P. Bertsekas, '*Dynamic Programming and Optimal Control*'. Fourth edition, Vol. I, Athena Scientific, 2017.
4. Abhishek Nandy, Manisha Biswas, '*Reinforcement Learning with Open AI, TensorFlow and Keras using Python*'. Apress Media, 2018.
5. Warren B. Powell, '*Reinforcement Learning and Stochastic Optimization: A Unified Framework for Sequential Decisions*'. John Wiley & Sons Inc., 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain foundational concepts of Reinforcement Learning.	**K2**
CO2	Apply learning algorithms to compute policies and value measures for sequential decision problems.	**K3**
CO3	Analyze learning performance across dynamic programming, Monte Carlo, and temporal-difference approaches.	**K4**
CO4	Evaluate approximation-based learning methods for scalability and decision accuracy in complex environments.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	2			2	2
CO3		2		2	2
CO4			3	3	3
	2	**2**	**3**	**3**	**3**

1-low, 2-medium, 3-high

Third ACM

CS25P08 QUANTUM COMPUTING

3 0 0 3

INTRODUCTION: Quantum measurements density matrices, Positive – Operator valued measure, Fragility of quantum information: Decoherence, Quantum superposition and entanglement, Quantum gates and circuits. **(11)**

QUANTUM BASICS AND PRINCIPLES: No cloning theorem & Quantum teleportation, Bell's inequality and its implications, Quantum algorithms & circuits. **(12)**

PERFORMANCE, SECURITY AND SCALABILITY: Quantum error correction: Fault tolerance; Quantum cryptography, Implementing quantum computing: Issues of fidelity; Scalability in quantum computing. **(12)**

QUANTUM COMPUTING MODELS: NMR quantum computing, Spintronics and QED model, Linear optical model, Nonlinear optical approaches; Limits of all the discussed approaches, Future of quantum computing. **(10)**

Total L: 45 periods

REFERENCES

1. Chris Bernhardt, *'Quantum Computing for Everyone'*. The MIT Press, 2020.
2. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia, *'Programming Quantum Computers: Essential Algorithms and Code Samples'*. SHROFF/ O'Reilly, 2019.
3. Dr. Christine Corbett Moran, *'Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit'*. Kindle Edition Packt, 2018.
4. Whurley, Floyd Earl Smith, *'Quantum Computing For Dummies'*. Wiley, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental principles and mechanisms underlying quantum computing systems.	**K2**
CO2	Apply quantum concepts and models to represent and manipulate quantum information.	**K3**
CO3	Analyze quantum algorithms and quantum circuit models to understand their computational advantages, limitations, and performance characteristics.	**K4**
CO4	Evaluate quantum algorithms, error correction techniques, and implementation models based on reliability and efficiency.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2			3	3	3
CO3			3	2	2
CO4	2			3	3
	2		**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P09 DATA INTENSIVE COMPUTING SYSTEM

3 0 0 3

BIG DATA AND INFRASTRUCTURE: Big data overview – Characteristics – Role of data Scientist – Big data in industry verticals – Infrastructure – Cloud computing – Data centre architecture – Compute, Network, Storage and Desktop virtualization – Storage devices. **(11)**

DATA ANALYTICS AND MAP REDUCE: Data analytics lifecycle – Discovery, Data preparation, Model planning, Model building, communicating results, Operationalizing – Hadoop distributed file system- MapReduce architecture – HADOOP ecosystem – Sample case studies – SPARK architecture – RDD – Transformations. **(11)**

STORAGE PLATFORMS: NoSQL stores – Key-Value stores – Columnar stores – Document stores – Graph databases – Case studies – HBase, MongoDB, Neo4j. **(11)**

THEORY AND METHODS: Map Reduce implementation for K Means, K-Medoids, SVM, PCA. Time series analysis –Text analysis – Stream analysis – Case studies. **(12)**

Total L: 45 periods

REFERENCES

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman. *'Mining of Massive Dataset'*. Second edition, Dreamtech Press, 2016.
2. Rathinaraja Jeyaraj, Ganeshkumar Pugalendhi, Anand Paul, *'Big Data with Hadoop MapReduce'*. CRC Press, 2020.
3. Seema Acharya, *'Demystifying NoSQL'*. Wiley, January 2020.
4. Rob J Hyndman, George Athanasopoulos, *'Forecasting: Principles and Practice'*. Third edition, OTexts, 2018.
5. Tyler Akidau, Slava Chernyak, and Reuven Lax, *'Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing'*. O'Reilly Media, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		Bloom's Level
CO1	Explain the fundamental concepts and significance of big data and analytics systems.	**K2**
CO2	Apply big data tools and frameworks to process large datasets.	**K3**
CO3	Analyze big data technologies and datasets for data-driven applications.	**K4**
CO4	Evaluate big data technologies and analytical models to recommend appropriate solutions for diverse applications.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2			3	3	3
CO3			3	3	3
CO4	2			2	2
	2		**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P10 COGNITIVE COMPUTING

3 0 0 3

INTRODUCTION: Cognitive computing paradigm – Evolution of cognitive systems – Characteristics – Cognitive vs Artificial intelligence – Cognitive computing architecture – Human cognition vs Machine cognition – Applications of cognitive computing. **(11)**

KNOWLEDGE REPRESENTATION AND REASONING: Knowledge representation – Logic based representation – Propositional and predicate logic –Semantic networks – Frames – Ontologies – Reasoning mechanisms – Rule-based systems – Inference techniques – Handling uncertainty. **(11)**

MACHINE LEARNING FOR COGNITIVE SYSTEMS: Machine learning overview – Supervised learning – Unsupervised learning – Reinforcement learning – Feature engineering – Classification – Regression – Clustering – Neural networks – Deep learning basics. **(11)**

NATURAL LANGUAGE PROCESSING AND PERCEPTION: Natural language processing – Text processing – Tokenization – Parsing – Information extraction – Sentiment analysis – Speech recognition – Computer vision basics – Pattern recognition – Cognitive perception. **(12)**

Total L: 45 periods

REFERENCES

1. Stuart Russell and Peter Norvig, *'Artificial Intelligence: A Modern Approach'*. Fourth edition, Pearson Education, Hoboken, New Jersey, 2021.
2. Jose Hernandez-Orallo, *'Cognitive Computing'*. First edition, Springer International Publishing, Cham, Switzerland, 2017.
3. IBM Redbooks, *'Cognitive Computing Fundamentals'*. First Edition, IBM Press, Armonk, New York, 2017.
4. Judith S. Hurwitz, Marcia Kaufman, and Adrian Bowles, *'Cognitive Computing and Big Data Analytics'*. Wiley Publications, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts and applications of cognitive computing systems.	**K2**
CO2	Apply knowledge representation and reasoning techniques for intelligent systems.	**K3**
CO3	Analyze machine learning, natural language processing, and perception techniques used in cognitive computing.	**K4**
CO4	Analyze cognitive computing approaches for processing and interpreting complex information.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		3		3	3
CO4			3	3	3
	3	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P11 NATURAL LANGUAGE PROCESSING

3 0 0 3

INTRODUCTION: Introduction – History of Natural Language Processing – Applications of NLP – Levels of language processing – Challenges in NLP – Linguistic essentials – Morphology – Syntax – Semantics – Pragmatics – NLP Pipeline – Text preprocessing – Text normalization – Tokenization – Stemming – Lemmatization – Stop word removal. **(12)**

LEXICAL, SYNTACTIC AND SEMANTIC ANALYSIS:– Regular expressions – N-grams – Word frequency analysis – Zipf's Law – Bag of words model – TF-IDF – Word embeddings – Part-of-Speech Tagging – Rule-based and Statistical taggers – Parsing techniques – Constituency parsing – Dependency parsing – Semantic analysis – Word sense disambiguation – Named entity recognition – Semantic role labeling. **(13)**

STATISTICAL AND MACHINE LEARNING METHODS FOR NLP: Language models – N-gram language models – Smoothing techniques – Hidden Markov models – Conditional random fields – Naive bayes classifier – Maximum entropy models – Neural networks – Recurrent neural networks – LSTM – Transformer models. **(10)**

NLP APPLICATIONS AND ADVANCED TOPICS: Information retrieval – Text classification – Sentiment analysis – Machine translation – Question answering systems – Speech processing – Dialogue systems – Chatbots – Ethical issues in NLP – Case studies. **(10)**

Total L: 45 periods

REFERENCES

1. Daniel Jurafsky and James H. Martin, *'Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models'*. Third edition, Pearson Education / Stanford University, 2026.
2. Steven Bird, Ewan Klein, and Edward Loper, *'Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit'*. First edition, O'Reilly Media, Sebastopol, California, 2009.
3. Christopher D. Manning and Hinrich Schütze, *'Foundations of Statistical Natural Language Processing'*. First edition, MIT Press, Cambridge, Massachusetts, 1999.
5. Yoav Goldberg, *'Neural Network Methods for Natural Language Processing'*. First edition, Morgan & Claypool Publishers, San Rafael, California, 2017.
6. Jacob Eisenstein, *'Introduction to Natural Language Processing'*. First edition, MIT Press, Cambridge, Massachusetts, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamentals, challenges, and applications of Natural Language Processing.	**K2**
CO2	Apply computational techniques to process and represent natural language data.	**K3**
CO3	Analyze different statistical and machine learning models used for syntactic, semantic, and contextual analysis of natural language.	**K4**
CO4	Evaluate various Natural Language Processing techniques and models for effective language processing.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		3		3	3
CO4			3	3	3
	3	**3**	**3**	**3**	**3**

CS25P12 DATA ANALYTICS

3 0 0 3

INTRODUCTION TO DATA MINING AND EXPLORING DATA: Introduction to Data Mining, Challenges in Data Mining, Data Mining tasks, Machine Learning, Predictive data analytics lifecycle, Predictive data analytics tools, Different types of data, Normal distribution, Identifying data quality issues, Missing values, Irregular cardinality, Data preparation, Normalization, Binning, Sampling. **(10)**

FEATURE SELECTION, DECISION TREE AND SIMILARITY-BASED LEARNING: Feature reduction – Statistics for feature selection, Chi-Squared Test, ANOVA F-test, RFE feature selection, Decision Trees, Shannon's Entropy Model, The ID3 Algorithm, The Nearest Neighbor Algorithm, Handling Noisy data, Data Normalization. **(12)**

PROBABILITY-BASED AND ERROR-BASED LEARNING: Fundamentals, Bayes' Theorem, Bayesian Prediction, Conditional Independence and Factorization, Standard Approach: The Naive Bayes Model, Simple Linear Regression, Measuring error, Error surfaces, Standard approach: Multivariable Linear Regression with Gradient Descent, Multivariable Linear Regression, Gradient Descent. **(12)**

DISTRIBUTED MACHINE LEARNING: Data Parallelism – Splitting Input Data, Parameter Server and all – Reduce – Building a data parallel training and serving pipeline – Model parallelism – Splitting the model – Pipeline input and layer split – Implementing model parallel training and serving workflows – Federated Learning and Edge Devices. **(11)**

Total L: 45 periods

REFERENCES

1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, '*Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples'*. Second edition, MIT Press, 2020.
2. Jason Brownlee, '*Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python*'. First edition, Machine Learning Mastery, 2020.
3. Christopher D. Manning and Hinrich Schütze, '*Foundations of Statistical Natural Language Processing*'. MIT Press. 1999.
4. Pang-Ning Tan; Michael Steinbach; Anuj Karpatne; Vipin Kumar '*Introduction to Data Mining*'. Second edition, Pearson Education, 2019.
5. Guanhua Wang, '*Distributed Machine Learning with Python*', Packt Publishing, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of data analytics, including distributed machine learning and data mining techniques, in the context of large-scale data analysis.	**K2**
CO2	Apply suitable knowledge representation techniques to model domain-specific problems using expert system tools and environments.	**K3**
CO3	Examine data problems by identifying important features for analytical tasks.	**K4**
CO4	Deliver a formal technical presentation on data analytics solutions by demonstrating domain proficiency and effectively communicating analytical insights.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				1	1
CO2	3			3	3
CO3		1	3	3	3
CO4		1	1	1	1
	3	**1**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P13 TEXT AND SPEECH ANALYSIS

3 0 0 3

TEXT ANALYSIS: Lexicon – Document structure detection – Text normalization – Linguistic analysis – Homograph disambiguation – Morphological analysis – Letter-sound conversion – Prosody – Generation schematic – Speaking style – Symbolic prosody – Duration assignment – Pitch generation. **(10)**

TEXT TO SPEECH SYNTHESIS: Attributes – Formant speech synthesis – Concatenative speech synthesis – Prosodic modification of speech – Source–filter models for prosody modification – Feature space for speaker recognition–Similarity measures– Evaluation of TTS systems, Concatenative and waveform synthesis methods, Sub-word units for TTS, Intelligibility and naturalness–Role of prosody. **(11)**

SPEECH PROCESSING AND RECOGNITION: Spoken language structure – Phonetics and phonology – Syllables and words – Syntax and semantics – Probability theory – Estimation theory – Significance testing – Information theory – Hidden Markov Models – Definition – Continuous and discontinuous HMM's – Practical issues and limitations – Acoustic modeling – Variability in the speech signal – Extracting features – Phonetic modeling – Adaptive techniques – Confidence measures – Other techniques. **(14)**

SPEECH SIGNAL REPRESENTATIONS AND CODING: Overview of digital signal processing – Speech signal representations – Short time fourier analysis – Acoustic model of speech production – Linear predictive coding – Cepstral processing – Formant frequencies – The role of pitch – Speech coding – LPC coder. **(10)**

Total L: 45 periods

REFERENCES

1. Lawrence Rabiner and Biing-Hwang Juang, '*Fundamentals of Speech Recognition*'. First edition, Prentice Hall Signal Processing Series, 1993.
2. Joseph Mariani, '*Language and Speech Processing*'. First edition, Wiley, 2009.
3. SadaokiFurui, '*Digital Speech Processing: Synthesis and Recognition*'. Second edition, Signal Processing and Communications, Marcel Dekker, 2000.
4. Thomas F.Quatieri, '*Discrete-Time Speech Signal Processing*'. First edition, Pearson Education, 2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, '*Spoken Language Processing – A guide to Theory, Algorithm and System Development*'. First edition, Prentice Hall PTR, 2001.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain speech signal processing fundamentals	**K2**
CO2	Apply text-to-speech synthesis techniques for speech generation	**K3**
CO3	Categorize speech recognition techniques	**K4**
CO4	Design and improve speech recognition systems	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1		1		1	1
CO2	3			3	3
CO3			3	3	3
CO4			2	2	2
	3	**1**	**3**	**3**	**3**

1–low,2–medium,3–high

CS25P14 SOFT COMPUTING

3 0 0 3

INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC: Introduction – Fuzzy Logic – Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems. **(11)**

NEURAL NETWORKS: Supervised Learning – Perceptrons – Backpropagation – Multilayer Perceptrons – Unsupervised Learning – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hamming Neural Network – Hopfield Neural Network – Bi-directional Associative Memory – Adaptive Resonance Theory Neural Networks – Support Vector Machines – Spike Neuron Models. **(12)**

GENETIC ALGORITHMS: Chromosome Encoding Schemes – Population initialization and selection methods – Evaluation function – Genetic operators – Crossover – Mutation – Fitness function – Maximizing function – Bit-wise operators – Convergence of Genetic Algorithm. **(10)**

NEURO FUZZY MODELING: ANFIS architecture – Hybrid learning – ANFIS as universal approximator – Coactive Neuro-fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro-fuzzy spectrum – Analysis of Adaptive Learning Capability – Fuzzy Logic Controller – Modeling a two-input sine function – Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Handwritten neural recognition. **(12)**

Total L: 45 periods

REFERENCES

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani, *'Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence'*. First edition, Prentice Hall, 1997.
2. S. Rajasekaran and G. A. V. Pai, *'Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications'*. First edition, PHI Learning, 2003.
3. Samir Roy and Udit Chakraborty, *'Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms'*. First edition, Pearson Education, 2013.
4. Himanshu Singh and Yunis Ahmad Lone, *Deep Neuro-Fuzzy Systems with Python with Case Studies and Applications from the Industry'*. Apress, 2020.
5. Roj Kaushik and Sunita Tiwari, '*Soft Computing – Fundamental Techniques and Applications'*. McGraw Hill, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of fuzzy logic, neural networks, genetic algorithms, and neuro-fuzzy systems used in soft computing.	**K2**
CO2	Apply soft computing techniques such as fuzzy inference systems, neural networks, and genetic algorithms to solve engineering problems.	**K3**
CO3	Analyze and compare the performance of soft computing models for classification, optimization, and pattern recognition applications.	**K4**
CO4	Design and evaluate hybrid soft computing models such as Neuro-Fuzzy and ANFIS systems for real-world applications.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2				3	3
CO3	3	3		3	3
CO4			2	2	2
	3	**3**	**2**	**3**	**3**

1-low, 2-medium, 3-high

CS25P15 RECOMMENDER SYSTEMS

3 0 0 3

INTRODUCTION TO RECOMMENDER SYSTEMS: Overview and taxonomy of recommender systems – Traditional and non-personalized recommenders – Data mining methods – Similarity measures: Cosine, Pearson, Jaccard – Dimensionality reduction – Singular Value Decomposition (SVD) – MovieLens dataset – Matrix factorization. **(10)**

CONTENT-BASED AND NEURAL RECOMMENDER SYSTEMS: High-level architecture of content-based systems – Item profiles and representation – Learning user profiles – Similarity-based retrieval – Classification algorithms – AutoRec: Rating prediction with autoencoders – Neural collaborative filtering for personalized ranking – Sequence-aware recommenders. **(12)**

FEATURE-RICH AND FACTORIZATION-BASED RECOMMENDERS: Feature-rich recommender systems – Factorization machines – Deep factorization machines – Personalized ranking methods – Hybrid recommendation approaches – Evaluation metrics: Precision, Recall, ROC curves. **(12)**

ATTACK-RESISTANT, GANS, AND PRACTICAL IMPLEMENTATION: Introduction to attacks on recommender systems – Individual and group attacks – Detection and mitigation strategies – Robust recommendation algorithms – Generative adversarial networks (GANs) for recommendation – Practical implementation: Similarity measures, SVD, User profile learning, Content-based and Collaborative filtering, Attack simulation, Accuracy evaluation. **(11)**

Total L: 45 periods

REFERENCES

1. Charu C. Aggarwal, '*Recommender Systems: The Textbook*'. Springer, 2016.
2. Dietmar Jannach, Markus Zanker, Alexander Felfernig, and Gerhard Friedrich, '*Recommender Systems: An Introduction*'. First edition, Cambridge University Press, 2011.
3. Francesco Ricci, Lior Rokach, Bracha Shapira, '*Recommender Systems Handbook*'. First edition, Springer, 2011.
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, '*Mining of Massive Datasets*'. Third edition, Cambridge University Press, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts and structural variations of intelligent suggestion mechanisms used for supporting decision-making in digital environments.	**K2**
CO2	Apply systematic modeling approaches for developing personalized solution frameworks based on descriptive attributes and learned behavioral patterns.	**K3**
CO3	Analyze advanced predictive techniques that integrate multiple information sources to improve adaptability, accuracy, and ranking effectiveness in complex scenarios.	**K4**
CO4	Evaluate the robustness and practical deployment of intelligent recommendation solutions considering performance measurement, resilience against manipulation, and real-world applicability.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				3	3
CO2	3			3	3
CO3		3		3	3
CO4			3	3	3
	3	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P16 EXPERT SYSTEMS

3 0 0 3

INTRODUCTION TO EXPERT SYSTEMS: Features of Expert Systems – ES Building, Real Experts – Keep Human in Loop, Organization of ES: Organizing knowledge – Representing knowledge – Expert Systems vs. Conventional programs: Characteristics of ES – Activities of ES – Types of problems that ES solve. **(10)**

EXPERT SYSTEM TOOLS KNOWLEDGE REPRESENTATION IN EXPERT SYSTEMS: Using Rules – Using Semantic Nets – Using Frames, Nature of Expert System tools: Programming languages – Knowledge Engineering languages – System building aids – Support facilities, ES building process, Stages in the development of ES tools. **(12)**

BUILDING AN EXPERT SYSTEM AND DIFFICULTIES WITH DEVELOPMENT: ES development – Possible, Justified, Appropriate, Building ES: Tasks – Stages. Choosing tools – Acquiring knowledge from experts – Knowledge acquisition process – Interviewing the expert, Difficulties in developing an ES: Lack of resources – Limitations – Long time, Common pitfalls in planning an ES: Choosing problem – Resources for building an ES – Choosing the ES tool. **(13)**

EXPERT SYSTEMS IN MARKETPLACE: ES at universities – Research organizations – Knowledge engineering companies, High performance expert systems used in research – Business – Computer systems – Expert systems to Intelligent systems. **(10)**

TOTAL L: 45 periods

REFERENCES

1. Patterson, '*Introduction to Artificial Intelligence and Expert Systems*'. Pearson Education India, 2015.
2. Spyros Tzafestas, '*Expert Systems in Engineering Applications*'. Springer, 2011.
3. Donald. A. Waterman, *'A Guide To Expert Systems'*. Third edition, Pearson Education, 2009.
4. J. Giarratano and G. Riley, *'Expert Systems -- Principles and Programming'*. Fourth edition, PWS Publishing Company, 2004.
5. Peter Jackson, '*Introduction to Expert Systems'*. Addison Wesley Longman, 1999.
6. Nikolopoulos, *'Expert Systems'*. Marcel Dekker Inc. 1997.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Summarize the theoretical foundations and operational mechanisms of expert systems.	**K2**
CO2	Employ expert system methodologies to solve knowledge-based problems in appropriate domains.	**K3**
CO3	Examine expert system problem scenarios to determine appropriate approaches and strategies	**K4**
CO4	Present a technical seminar on high-performance expert system applications by demonstrating domain understanding, and effectively communicating technical insights.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				1	1
CO2	3			3	3
CO3		3		3	3
CO4			1	1	1
	3	**3**	**1**	**3**	**3**

1-low, 2-medium, 3-high

CS25P17 GENERATIVE AI

3 0 0 3

INTRODUCTION: Introduction to Generative AI, Autoencoders – Representational power, layer size and depth, Undercomplete autoencoders, Denoising autoencoders, Contractive autoencoders, Variational autoencoders. **(10)**

GENERATIVE MODELS FOR TEXT: Language Models Basics – Building blocks of Language models – Transformer Architecture – Encoder and Decoder – Attention mechanisms – Generation of Text – Models like BERT and GPT models – Generation of Text – Autoencoding – Regression Models – Exploring ChatGPT – Prompt Engineering – Designing Prompts – Revising Prompts using Reinforcement Learning from Human Feedback (RLHF) – Retrieval Augmented Generation – Multimodal LLM. **(12)**

GENERATIVE ADVERSARIAL NETWORKS (GAN) : Generative Adversarial networks (GAN) – structure and training algorithm, Deep Convolutional GAN, Autoregressive models – Finite memory, long range memory through RNN and CNN, Visual Transformers ViT. **(11)**

OPEN SOURCE MODELS AND PROGRAMMING FRAMEWORKS: Training and Fine tuning of Generative models – GPT4All – Transfer learning and Pretrained models – Training vision models – Google Copilot - Programming LLM – LangChain – Open Source Models – Llama – Programming for TimeSformer – Deployment – Hugging Face. Case study: Generative AI use cases. **(12)**

Total L: 45 periods

REFERENCES

1. Goodfellow, Y. Bengio, and A. Courville, '*Deep Learning*'. MIT Press, 2016.
2. Denis Rothman, '*Transformers for Natural Language Processing and Computer Vision*'. Third edition, Packt Books, 2024.
3. David Foster,'*Generative Deep Learning'*. O'Reily Books, 2024.
4. Altaf Rehmani, '*Generative AI for Everyone'*. BlueRose One, 2024.
5. Raut, R., Pathak, P. D., Sakhare, S. R., & Patil, S. (Eds.), '*Generative Adversarial Networks and Deep Learning: Theory and Applications*'. CRC Press, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain fundamental concepts and computational approaches used for learning representations and generating data in intelligent systems.	**K2**
CO2	Apply appropriate machine learning and data modeling techniques to build and experiment with generative and predictive systems.	**K3**
CO3	Analyze the performance and behavior of learning architectures when applied to different types of data and application scenarios.	**K4**
CO4	Evaluate and justify generative-based solutions for real-world problems by comparing models, performance metrics, and practical constraints.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	2			2	2
CO3		2		3	3
CO4			3	3	3
	2	**2**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P18 AGENTIC AI

3 0 0 3

INTRODUCTION TO AGENTIC AI: Evolution of Agentic AI – Agent architecture: Perception, Reasoning, Planning, Action – LLM-driven agents vs. classical agents – Reactive, Deliberative and Hybrid agent models – Agent environments and task decomposition – Basics of agent memory: Episodic, Semantic and Vector memory. **(11)**

REASONING, PLANNING AND SELF-REFLECTION: Chain-of-Thought (CoT), Tree-of-Thought (ToT) – Self-reflection and error correction – Planning algorithms: STRIPS, PDDL, Goal-based planning – Action selection strategies – Incorporating domain knowledge into agent reasoning – Workflow generation via LLMs. **(12)**

TOOL-USE AND MULTI-AGENT SYSTEMS: Tool-use patterns – API-driven agent tasks – Multi-agent roles: Coordinator, Critic, Executor – Agent communication and shared-memory models – Multi-agent collaboration and negotiation – Overview of agentic frameworks: LangChain, AutoGen, ReAct – Building LLM-driven agents for practical workflows. . **(11)**

SAFETY, EVALUATION AND ALIGNMENT: Safety challenges in autonomous agents – Guardrails and constrained execution – Detecting hallucinations and unsafe actions – Performance evaluation metrics: Task Success, Safety Score, Efficiency – Ethical and social considerations in agent deployment – Verification and validation of agentic workflows. **(11)**

Total L: 45 periods

REFERENCES

1. Ken Huang, '*Agentic AI: Theories and Practices*'. First edition, Springer, 2025.
2. Michael Lanham, '*AI Agents in Action'*. Second edition (planned), Manning, 2025.
3. Ken Huang & Chris Hughes, '*Securing AI Agents: Foundations, Frameworks, and Real-World Deployment*'. First edition, Springer, 2025.
4. Michael Wooldridge, '*An Introduction to MultiAgent Systems'*. Second edition, Wiley, 2009.
5. Russell S and Norvig P, '*Artificial Intelligence: A Modern Approach*'. Fourth edition, Pearson, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		Bloom's Level
CO1	Explain the foundational ideas and structural characteristics of intelligent computational systems in practical application contexts.	**K2**
CO2	Apply systematic approaches for goal-oriented execution flow development in complex computational tasks.	**K3**
CO3	Analyze collaborative workflows with respect to coordination styles, information exchange patterns, and role distribution mechanisms.	**K4**
CO4	Evaluate intelligent solution deployments with respect to effectiveness, reliability, ethical responsibility, and societal impact.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				3	3
CO2	3			3	3
CO3		3		3	3
CO4			3	3	3
	3	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

CS25P19 DRONE TECHNOLOGIES

3 0 0 3

INTRODUCTION TO DRONE TECHNOLOGY: Drone concept – Vocabulary terminology – History of drone – Types of current generation of drones based on their method of propulsion – Drone technology impact on the businesses – Opportunities/applications for entrepreneurship and employ-ability – Classifications of the UAV **(10)**

DRONE DESIGN, FABRICATION AND PROGRAMMING: Overview of the main drone parts– Technical characteristics of the parts – Function of the component parts – Assembling a drone – Energy sources – Level of autonomy – Drones configurations – Methods of programming drone – Download program – Install program on computer – Running programs – Multi rotor stabilization – Wi-Fi connection. **(12)**

DRONE FLYING AND OPERATION: Concept of operation for drone – Flight modes – Operate a small drone in a controlled environment – Drone controls flight operations – Management tool – Sensors – Onboard storage capacity – Removable storage devices – Linked mobile devices and applications **(10)**

DRONE APPLICATIONS, SAFETY AND FUTURE TRENDS : Application based drone selection – Drones in the insurance sector – Drones in delivering mail, parcels and other cargo – Agriculture – Inspection of transmission lines and power distribution – Filming and panoramic picturing – Drone programming for specific applications – Safety risks – Guidelines to fly safely – Aviation regulation and license – Miniaturization of drones– Increasing autonomy of drones – Drones in swarms– Anti-Drone technology and security measures **(13)**

Total L: 45 periods

REFERENCES

1. Daniel Tal and John Altschuld, ‘*Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation*’. John Wiley & Sons, Inc., 2021.
2. Terry Kilby and Belinda Kilby, '*Make:Getting Started with Drones*'. First edition, Maker Media, Inc., 2016.
3. John Baichtal, '*Building Your Own Drones: A Beginners Guide to Drones, UAVs, and ROVs*’. First edition, Que Publishing, 2016.
4. Zavrsnik, '*Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance*'. First edition, Springer, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Explain the fundamentals of drone technology.	**K2**
CO2	Select appropriate sensors and actuators for Drones and operate drones in various flight modes in controlled and uncontrolled environments	**K3**
CO3	Choose suitable drone mechanism and components for specific applications	**K4**
CO4	Build drone-based applications abiding safety regulations and aviation standards	**-**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1		2		2	2
CO2	3			3	3
CO3			3	3	3
CO4			2	2	2
	3	**2**	**3**	**3**	**3**

1–low, 2–medium, 3–high

CS25P20 DATA SECURITY

3 0 0 3

DATA PROTECTION AND DATA SECURITY: Basics of data security – Hazards in the technical environment – Dangerous Software: Trojan Horse – Virus – Logical Bomb – Keylogger – Sniffer – Back Door, Removable Media: USB Devices – Smartphones – Other Mobile Devices. **(11)**

DIGITAL SYSTEMS AND INFORMATION SECURITY ESSENTIALS: Telephone systems – The greatest danger in the digitalized world – Data destruction – Data backup and restore – Encryption and website hacking. **(11)**

ENTERPRISE SECURITY SYSTEMS AND NETWORK DEFENSE: Common security problems – Identification of computers and IP address – Firewall – Router – Configuration of security systems – Demilitarized zone – organizational security. **(12)**

DATA SECURITY IN CLOUD AND IOT: Cloud security fundamentals – Data protection in cloud – IoT security fundamentals – Secure communication in cloud and IoT – Privacy and Data governance. **(11)**

Total L: 45 periods

REFERENCES

1. Thomas H. Lenhard, '*Data Security: Technical and Organizational Protection Measures against Data Loss and Computer Crime*'. First edition, Springer 2021.
2. Yuan Zhang, Chunxiang Xu, Xuemin Sherman Shen, '*Data Security in Cloud Storage*'. First edition, Springer 2021.
3. Ronald L. Kurtz, Russell Dean Vines., '*Cloud Security: A Comprehensive guide to secure Cloud Computing*'. Wiley Publishing, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts, threats, and protection methods in information security.	**K2**
CO2	Apply security techniques to protect data, systems, and networks.	**K3**
CO3	Analyze vulnerabilities and security mechanisms in computing environments.	**K4**
CO4	Evaluate and recommend effective security strategies for secure systems.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1				2	2
CO2	3			3	3
CO3		2		2	2
CO4			2	2	2
	3	**2**	**2**	**3**	**3**

1-low, 2-medium, 3-high

AUDIT COURSES

SE25A01 SUSTAINABLE DEVELOPMENT GOALS

2 0 0 0

MODULE 1: The "5P's" of the SDGs – People, Planet, Prosperity, Peace, Partnership - No Poverty, End poverty in all its forms everywhere – Zero Hunger, End hunger, achieve food security and improved nutrition and promote sustainable agriculture –Good Health and Well- Being, ensure healthy lives and promote well-being for all at all ages. **(8)**

MODULE 2: Quality Education, promote lifelong learning opportunities for all – Gender Equality, Achieve gender equality and empower all girls and women – Clean Water and Sanitation – Affordable and Clean Energy, Ensure access to affordable, reliable, sustainable and modern energy for all – Decent Work and Economic Growth. **(7)**

MODULE 3: Industry, Innovation and Infrastructure, Build resilient infrastructure, promote sustainable industrialization and foster innovation – Reduced Inequalities – Sustainable Cities and Communities – Responsible Consumption and Production, Ensure sustainable consumption and production patterns. **(7)**

MODULE 4: Climate Action, Take urgent action to combat climate change and its impacts – Life below Water, Conserve and sustainably use our oceans, seas and marine resources – Life on Land, Sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss – Promote just, peaceful and inclusive societies. **(8)**

Total L: 30 periods

REFERENCES

1. The United Nations, '*The Sustainable Development Goals'*. First edition, The United Nations, 2017.
2. Stephen Browne, '*Sustainable Development Goals and Un Goal-Setting'*. First edition,Routledge, 2017.
3. Korbla P. Puplampu, Kobena Hanso, Timothy Shaw, Kobena T. Hanson, and Timothy M. Shaw, '*From Millennium Development Goals to Sustainable Development Goals'*. First edition, Routledge, 2021.
4. Julia Walker, Alma Pekmezovic and Gordon Walker, '*Sustainable Development Goals'*. First edition, John Wiley& Sons Limited, 2019.
5. Rianne Mahon, Susan Horton, Simon Dalby and Diana Thomaz, '*Achieving the Sustainable Development Goals*'. First edition, Routledge, 2019.
6. https://sustainabledevelopment.un.org/resourcelibrary
7. https://en.unesco.org/themes/education/sdgs/material
8. https://www.unicef.org/sdgs/resources
9. https://www.undp.org/content/undp/en/home/sustainable-development-goals/resources.html
10. https://sdghub.com/resources/

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the significance of Sustainable Development Goals (SDGs) in global, national, and local development contexts.	**K2**
CO2	Analyze real-world issues through case studies and propose sustainable solutions aligned with relevant SDGs.	**K3**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	1	2	1	1
CO2	3	1	2	2	2
	3	**1**	**2**	**2**	**2**

1-low, 2-medium, 3-high

SE25A02 ENGLISH FOR RESEARCH PAPER WRITING

2 0 0 0

INTRODUCTION TO RESEARCH PAPER WRITING: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. **(6)**

PRESENTATION SKILLS: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction. **(6)**

TITLE WRITING SKILLS: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. **(6)**

RESULT WRITING SKILLS: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. **(6)**

VERIFICATION SKILLS: Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission. **(6)**

Total L: 30 periods

REFERENCES

1. Adrian Wallwork, '*English for Writing Research Papers'.* Springer New York Dordrecht Heidelberg London, 2011.
2. Robert A. Day and Barbara Gastel, '*How to Write and Publish a Scientific Paper'*. Ninth edition, Cambridge University Press 2022.
3. Goldbort R., '*Writing for Science'*. Yale University Press (available on Google Books) 2006.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the principles of academic writing, including clarity, conciseness, proper structuring of sentences, and the avoidance of ambiguity, redundancy, and plagiarism in research papers.	**K2**
CO2	Apply effective writing and presentation skills to prepare well-structured sections of a research paper (title, abstract, introduction, methods, results, and discussion), ensuring academic integrity and readiness for publication.	**K3**

COs – POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	1	3			1
CO2	2	3	2	1	2
	2	**3**	**2**	**1**	**2**

1-low, 2-medium, 3-high

SE25A03 DISASTER MANAGEMENT

2 0 0 0

INTRODUCTION TO DISASTERS: Disaster: Definition, Factors and Significance – Difference between Hazard and Disaster – Natural and Manmade Disasters: Differences, Nature, Types and Magnitude. **(8)**

IMPACTS AND TYPES OF DISASTERS: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystems – Natural Disasters: Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches – Man-made Disasters: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. **(7)**

DISASTER VULNERABILITY AND PREPAREDNESS IN INDIA: Disaster-Prone Areas in India: Seismic Zones, Areas Prone to Floods, Droughts, Landslides, Avalanches, Cyclones, and Coastal Hazards (with special reference to Tsunami) – Post-Disaster Diseases and Epidemics – Preparedness: Monitoring of Phenomena Triggering Disasters, Risk Evaluation, Use of Remote Sensing, Meteorological Data, Media Reports – Government and Community Preparedness. **(8)**

DISASTER RISK ASSESSMENT AND MANAGEMENT STRATEGIES: Disaster Risk: Concept and Elements – Disaster Risk Reduction – Global and National Disaster Risk Situations – Techniques of Risk Assessment – Global Cooperation and Early Warning Systems – People's Participation – Strategies for Survival. **(7)**

Total L: 30 periods

REFERENCES

1. Goel S. L., '*Disaster Administration and Management Text and Case Studies*'. Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. Nishitha Rai, Singh A. K., '*Disaster Management in India: Perspectives, issues and strategies'*.New Royal book Company, 2021.
3. Sahni and Pardeep,' *Disaster Mitigation Experiences and Reflections'*. Prentice Hall of India, New Delhi, 2001.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the nature, types, and impacts of natural and man-made disasters, along with India's disaster-prone regions and their vulnerabilities.	**K2**
CO2	Apply disaster preparedness and risk assessment strategies using tools such as remote sensing, meteorological data, and community participation to propose suitable management practices.	**K3**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	2		1	1
CO2	3	1	2	2	2
	3	**2**	**2**	**2**	**2**

1-low, 2-medium, 3-high

SE25A04 CONSTITUTION OF INDIA

2 0 0 0

HISTORY AND PHILOSOPHY OF THE CONSTITUTION: History of the Indian Constitution – Drafting Committee: Composition and Working – Philosophy of the Constitution – Preamble – Salient Features. **(8)**

FUNDAMENTAL RIGHTS AND DUTIES: Fundamental Rights – Right to Equality – Right to Freedom – Right against Exploitation – Right to Freedom of Religion – Cultural and Educational Rights – Right to Constitutional Remedies – Directive Principles of State Policy – Fundamental Duties. **(7)**

STRUCTURE OF GOVERNANCE: Organs of Governance: Parliament – Composition, Qualifications and Disqualifications – Powers and Functions – Executive: President, Governor, Council of Ministers – Judiciary: Appointment and Transfer of Judges – Qualifications, Powers and Functions. **(8)**

LOCAL ADMINISTRATION AND ELECTORAL PROCESS: Local Administration: District Administration – Role of District Collector – Municipalities – Mayor and Elected Representatives – Municipal Commissioner – Panchayati Raj Institutions (PRI): Zila Panchayat, Block Level, Village Level – Roles of Elected and Appointed Officials – Importance of Grassroots Democracy – Election Commission: Role and Functions – Chief Election Commissioner and Election Commissioners – Institutions for the Welfare of SC/ST/OBC and Women. **(7)**

Total L: 30 periods

REFERENCES

1. '*The Constitution of India,1950(Bare Act)*'. Government Publication.
2. Dr.Busi S. N, Dr.Ambedkar B. R., '*Framing of Indian Constitution*'. First edition, 2015.
3. Jain M. P., '*Indian Constitution Law'*. Ninth edition, Lexis Nexis, 2025.
4. Basu D. D., '*Introduction to the Constitution of India'*, Twenty sixth edition, Lexis Nexis, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the historical evolution, philosophy, and salient features of the Indian Constitution, including its fundamental rights, duties, and directive principles.	**K2**
CO2	Evaluate the structure and functioning of governance, local administration, and electoral processes in India, and assess their role in ensuring democracy, justice, and social welfare at both national and grassroots levels.	**K2**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	2			1
CO2	2	1	2		1
	2	**2**	**2**		**1**

1-low, 2-medium, 3-high

SE25A05 BUILDING COMMUNICATION SKILLS

2 0 0 0

INTRODUCTION: This course is aimed at enhancing the students' ability to land internships through improved communication skills. This course will cover two crucial elements –

1. Communication skills enhancement and
2. Career skills orientation with broader career guidance

At the end of this course, the students will

- be able to confidently communicate in English with improved outcomes in internships, and other career pathways
- have an orientation to the necessary digital tools & resources that can enhance communication skills
- have an understanding of best practices in professional communication
- have increasing digital literacy and understand the important of digital communication both in personal and professional lives

MODULE 1 COMMUNICATION SKILLS: In this module, essential communication skills required for the workplace are covered in a multi-part lecture series. This includes skill sets in Writing, Speaking, Vocabulary & Grammar. **(18)**

MODULE 2 CAREER SKILLS: In this module, an overall career orientation approach is taken to introduce students to the essential skills required to plan and progress towards crucial career choices. Sessions on profile building, workplace communication, reasoning & critical thinking, social media, privacy, digital communication, workplace communication tools & etiquette are discussed. The module concludes with a session on career planning and milestone tracking. **(12)**

Total L: 30 periods

REFERENCES

1. Norman Lewis, '*Word Power Made Easy: The Complete Handbook for Building a Superior Vocabu*lary'. First anchor ebook edition, March 2014
2. William Strunk Jr. and White E. B., '*The Elements of Style'*. Fourth edition, Macmillan Publishing, 2000.
3. Idioms & Phrasal Verbs List (Various sources and provided in class)
4. Steven Pinker, '*The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century'*. Penguin Publishers, 2014.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate improved oral and written communication skills applicable in internships and workplace environments.	**K3**
CO2	Analyze and apply career development strategies including digital tools, professional etiquette, and personal branding.	**K4**

COs – POs & PSOs MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	3	2	1	1
CO2	2	2	2		2
	2	**3**	**2**	**1**	**2**

1-low, 2-medium, 3-high