Marathwada Shikshan Prasarak Mandal's

DEOGIRI INSTITUTE OF ENGINEERING AND MANAGEMENT STUDIES

(An Autonomous Institute)

Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere, Raigad |B.Tech | M. Tech

Affiliated to Dr. Babasaheb Ambedkar Marathwada University, CSN| MBA

Approved by AICTE/UGC- Govt. of India & DTE- Govt. of Maharashtra

Deogiri College Campus, Railway Station Road, Chhatrapati Sambhajinagar-431005 (MS)

DTE CODE : 2114 0240-2367567, 2367577 www.dietms.org director@dietms.org

Department of Computer Science and Engineering

MTech COMPUTER SCIENCE AND ENGINEERING

PROGRAM STRUCTURE (2025-27)

Course Category			I	II	III	IV	Total Credits
Program Courses	Program Core Course (PCC)	-	12	04	04		24
		MOOC		04			
	Program Elective Course (PEC)		06	06			12
Vocational and Skill Enhancement Courses (VSE)	Seminar		01				02
	PG Lab		01				
Humanities Social Science and Management (HSSM)	Indian Knowledge System (IKS)			02			02
Experiential Learning Courses (EL)	Research Methodology			03			34
	Mini Project			01			
	Project				10	20	
Open Elective Courses (OE)	Open Elective (OE)				03		03
Multi-Disciplinary Minor Courses (MDM)	Multi-Disciplinary Minor (MDM)				03		03
Liberal Learning Courses (LLC)	Co-Curricular Courses (CC)		-	-	-	AU	AU
Total Credits			**20**	**20**	**20**	**20**	**80**

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M Tech in Computer Science and Engineering		
Course Category	**Credits**	**% Credits**
Program Core Courses **(PCC)**	24	30
Program Elective Courses **(PEC)**	12	15
Vocational & Skill Enhancement **(VSE)**	02	2
Humanity, Social Science & Management (AEC, EM, IKS, VEC) **HSSM**	02	2
Experiential Learning **(EL)**	34	43
Open Electives **(OE)**	03	4
Multi-Disciplinary Minor (MDM)	03	4
Total Credits	**80**	

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SEMESTER I

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	
PCC	PC251001	Mobile Computing	4			4	10	10	20	60	100	4
PCC	PC251002	Advanced Operating System	4			4	10	10	20	60	100	4
PCC	PC251003	Advanced Algorithms	4			4	10	10	20	60	100	4
PEC	PC251101-102	Program Elective I	3			3	10	10	20	60	100	3
PEC	PC251103-104	Program Elective II	3			3	10	10	20	60	100	3
SC-SEC	PC251401	Seminar			2	2	15	15		20	50	1
SC-SEC	PC251402	PG Lab			2	2	15	15		20	50	1
Total			**18**		**4**	**22**					**600**	**20**

SEMESTER II

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	
PCC	PC252004	Advanced Database Management Systems	4			4	10	10	20	60	100	4
PCC	PC252005	MOOC/SWAYAM	4			4	10	10	20	60	100	4
PEC	PC252105-106	Program Elective III	3			3	10	10	20	60	100	3
PEC	PC252107-108	Program Elective IV	3			3	10	10	20	60	100	3
#HSSM-IKS	PG252501	Interdisciplinary Perspective on Indian Science and Technology	2			2	10	10	20	60#	100	2
ELC	PG252601	Research Methodology	3			3	10	10	20	60	100	3
ELC	PC252602	Mini Project			2	2	15	15		20	50	1
Total			**19**		**2**	**21**					**650**	**20**

SEMESTER III

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	
PCC	PC253006	Distributed Systems	4			4	10	10	20	60	100	4
OE	PC253301	Open Elective	3			3	10	10	20	60	100	3
MDM	PC253201	Multi- Disciplinary Minor	3			3	10	10	20	60	100	3
ELC	PC253603	Dissertation Part I			10	10	25	25		50	100	10
Total			**10**		**10**	**20**					**400**	**20**

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SEMESTER IV													
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	
ELC	PC254604	Dissertation Part II			20	20	50	50		100	200	20
CC	PC254701	Communication Skills and Technical Writing	2			2	25	25			AU	AU
Total			**2**		**20**	**22**					**200**	**20**

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OE and MDM courses

Note: OE and MDM Minor courses shall be offered through the SWAYAM/NPTEL online learning platform. The Board of Studies (BoS) shall identify, approve, and recommend the course based on its relevance to the program curriculum, academic quality, and prevailing industry standards.

Program Elective Courses (PEC)

Semester	Course Category	No. of Credits		Computer Science and Engineering	
SEM I	Program Elective I	3	**Course Code**	PC251101	PC251102
			Course	Artificial Neural Networks	Data Analytics
	Program Elective II	3	**Course Code**	PC251103	PC251104
			Course	Digital Image Processing and Forensics Science	Cluster, Grid and Cloud Computing
SEM II	Program Elective III	3	**Course Code**	PC252105	PC252106
			Course	Pattern Recognition	Cryptography and Network Security
	Program Elective IV	3	**Course Code**	PC252107	PC252108
			Course	Speech Modelling and Recognition	Generative AI

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Course Title: Mobile Computing **Course Code: PC251001**	**Course Category: PCC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs / week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: First Year (Semester I)	ESE	60 Marks

Course Prerequisite:
Fundamentals of Computer Networks (OSI Model, TCP/IP, routing basics), Basics of Digital Communication and Signal Processing (modulation, coding, error control), Knowledge of Probability, Statistics, and Queueing Models .

Course Description: The course equips students with knowledge of cellular communication (1G–3G), GSM/UMTS, WLANs, Bluetooth, ad hoc and sensor networks, along with protocols, energy efficiency,
mobility, security, and topology control – preparing them for advanced study or careers in wireless and mobile networking.

Course Objectives:

1. Introduce the fundamentals of cellular communication systems
2. Study GSM, UMTS, WLAN, Bluetooth, and wireless transmission technologies .
3. Understand the concepts of ad hoc and mobile ad hoc networks (MANETs).
4. Explore wireless sensor networks

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Understand Cellular and Wireless Fundamentals.	Understand L2
CO2	Analyze Mobile and Wireless Networking Protocols.	Analyze L4
CO3	Design and Evaluate Ad Hoc and Mobile Ad Hoc Networks.	Create L5
CO4	Apply Wireless Sensor Networks and Topology Control Concepts	Apply L3

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	2	–	–	–	–	1	–	2	3	2
CO2	2	3	2	2	3	–	–	–	–	2	–	2	3	2
CO3	2	3	3	2	3	–	–	–	–	2	1	2	3	3
CO4	2	3	3	3	3	–	–	–	–	2	1	3	3	3

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Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Fundamentals of Cellular Communications** Introduction to Cellular Systems, 1G and 2G Systems, Evolution from 1G to 3G, Teletraffic Engineering Basics, Radio Propagation & Path-Loss Models, Cellular Geometry & Interference, Frequency Management & Channel Assignment.	8 Hrs.
Unit 2	**GSM and Cellular Systems** Multiple Access Techniques (FDMA, TDMA, CDMA), GSM Logical Channels and Frame Structure, Privacy and Security in GSM, Mobility Management in Cellular Network, UMTS (Overview of 3G Cellular Systems).	8 Hrs.
Unit 3	**Wireless Transmission and WLANs** Fundamentals of Wireless Transmission, Spread Spectrum (SS) and CDMA Systems, Wireless Medium Access Control, IEEE 802.11 Architecture and Protocols (Wi-Fi), Bluetooth & High-Speed WLAN Technologies.	8 Hrs.
Unit 4	**Ad Hoc Wireless Networks** Issues in Ad Hoc Networks: Medium Access, Routing, Multicasting, Transport Layer Protocols and QoS Provisioning, Energy Management & Consumption Models, Traffic Integration across PAN, LAN, and Geographical Wireless Networks.	8 Hrs.
Unit 5	**Mobile Adhoc Networks (MANETs)** Introduction, Models of Operation, Applications, DSDV: Overview, Route Advertisement, Properties, DSR: Route Discovery, Maintenance, Multicast Routing, AODV: Unicast & Multicast Route Establishment, Broadcast Optimizations, Link Reversal Routing, TORA, Energy-Aware Routing (Associativity-Based, Beaconing).	8 Hrs.
Unit 6	**Wireless Sensor Networks and Topology Control** Sensor Networks Overview: Introduction, Applications, Design Issues, Sensor Node & Network Architecture, OS and Programming (intro), MAC & Routing Protocols (Data-Centric, Hierarchical, Location-Based), Deployment, Scheduling, Coverage Issues, Topology Control & Clustering (Graph Models, Dominating Sets Backbone Formation), Security, Privacy, Power Management.	8 Hrs.

Sr. No.	Textbooks
1.	Raj Kamal, Mobile Computing, Oxford University Press, 2nd Edition, 2015.
2.	Jochen Schiller, Mobile Communications, Pearson Education, 2nd Edition, 2012.
	Reference Books

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1.	William Stallings, Wireless Communications and Networks, Pearson, 2nd Edition, 2005.
2.	Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, Wiley, 2010.
3.	Theodore S. Rappaport, Wireless Communications: Principles and Practice, Pearson, 2nd Edition, 2010.
	Web Resources
1.	Principles of Modern CDMA/MIMO/OFDM Wireless Communications, NPTEL, https://nptel.ac.in/courses/117104115.
2.	5G Wireless Standard Design, NPTEL, https://nptel.ac.in/courses/117104484.
3.	Introduction to Wireless and Cellular Communication, NPTEL, https://onlinecourses.nptel.ac.in/noc21_ee66 .

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Course Title: Advanced Operating System **Course Code: PC251002**	**Course Category: PCC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs / week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: First Year (Semester I)	ESE	60 Marks
Course Prerequisite: Operating System		
Course Description: An advanced operating systems course explores in-depth concepts of OS design and implementation, focusing on modern challenges like distributed systems, virtualization, and cloud computing. Students learn to analyze seminal research papers, develop a strong understanding of state-of-the-art techniques, and gain practical experience through system design and evaluation, often culminating in a semester-long project.		
Course Objectives: 1. Define the fundamentals of Operating Systems. 2. Explain distributed operating system concepts that include architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols. 3. Illustrate distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols. 4. Identify the components and management aspects of Real time, Mobile operating Systems		

Course Outcomes:

COs	After completion of the course students should be able to	Bloom's Level
CO1	Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system	Remember L1
CO2	Learn the various resource management techniques for distributed systems	Understand L2
CO3	Identify the different features of real time and mobile operating system	Apply L3
CO4	Modify existing open source kernels in terms of functionality or features used	Analyze L4

CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	1	1	-	-	-	1	1	2	2
CO2	3	2	-	1	-	1	1	-	-	-	1	1	2	2
CO3	3	2	-	-	-	1	1	-	-	-	1	1	2	2
CO4	3	2	-	-	-	1	1	-	-	-	1	1	2	2

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Assessment	
CA-1 (a) (10M)	Assignment
CA-2 (b) (10M)	Assignment
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**OS Overview and System Structure** Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Computing environments.	6 Hrs.
Unit 2	**Process Management** Process concept; Process scheduling; Operations on processes. Multithreaded Programming: Overview; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms	6 Hrs.
Unit 3	**Process Coordination** Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; problems of synchronization; Monitors Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock	6 Hrs.
Unit 4	**Architectures of Distributed Systems** Architectures of Distributed Systems: System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.	6 Hrs.
Unit 5	**Introduction of Distributed Mutual Exclusion** Theoretical Foundations: Inherent Limitations of a Distributed System, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection. Distributed Mutual Exclusion: Introduction, The Classification of Mutual Exclusion Algorithms, Non-Token – Based Algorithms: Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm	6 Hrs.
Unit 6	**Distributed Mutual Exclusion** Token-Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal's Heuristic Algorithm, Raymond's Heuristic Algorithm	6 Hrs.

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Sr. No.	Textbooks
1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition,Wiley-India, 2010
2.	Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata McGraw- Hill Edition 2001
	Reference Books
1.	Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.
2.	Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall, Edition –2, 2007 E-Resources: 1. https://www.udacity.com/course/advanced-operating-systems--ud189
	Web Resources
1.	Fundamentals of operating system, NPTEL, https://nptel.ac.in/courses/106105214
2.	Advanced Topics in Operating Systems Stanford School of Engineering , https://online.stanford.edu/courses/cs240-advanced-topics-operating-systems

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Course Title: Advanced Algorithm **Course Code: PC251003**	**Course Category: PCC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs / week	CA-1	10 Marks
Tutorial: –	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: First Year (Semester I)	ESE	60 Marks

Course Prerequisite:

Strong understanding of DSA (sorting, searching, hashing, graphs, trees), Familiarity with Mathematics for Computer Science (DM, Probability, Linear algebra), Basic knowledge of Computational Complexity (Big-O notation, recursion), Exposure to Programming in C/C++/Java/Python for algorithm implementation

Course Description: This course introduces advanced techniques in the design and analysis of algorithms. Topics include asymptotic analysis, recurrence solving, amortized analysis, number-theoretic algorithms, string matching, advanced sorting, graph algorithms, and specialized data structures. It also covers matrix computations, Fast Fourier Transform (FFT), linear programming, and probabilistic algorithms. Emphasis is on applying these methods to efficiently solve complex computational problems.

Course Objectives:

1. Introduce advanced algorithm design and analysis techniques including recurrence solving, amortized analysis, and asymptotic growth of functions.
2. Develop competence in applying mathematical foundations such as number theory, linear algebra, and Fourier transforms to solve computational problems.
3. Expose students to advanced data structures and graph algorithms for efficient handling of complex networks, searching, and optimization tasks.
4. Familiarize students with modern algorithmic paradigms including linear programming, probabilistic and randomized algorithms, and their applications in real-world problem solving.
5. Encourage problem-solving and research orientation by applying advanced techniques to analyze, design, and implement efficient algorithms for computationally hard problems.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Understand asymptotic notations, recurrence solving techniques, and amortized analysis to evaluate the time complexity of algorithms.	Understand L2
CO2	Apply number-theoretic techniques such as Chinese Remainder Theorem, primality testing, and RSA cryptosystem, advanced string matching and sorting algorithms for solving problems.	Apply L3
CO3	Apply advanced graph algorithms, tree-based data structures, divide-and-conquer and Fourier transform techniques to solve the problems.	Apply L3
CO4	Demonstrate probabilistic, randomized, and linear programming methods to model and solve computationally hard problems	Analyze L4

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CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	2	-	-	-	2	-	-	1	1	2	2
CO2	3	2	2	2	-	-	-	2	-	-	1	1	2	2
CO3	-	3	2	2	-	-	-	2	-	-	1	1	2	2
CO4	3	2	-	2	-	-	-	2	-	-	1	1	2	2

Assessment	
CA-1 (a) (10M)	Subjective Test
CA-2 (b) (10M)	Problem Solving using Programming
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Fundamentals of Analysis Techniques and Recurrences and Solution of Recurrence equations** Growth of Functions: Asymptotic notations, Standard notations and common functions. The substitution method, The recurrence tree method, The master method, Amortized Analysis: Aggregate, Accounting and Potential Methods.	8 Hrs.
Unit 2	**Representation of integers and String-Matching Algorithms** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation, Powers of an element, RSA cryptosystem, Primality testing, Integer factorization. Naïve string Matching, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm, Boyer – Moore algorithms. Sorting: Review of various sorting algorithms, topological sorting	8 Hrs.
Unit 3	**Graph Algorithms** Johnson's Algorithm for sparse graphs, Maxflow-mincut theorem, Flow networks and Ford-Fulkerson method, Maximum bipartite matching. **Trees:** Red Black Trees, B Trees, Fibonacci Heaps, van Emde Boas Trees	8 Hrs.

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Unit 4	**Matrix Computations** Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	8 Hrs.
Unit 5	**Polynomials and the FFT and Discrete Fourier Transform (DFT)** Representation of polynomials; The DFT and FFT, Efficient implementation of FFT, Edmond's Blossom algorithm to compute augmenting path. In complex field, DFT in modulo ring, Fast Fourier Transform algorithm, Schönhage - Strassen Integer Multiplication algorithm.	8 Hrs.
Unit 6	**Linear Programming and Probabilistic and Randomized Algorithms** Formulation of Problems as Linear Programs, Duality, Simplex, Interior Point, and Ellipsoid Algorithm, proof of NP-hardness and NP-completeness. Probabilistic algorithms, Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms, Probabilistic numeric algorithms.	8 Hrs.

Sr. No.	Textbooks
1.	Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI, 2014.
2.	Aho, Hopcroft, Ullman "The Design and Analysis of Computer Algorithms".
	Reference Books
1.	Kenneth A. Berman. Algorithms. Cengage Learning. 2002
2.	Kleinberg and Tardos."Algorithm Design"
	Web Resources
1.	https://nptel.ac.in/courses/106/101/106101060/

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Course Title: Artificial Neural Networks Course **Code: PC251101**		**Course Category: PEC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: First Year (Semester I)	ESE	60 Marks

Course Prerequisite:

Linear algebra, probability, statistics, and calculus. Proficiency in Python programming with libraries such as NumPy and scikit-learn is required, Basic knowledge of machine learning concepts, optimization methods, and prior exposure to data science or related courses is recommended.

Course Description: This course explores Artificial Neural Networks (ANNs) from fundamentals to modern deep learning. It covers neuron models, learning principles, feedforward and multilayer networks, CNNs, RNNs, autoencoders, and RBF networks. Advanced topics include GANs, Transformers, and SOMs, with applications in vision, speech, and sequence modeling, emphasizing ethics and future trends.

Course Objectives:

1. Understand foundations of artificial and biological neural networks
2. Apply ANN models for classification, regression, and clustering tasks
3. Explore advanced architectures like CNNs, RNNs, GANs, and Transformers
4. Analyze applications, ethics, and emerging AI trends.

Course Outcomes

COs	**After completion of the course student should be able to**	**Bloom's Level**
CO1	After completion of the course, students should be able to define fundamental concepts of artificial and biological neurons, neural architectures, learning principles, and core models used in artificial neural networks.	Remember L1
CO2	After completion of the course, students should be able to explain the functioning of different ANN architectures such as feedforward, CNNs, RNNs, SOMs, and advanced models like GANs and Transformers, along with their learning mechanisms.	Understand L2
CO3	After completion of the course, students should be able to apply suitable neural network models and training algorithms to solve classification, regression, clustering, and sequence modeling tasks across diverse application domains.	Apply L3
CO4	After completion of the course, students should be able to evaluate the performance of neural network models using appropriate metrics like accuracy, efficiency, and scalability.	Analyze L4
CO5	After completion of the course, students should be able to analyze complex problems, select appropriate ANN architectures.	Analyze L4

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CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3	1	–	–	–	–	–	–	–	–	–	1	2	2
CO2	3	2	1	–	1	–	–	–	–	–	–	1	2	2
CO3	2	3	3	1	3	–	–	2	–	–	–	2	2	2
CO4	1	3	–	3	2	–	–	2	–	–	–	1	2	2
CO5	1	3	3	2	2	–	–	2	–	–	–	2	2	2

Assessment	
CA-1 (a) (10M)	Subjective Test / Open book test / etc
CA-2 (b) (10M)	Model Making / Assignment / Presentation / etc
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Foundations of Artificial Neural Networks** Introduction to ANN: History, motivation, applications, Biological vs. Artificial Neural Networks, Pattern analysis tasks: Classification, Regression, Clustering, Neuron models: Perceptron, Sigmoid, ReLU, Softmax, Architectures: Feedforward, Feedback, Hybrid, Learning principles: Supervised, Unsupervised, Reinforcement, Linear models for regression and classification	6 Hrs
Unit 2	**Statistical Learning and Shallow Models** Polynomial & Bayesian curve fitting, Linear basis function models, Bias–variance decomposition, Logistic regression, Bayesian logistic regression, Regularization (L1, L2, dropout intuition), Kernel methods & introduction to Support Vector Machines (SVMs)	6 Hrs
Unit 3	**Feedforward and Deep Networks** Perceptron and Multilayer Feedforward Neural Networks, Backpropagation algorithm and training challenges (vanishing/exploding gradients), Optimization methods: SGD, Momentum, Adam, RMSprop, Autoencoders: Basic, Denoising, Variational Autoencoders	6 Hrs
Unit 4	**4. Specialized Neural Network Architectures** Radial Basis Function (RBF) networks, Convolutional Neural Networks (CNNs): Architecture, feature maps, pooling, Applications of CNNs in image and signal processing, Recurrent Neural Networks (RNNs): Vanilla RNNs, Long Short-Term Memory (LSTM)	6 Hrs

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Unit 5	**5. Emerging Architectures and Generative Models** Self-organizing maps and topological mapping (Kohonen's SOM), Hopfield Networks, Boltzmann Machines, and Restricted Boltzmann Machines (RBMs), Generative Adversarial Networks (GANs): Architecture and applications, Transformers and Attention Mechanisms (BERT, GPT overview)	6 Hrs
Unit 6	**6. Applications, Ethics** Applications of ANN in computer vision, natural language processing, bioinformatics, and speech recognition, Explainable AI (XAI) and interpretability of neural networks, Ethical issues in AI: Bias, fairness, accountability	6 Hrs

Sr.No.	Textbooks
1.	B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 1999
2	Satish Kumar, Neural Networks – A Classroom Approach, Tata McGraw-Hill, 2003
	Reference Books
3	S.Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 1998
4	C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
	Web Resources
1	https://www.coursera.org/learn/introduction-to-neural-networks?utm_source=chatgpt.com
2	https://www.geeksforgeeks.org/deep-learning/deep-learning-tutorial/?utm_source=chatgpt.com

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Course Title: Data Analytics Course **Code: PC251102**		**Course Category: PEC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: First Year (Semester I)	ESE	60 Marks

Course Prerequisite:
Students should have prior knowledge of statistical probability, linear algebra, and basic programming in Python/R, Familiarity with databases and data visualization tools is recommended.

Course Description: This course provides a comprehensive introduction to Data Analytics, covering the process of extracting knowledge and insights from structured and unstructured data. Students will learn data preprocessing, exploratory data analysis, statistical methods, predictive modeling, and visualization techniques. The course integrates practical implementation using Python/R and emphasizes real-world applications in business, finance, healthcare, and engineering.

Course Objectives:
This course will enable students to:

1. Understand the data analytics lifecycle and its importance in decision making.
2. Perform data preprocessing, cleaning, and transformation.
3. Apply statistical and machine learning methods to analyze data.
4. Use visualization tools to communicate insights effectively.
5. Develop real-world problem-solving skills using analytics techniques.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Understand the fundamentals of data analytics and lifecycle of data-driven decision making	Remember L1
CO2	Perform data preprocessing, cleaning, handling missing values, and transformations	Understand L2
CO3	Apply statistical techniques and hypothesis testing for data analysis	Apply L3
CO4	Build predictive models using regression, classification, and clustering techniques	Analyze L4
CO5	Visualize and interpret results using modern visualization libraries and tools	Analyze L4

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CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	2	1	-	1	-	-	-	-	1	2	2
CO2	3	3	2	2	2	-	1	-	-	-	-	1	2	1
CO3	3	3	2	3	2	-	1	-	-	-	-	1	2	2
CO4	3	3	3	3	3	-	1	-	-	-	-	1	2	2
CO5	2	2	3	2	3	-	1	-	-	1	-	1	2	1

Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction** Definition, Importance, Data Analytics Lifecycle, Types of Data Analytics (Descriptive, Diagnostic, Predictive, Prescriptive), Applications across industries.	6 Hrs.
Unit 2	**Data Preprocessing and Cleaning** Data collection, Data integration, Data reduction, Handling missing values, Data transformation and normalization, Feature engineering.	6 Hrs.
Unit 3	**Exploratory Data Analysis** Descriptive statistics, Probability distributions, Hypothesis testing, Correlation and Covariance, Dimensionality reduction (PCA).	6 Hrs.
Unit 4	**Predictive Analytics and Machine Learning** Regression analysis, Classification methods (Decision Trees, Logistic Regression, Naïve Bayes, k-NN), Clustering (k-Means, Hierarchical), Model evaluation metrics.	6 Hrs.
Unit 5	**Data Visualization and Communication** Principles of data visualization, Dashboards, Storytelling with data, Tools: Matplotlib, Seaborn, Tableau/PowerBI, Case studies.	6 Hrs.
Unit 6	**Applications and Emerging Trends** Big Data Analytics, Cloud-based Analytics, Text and Sentiment Analysis, Ethical and Privacy Issues in Data Analytics, Industry use cases.	6 Hrs.

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Sr. No.	Textbooks
1.	Wes McKinney, "Python for Data Analysis", O'Reilly Media, 2nd Edition, 2017.
2.	Rajendra Akerkar, "Data Analytics", McGraw Hill, 2014.
	Reference Books
1.	Anil Maheshwari, "Data Analytics Made Accessible", 2nd Edition, Amazon Publishing, 2017.
2.	Foster Provost, Tom Fawcett, "Data Science for Business", O'Reilly Media, 2013.
3.	Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning", Springer, 2017.

	Web Resources
1.	https://userpilot.com/blog/resources-for-data-analyst/
2.	https://onlinecourses.nptel.ac.in/noc21_cs45/preview
3.	https://nptel.ac.in/courses/106107220

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Course Title: Digital Image Processing and Forensics Science Course Code: PC251103		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: First-year (Semester I)	ESE	60 Marks

Course Prerequisite:
Basic mathematics including linear algebra, probability, and calculus, along with fundamentals of digital signal processing, Familiarity with computer programming in Python or MATLAB and introductory computer science concepts is required, Exposure to basic image representation and data structures is recommended.

Course Description: This course introduces digital image processing fundamentals, including image representation, enhancement in spatial and frequency domains, and segmentation techniques. It also explores digital forensics concepts, methodologies, tools, and applications for secure data handling, hidden information detection, and forensic analysis in military, law enforcement, and business environments.

Course Objectives:
1. To understand the roles of image processing systems in a variety of applications.
2. To explore and implement programs to read/write and manipulate images: enhancement, segmentation, spatial filtering.
2. To develop Fourier transform for image processing in frequency domain.
3. To evaluate the methodologies for image segmentation

Course Outcomes:

COs	After completion of the course student should be able to	Bloom's Level
CO1	Utilize basic image fundamentals and perform mathematical transformations necessary for image processing	Remember L1
CO2	Describe image enhancement techniques in Spatial &frequency domain	Understand L2
CO3	Apply restoration models and compression models for image processing.	Apply L3
CO4	Synthesis image using segmentation and representation techniques	Analyz e L4

CO-POMapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	-	-	-	-	1	-	1	2	2
CO2	2	-	-	1	1	-	-	-	-	1	-	1	2	2
CO3	3	3	-	-	1	-	-	-	-	1	-	1	2	2
CO4	1		3		1					1		1	2	2

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Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Model Making / Assignment / Presentation / etc
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction** Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Examples of fields that uses digital image processing	6 Hrs
Unit 2	**Image Enhancement in the Spatial Domain** Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	6 Hrs
Unit 3	**Image Enhancement in Frequency Domain** Image Enhancement In Frequency Domain: Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT, Discrete Cosine Transform (DCT), Image filtering in frequency domain.	6 Hrs
Unit 4	**Image Segmentation** Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.	6 Hrs
Unit 5	**Image Compression** Fundamentals of Image compression: compression ratio, types of image compression, lossless image compression, lossy image compression, Data Redundancy, Huffman Coding, Run-length encoding, JPEG.	6 Hrs
Unit 6	**Introduction To Digital Forensics** Digital forensics fundamentals: Use of Computer Forensics - Benefits of Professional Forensics Methodology - Steps Taken by Computer Forensics Specialists - Case Studies - Types of Computer Forensics Technology: Military, Law Enforcement, Business - Specialized Forensics Techniques - Hidden Data and How to Find It - Protecting Data from Being Compromised - Internet Tracing Methods	6 Hrs

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Sr. No.	Textbooks
1.	Gonzalez.R.C& Woods. R.E., "Digital Image Processing", 3rd Edition, Pearson Education, Indian edition published by Dorling Kindersely India Pvt. Ltd. Copyright© 2009, Third impression 2011.
2.	John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2015, Second Edition, Charles River Media, Inc
	Reference Books
1.	Milan Sonka,"Image Processing, analysis and Machine Vision", Thomson Press India Ltd, Fourth Edition.
2.	Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.
3.	S. Sridhar , Digital Image Processing, Oxford University Press, 2nd Ed, 2016
	Web Resources
1.	Digital Image Processing, NPTEL, https://nptel.ac.in/courses/117105135
2.	Digital Image Processing (IIT Kharagpur), NPTEL / SWAYAM, https://onlinecourses.nptel.ac.in/noc22_ee116
3.	Remote Sensing and Digital Image Processing of Satellite Data, NPTEL, https://nptel.ac.in/courses/105107160

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Course Title: Cluster, Grid and Cloud Computing Course Code: PC251104		Course Category:PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: FirstYear (Semester I)	ESE	60 Marks

Course Prerequisite:

Basic knowledge of Computer Networks,Understanding of Operating Systems,Fundamentals of Distributed Systems,Familiarity with Programming in C/C++ or Java,Basic understanding of Parallel Computing concepts

Course Description: This course provides an in-depth study of advanced distributed computing paradigms including Cluster Computing, Grid Computing, and Cloud Computing. It covers the hardware and software architectures that underpin high-performance distributed systems, focusing on clustering techniques, message passing models, and grid infrastructures. The course also explores modern cloud computing concepts, platforms, service models, and the challenges associated with deploying and managing applications in the cloud environment.

Course Objectives:

1. Understand the fundamental principles and hardware technologies of cluster-based distributed computing.
2. Develop and analyze parallel applications using shared memory and message passing models such as OpenMP and MPI.
3. Evaluate and optimize the performance of cluster systems using various benchmarking tools.
4. Explain the concepts, architecture, and applications of Grid Computing, including virtual organizations and programming models.
5. Comprehend the characteristics, service models, and deployment scenarios of Cloud Computing.

Course Outcomes:

COs	After completion of the course student should be able to	Bloom's Level
CO1	Explain the concepts, hardware technologies, and software architectures of cluster computing, including shared memory (OpenMP) and message passing (MPI/PVM) models.	Understand L2
CO2	Apply and analyze advanced MPI features, performance evaluation tools (HINT, netperf, Iperf), and tuning methods for efficient cluster-based distributed computing.	Apply L3
CO3	Evaluate the architectures, programming models, and applications of grid computing, including virtual organizations, computational/data grids, and semantic grids.	Evaluate L5
CO4	Assess and compare cloud computing models (SaaS, PaaS, IaaS), platforms (AWS, Azure, Google App Engine), cloud storage systems (GFS, HDFS, Dynamo, HBase), and address challenges like QoS, dependability, and interoperability.	Evaluate L5

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CO-PO Mapping

CO-PO Mapping														
COs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	-	-	-				1	2	2
CO2	3	3	3	2	3	-	-	-				1	2	2
CO3	3	3	2	2	2	1	1	1				1	2	2
CO4	3	3	3	2	3	2	2	2				1	2	2

Assessment	
CA-1 (a) (10M)	Subjective Test / Open book test / etc
CA-2 (b) (10M)	Model Making / Assignment / Presentation / etc
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	Cluster Computing A general introduction to the concept of cluster based distributed computing. Hardware technologies for cluster computing, including a survey of the possible node hardware and high-speed networking hardware and software. Software and software architectures for cluster computing, including both shared memory (OpenMP) and message passing (MPI/PVM) models	6 Hrs
Unit 2	Software and software architectures for cluster computing, including both shared memory (OpenMP) and message passing (MPI/PVM) models	6 Hrs
Unit 3	MPI-2 extension, dynamic process creation, one-sided communication, parallel I/O. Variants based on new low level protocols (MVAPICH), evaluation and tuning of system and software performance. Performance evaluation tools, HINT, netperf, netpipe, ttcp, Iperf.	6 Hrs

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Unit 4	Grid Computing. The Grid - Past, Present, Future, A New Infrastructure for 21st Century Science – The Evolution of the Grid - Grids and Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques – Grid applications. The concept of virtual organizations – Grid architecture –Grid architecture and relationship to other Distributed Technologies – computational and dataGrids, semantic grids	6 Hrs
Unit 5	Cloud Computing Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS.	6 Hrs
Unit 6	Cloud computing platforms: Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing. Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Issues in cloud computing, Implementing real time application over cloud platform Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment.	6 Hrs

Sr. No.	Textbooks
1.	Rajkumar Buyya, High Performance Cluster Computing – Volume 1: Architectures and Systems; Volume 2: Programming and Applications, Pearson.
2	Rajkumar Buyya, High Performance Cluster Computing: Architectures and Systems, Pearson, 1st Edition.
3	Fran Berman, Geoffrey Fox, Anthony J. G. Hey – Grid Computing: Making the Global Infrastructure a Reality, Wiley..
	Reference Books
1.	Ian Foster, Carl Kesselman, The Grid 2: Blueprint for a New Computing Infrastructure, Morgan Kaufmann, New Delhi, 2004
2	Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra – Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann.
3	George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair – Distributed Systems: Concepts and Design, Pearson.
	Web Resources
1.	NPTEL – Parallel and Distributed Systems (Cluster Focus) https://nptel.ac.in/courses/106/104/106104184/
2	NPTEL – Cloud Computing (IIT KGP/IIT Madras). https://nptel.ac.in/courses/106/105/106105167/
3	ACM Digital Library – Cloud & Cluster Research. https://dl.acm.org

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Course Title: Seminar **Course Code: PC251401**		**Course Category: SC-SEC**
Teaching Scheme	**Examination Scheme (As Applicable)**	
Practical's/Sessions: 02 Hours/Week	CA-I	15 Marks
	CA-II	15 Marks
Semester: First Year (Semester-I)	ESE	20 Marks

Course Prerequisite:
Basic understanding of core subjects in specialization, Ability access, and interpret scientific literature, Exposure to technical report writing and presentation.

Course Description:
The M. Tech Seminar course is designed to enhance student ability to identify, analyze and present research-oriented or industry-relevant topics related to their field of specialization. It provides a platform to review recent literature, critically analyze methodologies, and effectively communicate technical concepts written and oral forms. The course emphasizes independent learning analytical thinking presentation and interaction with peers and faculty to prepare students for research and professional careers.

Course Objectives:

1. To enhance the ability to conduct a comprehensive literature review on a selected research/technical topic.
2. To develop skills in critical analysis, organization, and synthesis of technical information.
3. To improve proficiency in technical report writing and formatting.
4. To strengthen communication skills through oral presentation and discussion.
5. To build confidence in defending technical ideas and responding to queries effectively.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Identify and select a relevant research topic in Mechanical Engineering through a literature survey.	Apply L3
CO2	Analyze and summarize state-of-the-art developments in the chosen area.	Analyze L4
CO3	Prepare a well-structured seminar report following technical writing standards.	Evaluate L5
CO4	Deliver an effective oral presentation with clarity and professionalism.	Create L6
CO5	Demonstrate the ability to answer questions, engage in discussions, and defend ideas confidently.	Evaluate L5

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CO-PO Mapping

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	3	-	1	-	1	2	2	1	3	3	3
CO2	3	3	2	3	-	1	-	1	2	2	1	3	2	2
CO3	2	2	2	1	-	1	-	2	2	3	2	3	3	2
CO4	1	1	1	2	-	1	-	1	3	3	2	3	1	2
CO5	1	2	1	2	-	1	-	2	3	3	2	3	2	2

Assessment

Evaluation and Examination

The seminar will be evaluated out of a total of 50 marks, with 30 marks for internal assessment and 20 marks for the semester-end examination. The semester-end examination will be conducted by a committee of three faculty members. Students must submit their completed reports, which should be authenticated by both their guide and the Head of the Department. Each student will individually present their work to the committee, who will then evaluate them and award marks.

CA-I (a) (15M)	Review-I: 15 Marks (Concept/knowledge in the topic:10 marks, Literature: 05 marks)
CA-II (b) (15M)	Review-II: 15 Marks (Report writing & Presentation: 15 Marks)
ESE (Practical/viva voce(c))(20M)	20 Marks (Individual evaluation through viva voce/test:20 marks)
Total (d)	50 Marks

Course Content

The seminar requires each candidate to prepare a report on a topic that they and their supervisor have mutually agreed upon. This topic must be a current problem in the field of Computer Science and Engineering and should have a strong research orientation. The candidate is expected to demonstrate a thorough understanding of the recent developments related to their chosen topic. Once the report is complete, the candidate will present it to an examining committee, as well as to other faculty members from the department. The PG coordinator and the Head of the Computer Science and Engineering Department will form this committee to evaluate the seminar.

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Course Title: PG Lab		
Course Code: PC251402		**Course Category: SC-SEC**
Teaching Scheme	**Examination Scheme**	
Practical's /Sessions: 02 Hours/Week	CA-I	15 Marks
	CA-II	15 Marks
Semester: First Year (Semester I)	ESE	20 Marks
Course Prerequisite: Operating System		
Course Description: An advanced operating systems course explores in-depth concepts of OS design and implementation, focusing on modern challenges like distributed systems, virtualization, and cloud computing. Students learn to analyze seminal research papers, develop a strong understanding of state-of-the-art techniques, and gain practical experience through system design and evaluation, often culminating in a semester-long project.		
Course Objective: 1. Process Management and Multithreading 2. CPU Scheduling and Performance Analysis 3. Process Synchronization and Inter-Process Communication (IPC) 4. Memory Management 5. File System Management and I/O		

Course Outcomes:

COs	After completion of the course students should be able to	Bloom's Level
CO1	The ability to implement core operating system concepts like process scheduling, inter-process communication (IPC), and synchronization.	Apply L3
CO2	Design and analyze file systems and memory management schemes	Analyze L4

CO-PO Mapping:

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	1	1	2	2	2
CO2	3	3	3	3	3	-	-	-	-	1	1	2	2	2

Assessment	
CA-I (a) (15M)	Practical implementation of concept/ Laboratory Performance and Attendance Lab Records and Technical Report
CA-II (b) (15M)	Practical implementation of concept/ Experiment Conduction, Observation and Data Collection Marks Viva voce (during lab session)

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Sr. No.	List of Experiments/Activities	Hours
1.	Write a program to create a new process that exec a new program using system calls fork (), execlp () & wait ()	2 Hrs.
2.	Write a program to display PID and PPID using system calls getpid () & getppid ()	2 Hrs.
3.	Write a program using I/O system calls open (), read () & write () to copy contents of one file to another file	2 Hrs.
4.	Process Management Write a program to implement multithreaded program using pthreads	2 Hrs.
5.	Write program to simulate the following CPU scheduling algorithms a) FCFS b) SJF c) Priority d) Round Robin	2 Hrs.
6.	Process synchronization Write a program to simulate producer-consumer problem using Semaphores	2 Hrs.
7.	Deadlock Write a program to simulate Banker's algorithm for the purpose of deadlock avoidance	2 Hrs.
8.	Write a program to simulate deadlock detection.	2 Hrs.

Sr. No.	Textbooks
1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition,Wiley-India, 2010
2.	Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata McGraw- Hill Edition 2001

	Reference Books
1.	Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009
2.	Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall, Edition –2, 2007
	Web Resources
1.	Advanced Topics in Operating Systems Stanford School of Engineering https://online.stanford.edu/courses/cs240-advanced-topics-operating-systems

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Course Title: Advanced Database Management System **Course Code: PC252004**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs / week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: First Year (Semester I)	ESE	60 Marks

Course Prerequisite:
Basic knowledge of Database Management Systems (DBMS) – ER modeling, relational algebra, SQL, Understanding of Data Structures and Algorithms, Familiarity with Operating System concepts (transactions, concurrency), Basic exposure to Computer Networks (useful for distributed DBMS).

Course Description: This course explores advanced concepts in database design and management. It covers schema refinement, normalization, physical design and tuning, parallel and distributed databases, object-oriented databases, web and XML-based data management, mobile databases, and database security. Emphasis is on applying these techniques to design efficient, scalable, and secure database systems for modern applications.

Course Objectives:

1. Develop skills in schema refinement and normalization for effective relational database design.
2. Introduce physical design and tuning techniques to improve database performance.
3. Familiarize students with advanced database models such as parallel, distributed, and object-oriented databases.
4. Expose students to emerging technologies including XML, web-integrated, and mobile databases.
5. Ensure secure and reliable data management i.e. database security and administration practices

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Design relational schemas by applying schema refinement, functional dependencies, and normalization techniques.	Apply L3
CO2	Implement physical database design strategies such as indexing, clustering, and query optimization to enhance performance.	Analyze L4
CO3	Analyze parallel, distributed, and object-oriented database concepts to address scalability and data distribution challenges.	Analyze L4
CO4	Integrate advanced database technologies such as XML, web-enabled DBMS, mobile databases, and security mechanisms into modern applications.	Analyze L4

CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	-	-	-	-	-	1	2	3
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	1
CO3	-	3	2	2	-	-	-	-	-	-	-	1	2	2
CO4	3	2	2	2	-	-	-	-	-	-	-	1	2	1

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Assessment	
CA-1 (a) (10M)	Subjective Test
CA-2 (b) (10M)	Database Modelling/ Query Simulation and optimization / Assignment
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Database Design** Schema Refinement and Normal Forms: Introduction to schema refinement, functional dependencies, reasoning about FD's, Normal forms, properties of decompositions, Normalization, schema refinement in database designs, other kinds of dependencies. Physical Database Design and Tuning, guidelines for index selection, basic examples of index selection, clustering and indexing, indexes that enables index- only plan, tools to assist in index selection.	8 Hrs.
Unit 2	**Overview of database and Parallel Database** Database tuning, choices in tuning the conceptual schema, choices in tuning queries and views, Impact of concurrency. Parallel databases: introduction, architecture for parallel databases, parallel query evaluation, parallelizing individual operations, parallel query optimization.	8 Hrs.
Unit 3	**Distributed DBMS** Concepts and Design: Introduction, overview of networking, functions and architecture of a DBMS, distributed relational database design, transparencies in a DDBMS, Dates twelve rules for a DBMS. Distributed DBMS—Advanced Concepts: Distributed Transaction Management, Distributed Concurrency control, Distributed deadlock management, distributed database Recovery, the X/Open Distributed Transaction Processing Model, Distributed Query optimization, distribution in oracle.	8 Hrs.
Unit 4	**Object-Oriented DBMS** Concepts and Design: Next-generation databased systems, introduction to OODBMSs, Persistence in OODBMSs, Issues in OODBMSs, Advantages and disadvantages of OODBMSs, comparison of ORDBMS and OODBMS, object-oriented database design and object-oriented analysis and design with UML.Object-Oriented DBMS—Standards and Systems: Object Management Group, Object Data Standard ODMG 3.0,1999, Object Store.	8 Hrs.
Unit 5	**Web Technology and DBMS** Introduction to the internet and the Web, the web, scripting languages, common gateway interface, HTTP Cookies, Extending the web server, Java, Microsoft web platform and oracle internet platform. Semi structured Data and XML: Semi structure data, Introduction to XML, XML-Related technologies, XML schema, XML Query Languages, XML and databases and XML in oracle.	8 Hrs.
Unit 6	**Introduction to Mobile Databases** Mobile DBMS, Issues with mobile DBMS. Security and administration: Database security, Countermeasures- computer based controls, security in Microsoft office access DBMS, security in Oracle DBMS, DBMSs and Web security, Database Administration	8 Hrs.

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Sr. No.	Textbooks
1.	Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill, 3rd Edition, 2013.
2.	Thomas M. Connolly, Carolyn E. Begg, "Database Systems - A Practical Approach to Design,Implementation, and Management", Sixth Edition ,Pearson Education, 2015.
	Reference Books
1.	RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
2.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019
	Web Resources
1.	https://link.springer.com/book/10.1007/978-3-7091-2704-9

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Course Title: MOOC/SWAYAM **Course Code: PC252005**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: First Year (Semester II)	ESE	60 Marks
Course Description: This course is part of a curated set of MOOCs offered, with the specific courses selected and approved by the Board of Studies (BoS) to ensure alignment with current academic and industry standards.		

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Course Title: Pattern Recognition **Course Code: PC252105**	**Course Category: PEC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: ----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: First Year (Semester II)	ESE	60 Marks

Course Prerequisite:
Linear Algebra & Calculus, Probability & Statistics, Basic Machine Learning Concepts.

Course Description: This course introduces the fundamentals of Pattern Recognition, covering feature extraction, selection, and dimensionality reduction. It explores statistical and machine learning classifiers, clustering methods, and soft computing approaches such as SVMs and neuro-fuzzy systems. Emphasis is placed on both theoretical foundations and practical applications in AI and data analysis.

Course Objectives:

1. To Introduce the fundamental concepts, paradigms, and architecture of pattern recognition systems
2. To Develop an understanding of feature representation, feature selection, and dimensionality reduction techniques for effective pattern analysis
3. To Provide insights into clustering algorithms, similarity measures, and unsupervised learning methods for pattern discovery.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Understand the Fundamentals of Pattern Recognition.	Understand L2
CO2	Apply Feature Engineering and Dimensionality Reduction.	Apply L3
CO3	Implement Statistical and Machine Learning Classifiers.	Analyze L4
CO4	Explore Clustering and Advanced Recognition Methods	Evaluate L5

CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	2	–	–	–	–	1	–	2	3	2
CO2	2	3	2	2	3	–	–	–	–	2	–	2	3	3
CO3	2	3	3	2	3	–	–	–	–	2	1	2	3	3
CO4	2	3	3	3	3	–	–	–	–	2	1	3	3	3

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Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction to Pattern Recognition** Basic concepts and definitions, Data sets for Pattern Recognition, Structure of a typical pattern recognition system, Paradigms of Pattern Recognition (statistical, syntactic, neural, etc.), Representations of Patterns and Classes, Metric and non-metric proximity measures.	6 Hrs.
Unit 2	**Features and Feature Selection** Feature vectors and feature spaces, Properties of good features, Different approaches to Feature Selection, Branch and Bound Schemes, Sequential Feature Selection.	6 Hrs.
Unit 3	**Dimensionality Reduction** Curse of dimensionality, Principal Component Analysis (PCA), Limitations of PCA, Kernel PCA and non-linear dimensionality reduction methods.	6 Hrs.
Unit 4	**Statistical Pattern Classification** Bayes classifier – decision boundaries, Risk and error probabilities, Measures of classification performance, Linear Discriminant Function (LDF), Mahalanobis Distance, Fisher's Linear Discriminant Analysis (LDA).	6 Hrs.
Unit 5	**Machine Learning Classifiers** K-Nearest Neighbor (K-NN) Classifier, Single Layer Perceptron, Multi-layer Perceptron (MLP) and backpropagation, Training set, test set concepts, Standardization and normalization techniques.	6 Hrs.
Unit 6	**Clustering and Advanced Techniques** Basics of clustering: similarity/dissimilarity measures, clustering criteria, Distance functions and similarity measures, K-means, K-medoids, DBSCAN, Fuzzy C-Means (FCM), Support Vector Machines (SVMs), Structural Pattern Recognition, Soft-computing and Neuro-fuzzy techniques, Real-life applications of Pattern Recognition.	6 Hrs.

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Sr. No.	Textbooks
1.	Devi V.S. Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press,Hyderabad.
2.	R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.

	Reference Books
1.	Statistical pattern Recognition; K. Fukunaga; Academic Press, 2000
2.	S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3.	Rajjan Shinghal, Pattern Recognition: Techniques and Applications, Oxford University Press, 2015.
	Web Resources
1.	PatternRecognitionandApplication,NPTEL,https://onlinecourses.nptel.ac.in/noc19_ee56/ preview
2.	Pattern Recognition, NPTEL, https://nptel.ac.in/courses/117108048
3.	Principles of Pattern Recognition I, NPTEL, https://nptel.ac.in/courses/106106046

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Course Title: Cryptography and Network Security Course Code: PC252106		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Third Year (Semester V)	ESE	60 Marks

Course Prerequisite:

Basic knowledge of Computer Networks and Operating System, Fundamentals of Mathematics including discrete mathematics and algebra, Introduction to Programming Concepts

Course Description:

This course provides a comprehensive introduction to information security and cryptography principles. It covers foundational security concepts, common threats and vulnerabilities, and essential cryptographic techniques. The course explores both classical and modern cryptographic algorithms, including symmetric and asymmetric encryption methods. Key topics include security models, authentication protocols, digital signatures, network security practices, and system security mechanisms such as firewalls and intrusion detection systems. Emerging areas such as cloud security, blockchain technology, and quantum cryptography are also introduced. Through theoretical learning and practical application, students gain the skills needed to design and analyze secure computing systems.

Course Objectives:

1. Understand fundamental security concepts, security models, and the nature of threats and attacks in computing environments.
2. Apply classical and modern cryptographic techniques including symmetric and asymmetric encryption algorithms.
3. Analyze the mathematical foundations critical to cryptographic algorithms and their applications in secure communications.
4. Evaluate cryptographic hash functions, digital signatures, and authentication mechanisms in network security.
5. Demonstrate knowledge of network security protocols and practices including SSL/TLS, IPSec, VPNs, and wireless security standards.

Course Outcomes:

COs	After completion of the course student should be able to	Bloom's Level
CO1	Explain fundamental concepts of security, threats, vulnerabilities, attacks, and security models/policies, along with cryptographic principles.	Understand L2
CO2	Apply classical and modern cryptographic techniques, symmetric/asymmetric algorithms, and hashing methods for ensuring confidentiality, integrity, and authentication.	Apply L3
CO3	Analyze and evaluate network security mechanisms such as authentication protocols, SSL/TLS, IPSec, VPNs, wireless security, and intrusion detection/prevention systems.	Analyze L4
CO4	Assess and compare system security challenges including malware, DoS/DDoS, cloud, IoT, blockchain, and emerging technologies like quantum cryptography for secure computing environments.	Evaluate L5

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CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	1	-	-	2	-	-	-	1	2	2
CO2	3	3	2	-	2	-	-	-	-	-	-	1	2	2
CO3	3	3	3	2	3	1	-	2	-	-	-	1	3	3
CO4	3	3	2	3	3	2	2	2	-	-	-	1	2	2

Assessment	
CA-1 (a) (10M)	Subjective Test
CA-2 (b) (10M)	Subjective Test / Presentation
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction to Security** Security concepts: Threats, vulnerabilities, attacks, services, mechanisms. Security models and policies. OSI security architecture. Types of security attacks: Active vs. Passive. Introduction to cryptography and steganography.	6 Hrs
Unit 2	**Classical and Modern Cryptography** Classical substitution & transposition techniques. Stream ciphers and block ciphers. Symmetric encryption algorithms: Data Encryption Standard (DES), Advanced Encryption Standard (AES), IDEA, RC5, Blowfish, Modes of operation (ECB, CBC, CFB, OFB, CTR). Cryptanalysis basics.	6 Hrs
Unit 3	**Number theory & algebra for cryptography** Modular arithmetic, GCD, Euler's theorem, Fermat's theorem, Chinese remainder theorem. Public key cryptosystems: RSA algorithm, ElGamal encryption, Diffie-Hellman key exchange, Elliptic Curve Cryptography (ECC). Applications of public key cryptography.	6 Hrs
Unit 4	**Hashing & Digital Signatures** Cryptographic hash functions: MD5, SHA family. Message authentication codes (MAC). Digital signatures and authentication protocols. Public Key Infrastructure (PKI), X.509 certificates.	6 Hrs
Unit 5	**Network Security Practices** Authentication methods (passwords, biometrics, challenge-response). Kerberos authentication system. Transport-level security: Secure Socket Layer (SSL), Transport Layer Security (TLS). Network layer security: IPSec, VPNs. Wireless network security (WPA, WPA2, 802.11i).	6 Hrs

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Unit 6	**System Security & Advancement** Firewalls and intrusion detection/prevention systems (IDS/IPS). Malware: Viruses, worms, Trojans, ransomware. Denial of Service (DoS, DDoS) attacks. Security in cloud computing and IoT environments, Blockchain and cryptocurrency basics, Quantum cryptography (introduction).	6 Hrs

Sr. No.	Textbooks
1	William Stallings – Cryptography and Network Security: Principles and Practice, Pearson, 8th Edition
2	Behrouz A. Forouzan – Cryptography and Network Security, McGraw Hill, 3rd Edition.
3	Atul Kahate – Cryptography and Network Security, McGraw Hill, 3rd Edition.
	Reference Books
1.	William Stallings – Cryptography and Network Security: Principles and Practice, Pearson, 8th Edition
2	Behrouz A. Forouzan – Cryptography and Network Security, McGraw Hill, 3rd Edition.
3	Atul Kahate – Cryptography and Network Security, McGraw Hill, 3rd Edition.
4	Bruce Schneier – Applied Cryptography: Protocols, Algorithms, and Source Code in C, Wiley.
	Web Resources
1.	NIST Cybersecurity Framework – https://www.nist.gov/cyberframework
2	OWASP (Open Web Application Security Project) – https://owasp.org
3	IBM Security Learning Hub – https://www.ibm.com/security/learn
4	Practical Cryptography (Blog & Tutorials) – http://practicalcryptography.com

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Course Title: Natural Language Processing **Course Code: PC252107**	**Course Category: PEC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: --	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:
Understanding of fundamental machine learning concepts such as supervised/unsupervised learning, classification, and regression, Basic knowledge of programming, Basic knowledge of language structuring

Course Description: This module introduces students to the foundational concepts of NLP, emphasizing text preprocessing tasks such as tokenization, stemming, and lemmatization. Students will also explore different text representation techniques like BoW, TF-IDF, and N-grams. By the end, students should be able to explain the challenges and opportunities in NLP and how various preprocessing steps shape text data.

Course Objectives:

1. To provide foundational knowledge of NLP
2. To develop practical skills in sequence modelling and advanced NLP techniques
3. To enable critical evaluation and responsible use of NLP systems.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	After completion of the course, students should be able to explain core NLP concepts such as tokenization, stemming, lemmatization, and text representation techniques.	Understand L2
CO2	After completion of the course, students should be able to apply syntactic analysis techniques like POS tagging, dependency parsing, and use word embeddings for text analysis.	Apply L3
CO3	After completion of the course, students should be able to analyze semantic models for tasks like named entity recognition (NER) and sentiment analysis using deep learning approaches.	Analyze L4
CO4	After completion of the course, students should be able to evaluate NLP models using performance metrics like Precision, Recall, BLEU, and ROUGE in real-world applications.	Evaluate L5

CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1	1	1	1	-	-	-	-	-	1	2	2
CO2	2	3	1	1	1	1	-	-	-	-	-	1	2	2
CO3	3	3	1	1	1	1	-	-	-	-	-	1	2	2
CO4	1	-	3	1	1	1	-	-	-	-	-	1	2	2

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Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Introduction to NLP** Overview of NLP, Challenges in NLP, Language and Linguistics Basics, Text Preprocessing: Tokenization, Text Normalization, Stemming and Lemmatization, Porter Stemmer, Snowball Stemmer, Text Representation: BoW, TF-IDF, N-grams	6 Hrs.
Unit 2	**Syntax and Parsing** Syntactic Analysis: Context-Free Grammars (CFGs), Parse Trees, Dependency Parsing, Part-of-Speech Tagging (POS) HMM, CRF, Word Embeddings, Vector Space Models, Word2Vec,Skip-gram, GloVe, Evaluation of Word Embeddings	6 Hrs.
Unit 3	**Semantic Analysis** Word Sense Disambiguation (WSD): Supervised and Unsupervised methods, Named Entity Recognition (NER), CRFs and BiLSTMs for NER, Sentiment Analysis, Opinion Mining, RNN, LSTM, GRU for semantic analysis	6 Hrs.
Unit 4	**Sequence Modelling and Language Models** Markov Models, Seq2Seq, Machine Translation, Text Summarization, Pretrained Language Models: BERT, GPT, T5, RoBERTa, and DistilBERT, Transfer Learning	6 Hrs.
Unit 5	**Evaluation Metrics and Applications** Precision, Recall, F1 Score, BLEU score for Machine Translation, ROUGE score for Summarization, Applications of NLP: Text Classification, Machine Translation, Speech Recognition, Information Retrieval and Search Engines	6 Hrs.
Unit 6	**Ethical Considerations in NLP** Bias in Language Models: Gender, racial, and socio-cultural biases in NLP models, Data Privacy Concerns: Ethical implications, Fairness in AI Systems	6 Hrs.

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Sr. No.	Textbooks
1.	Jurafsky, Daniel and Martin, James H., Speech and Language Processing, Pearson, 2021.
2.	Bird, Steven, Klein, Ewan, and Loper, Edward, Natural Language Processing with Python, O'Reilly Media, 2009.
3.	Goldberg, Yoav, Neural Network Methods for Natural Language Processing, Morgan & Claypool, 2017.
4.	Eisenstein, Jacob, Introduction to Natural Language Processing, MIT Press, 2019.
	Reference Books
1.	Manning, Christopher D. and Schütze, Hinrich, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
2.	Cambria, Erik and White, Bebo, Jumping NLP Curves: A Review of Natural Language Processing Research, IEEE Computational Intelligence Magazine, 2014.
3.	Aggarwal, Charu C., Machine Learning for Text, Springer, 2018.
4.	Vaswani, Ashish et al., Attention Is All You Need, NeurIPS, 2017.
	Web Resources
1.	Natural Language Processing, NPTEL, https://nptel.ac.in/courses/106/106/106106211
2.	Natural Language Processing Specialization, Coursera (Deeplearning.ai), https://www.coursera.org/specializations/natural-language-processing
3.	Deep Learning for Natural Language Processing, Stanford CS224N, http://web.stanford.edu/class/cs224n/

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Course Title: Explainable AI Ethics **Course Code: PC252108**	**Course Category: PEC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs / week	CA-1	10 Marks
Tutorial: ---	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: First Year (Semester II)	ESE	60 Marks
Course Prerequisite: Machine Learning **,** Python Programming		
Course Description: This course explores the principles, methods, and ethical considerations of Explainable Artificial Intelligence (XAI). With the growing deployment of AI systems in critical domains such as healthcare, finance, governance, and security, it is essential to design models that are not only accurate but also transparent, interpretable, and aligned with ethical values.		
Course Objectives: 1. To understand how to explain machine learning models with various techniques. 2. To explain various factors affecting the efficiency of machine learning models. 3. To apply the explain ability while applying ML models in practical applications.		

Course Outcomes:		
COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Understand the concept and importance of explainability in AI models	Understand L2
CO2	Apply visual explanations techniques such as PDP, ICE, Surrogate Models, and Feature Importance	Apply L3
CO3	Explain structured data, images, and unstructured data using Deep Explainers and LLMs	Analyze L4
CO4	Evaluate the application of explainability techniques in model development processes	Evaluate L5
CO5	Critically assess the ethical implications of AI systems and apply responsible AI principles.	Understand L2

CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	1	-	-	-	-	-	-	-	2	1	1
CO2	2	3	2	2	3	-	-	-	-	-	-	2	1	1
CO3	2	3	2	3	3	-	-	-	-	-	-	2	1	1
CO4	2	3	2	-	-	-	-	-	-	-	-	3	1	1
CO5	-	-	-	-	-	3	2	2	-	-	-	3	1	1

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Assessment	
CA-1 (a) (10M)	Assignment
CA-2 (b) (10M)	Assignment
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Explainability** What and Why, When not to use explain ability; Types of explainability and Taxonomy, Explain ability in the model development process.	6 Hrs.
Unit 2	**Visual Explanations** Transparent models and RuleFit, Partial Dependency Plots, Partial Dependency plot (PDP) Transparent models and RuleFit, Partial Dependency Plots, Partial Dependency plot (PDP)	6 Hrs.
Unit 3	**Global Visual Explanations** Individual conditional expectations (ICE), Applications of these plots, Global Explanations – Surrogate Models, Feature Importance	6 Hrs.
Unit 4	**Local Explanations** LIME, Shapley values, Explaining Structured	6 Hrs.
Unit 5	**Explainability for Diverse Data Types** Data Explaining Images and Unstructured Data and Text Deep Explainers, Time Series Explainers, LLM, Foundation Models.	6 Hrs.
Unit 6	**Ethics and Responsible AI** Ethical principles: fairness, accountability, transparency, privacy, and bias, Explainability in regulated industries (healthcare, finance, governance), Human-centric design of AI systems, Global guidelines and governance frameworks for Responsible AI, Future directions of Explainable AI and Ethical AI adoption	6 Hrs.

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Sr. No.	Textbooks
1.	Denis Rothman "Hands-On Explainable AI (XAI with Python", Packt Publishing, 2020
2.	Explainable AI for Practitioners by Michael Munn, David Pitman, O'Reilly Media 2022, ISBN: 9781098119133
3	Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Lecture Notes in Artificial Intelligence, Springer Nature, 2019

	Reference Books
1.	Christoph Molnar "Interpretable Machine Learning" A comprehensive guide to interpretable machine learning methods, including LIME, SHAP, and partial dependence plots.
2.	Uday Kamath, John Liu "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning
3	Mark Coeckelbergh "AI Ethics (The MIT Press Essential Knowledge series)" A philosophical examination of the ethical implications of AI, addressing concrete questions beyond common scenarios.
	Web Resources
1.	https://www.ibm.com/think/topics/explainable-ai?utm_source=chatgpt.com
2.	Towards Explainable AI https://www.youtube.com/watch?v=2nUiVJiVchw

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Course Title: Interdisciplinary Perspective on Indian Science and Technology Course Code: PG252501		Course Category: HSSM-IKS
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: Semester II	ESE	60 Marks
Course Prerequisite: None		

Course Description:

The course Interdisciplinary Perspective on Indian Science and Technology introduces students to India's rich contributions in mathematics, astronomy, architecture, metallurgy, textiles, and agriculture. It emphasizes the scientific principles embedded in traditional practices, tracing their historical development and global impact. Students will explore how ancient Indian innovations such as the number system, astronomical instruments, town planning, metallurgy, and sustainable farming shaped modern science and engineering. The course bridges theoretical understanding with practical relevance, enabling appreciation of indigenous knowledge systems and their applications in contemporary contexts.

Course Objectives:

1. To understand the foundational concepts and necessity of the Indian Knowledge System.
2. To identify key historical contributions of Indian scholars in mathematics, astronomy, architecture, metallurgy, textiles, and agriculture.
3. To interpret the scientific principles and techniques underlying traditional Indian practices.
4. To analyze the relevance of IKS in modern scientific and technological contexts.
5. To appreciate the global influence and sustainability of Indian innovations throughout history.

Course Outcomes:

COs	After completion of the course, students should be able to	Bloom's Level
CO1	Recall key concepts, terminologies, historical developments, and contributions in Indian Mathematics, Astronomy, Architecture, Metallurgy, Textiles, and Agriculture.	L1 Remember
CO2	Explain the principles, methods, and scientific basis of Indian Knowledge Systems in various domains such as mathematics, astronomy, architecture, metallurgy, textiles, and agriculture.	L2 Understand
CO3	Use traditional Indian scientific and technological methods to address contemporary or theoretical problems in relevant fields.	L3 Apply
CO4	Examine the relevance, strengths, and limitations of Indian Knowledge Systems in addressing contemporary scientific, environmental, technological, and societal challenges.	L4 Analyze

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CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	-	-	-	-	-	-	-	-	1	2	2
CO2	1	1	-	-	-	-	-	-	-	-	-	1	2	2
CO3	1	1	-	-	-	1	-	-	-	-	-	1	2	2
CO4	1	1	-	-	-	1	-	-	-	-	-	1	2	2

Assessment	
CA-1 (a) (10M)	Subjective Test / Open-book test / etc.
CA-2 (b) (10M)	Model Making / Assignment / Presentation / etc.
MSE (c) (20M)	Mid Sem Examination

Course Contents		
Unit 1	**Indian Mathematics** Necessity of Indian Knowledge System, Defining Indian Knowledge System, Contributions of Indian Mathematicians, Historical Evidence and features of Indian Numerical Number System, The Idea of Zero and Infinity, Decimal System, Representation of Large Numbers, Global Spread and Adoption of Indian Numericals, Arithmetic (Square of a Number, Square Root, Series and Propagation), Geometry (Simple Constructions from Sulba-Sutras,e.g, Right Angle Triangle, The Value of Pi), Trigonometry and Algebra in IKS, Modern Indian Contributions to Mathematics	4 Hrs
Unit 2	**Indian Astronomy** Historical Development of Indian Astronomy, Astronomy for Timekeeping, Solar and Lunar Motions, The Celestial Coordinate System, Various Regional Indian Calendar Systems, Planetary Model of Aryabhata and Nilakantha, Astronomical Instruments, Various Royal Endeavors for Astronomy (e.g., Jaisingh's Jantar Mantar), Modern Indian Contributions to Astronomy	4 Hrs

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Unit 3	**Indian Architecture and Town Planning** Sthapatya-Veda and Vastu-Shastra, Historical Features of Indian Town Planning, Water Management and Drainage Systems, Town Town Planning of Harappan Cities, Temple Architecture, Features and Examples of Cave, Rock Cut, Nagara, Dravida, Kalinga, Vesara, Deccan, Rajput, Mughal, Indo-Saracenic Architecture Styles, Modern Indian Contributions to Architecture and Town Planning	4 Hrs
Unit 4	**Indian Metallurgy** Ancient Mining and Ore Extraction Technologies, Mining and Manufacture of Zinc, Copper and its Alloys, Silver, Gold, Mercury and Lead, Iron Extraction from Biotite, Steel Manufacturing, Global Influence of Wootz Steel, Wax Casting, Modern Indian Contributions to Metallurgy	4 Hrs
Unit 5	**Indian Textile** Textile Traditions in Ancient India, The Variety and Diversity of Indian Textiles, Types of Fabrics and Materials, Cotton and Silk, Weaving Techniques and Looms, Dyeing Process and Natural Colors, Major Textile Centers, Significance of Indian Textile in Historical Global Trade, Fall of Indian Textile in Colonial Era, Modern Indian Contributions to Textile	4 Hrs
Unit 6	**Indian Agriculture** Importance of Agriculture in Ancient India, Traditional Crops (Grains, Fruits, Vegetables Spices), Significance of Indian Agricultural Products in Historical Global Trade, Significance of Agriculture and Irrigation for the Indian Kings, The Ery System of South India, Traditional Farming Techniques (Land Preparation, Sowing Techniques, Weeding and Pest Management, Harvesting and Storage), Irrigation Techniques and Rainwater Harvesting, Modern Indian Contributions to Agriculture	4 Hrs

Sr.No.	Textbooks
1.	D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
2.	B. Mahadevan, Nagendra Pavana, Vinayak Rajat Bhat, Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning, 2022
3.	Kapil Kapoor, Awadhesh Kumar Singh, Indian Knowledge Systems, D.K. Print World Ltd; First Edition (15 October 2005)
4.	Bhag Chand Chauhan, IKS: The Knowledge system of Bharata, Garuda Prakashan (13 March 2023)
5.	Science in India: A Historical Perspective by B V Subbarayappa, Rupa & Co (2013)

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	Reference Books
1.	G. G. Joseph, Indian Mathematics Engaging the World from Ancient to Modern Times, World Scientific, London, 2016
2.	History of Astronomy: A Handbook, Edited by K. Ramasubramanian, Aniket Sule, andbMayank Vahia, SandHI, IIT Bombay, and T.I.F.R. Mumbai, 2016.
3.	History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramkrishna Mission Institute of Culture, Kolkata (2014).
4.	Christopher Tadgell, History of Architecture in India, Architecture Design and Technology Press (1990)
5.	Bindia Thapar, Introduction to Indian Architecture, Periplus Asian Architecture Series
	Web Resources
1.	Indian Knowledge System Division, Ministry of Education, Government of India, https://iksindia.org/lectures-and-videos.php

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Course Title: Research Methodology **Course Code: PG252601**		**Course Category: ELC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: First Year (Semester II)	ESE	60 Marks

Course Prerequisite: Basic knowledge of engineering fundamentals, Familiarity with undergraduate-level mathematics and statistics, Ability to use computers and standard engineering software tools

Course Description:

This course introduces postgraduate engineering students to the principles, processes, and practices of research methodology. It emphasizes problem identification, literature review, research design, data collection, analysis, and interpretation. The course also covers ethical practices, mathematical modeling, computational tools, and scientific communication through thesis, research papers, and presentations. It aims to equip students with essential skills to undertake independent research projects and contribute effectively to the advancement of science and technology.

Course Objectives:

1. To provide a clear understanding of the fundamentals and process of research in engineering.
2. To develop the ability to identify research problems through literature review and formulate hypotheses.
3. To impart knowledge of research ethics, integrity, and professional responsibility.
4. To familiarize students with research design, data collection, analysis, and interpretation techniques.
5. To introduce mathematical modelling and computational tools relevant to engineering research.
6. To develop effective academic writing and presentation skills for disseminating research outcomes.

Course Outcomes:

Cos	After completion of the course student should be able to	Bloom's Level
CO1	Recall the meaning, objectives, and types of research, along with problem identification and hypothesis formulation.	L1 Remember
CO2	Demonstrate understanding of ethical issues, research integrity, plagiarism, and intellectual property rights.	L2 Understand
CO3	Design appropriate research methodologies, select data collection methods, and apply suitable statistical techniques for analysis.	L3 Apply
CO4	Develop and validate mathematical and computational models for engineering applications using appropriate tools/software.	L4 Evaluate
CO5	Write and present research outputs in the form of proposals, reports, papers, and presentations adhering to academic standards.	L5 Create

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CO PO Mapping														
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	1			1	1		2	2	2
CO2	2	2	2	2	2	3			3	2		2	2	2
CO3	3	3	3	3	3	2				2		2	2	2
CO4	3	3	3	1	3	1			2	2		2	2	2
CO5	2	2	2	2	2	2			3	2		2	2	2

Assessment	
CA-1 (a)(10M)	Subjective Test / Open book test / Assignment.
CA-2 (b)(10M)	Assignment / Presentation/ Case Study
MSE (c)(20M)	Mid Sem Examination

Course Contents		
Unit 1	**Introduction to Research:** meaning, objectives, motivation, types, Research process, Criteria of good research, Importance of literature review in defining a problem, Literature review: primary and secondary sources, Critical literature review, Identifying gap areas from literature and research database, Research problem: selection, necessity and formulation, Technique Involved in Defining a Problem, Hypothesis formation, Problems Encountered by Researchers	6 Hrs
Unit 2	**Research Ethics:** Ethical considerations in research, Plagiarism, Intellectual Property, Research Integrity, and misconduct, Ethical issues in data collection, experimentation, and analysis, Ethical considerations in publication and peer review, Case studies of ethical dilemmas in engineering research, Conflict of interest, Ethics in Emerging Technologies like AI	6Hrs
Unit 3	**Research Design, Experimentation, Analysis And Data Analysis and Interpretation:** Experimental and non-experimental research designs, Sampling techniques, and sample size determination, Data collection methods: Surveys, interviews, and observation, Instrumentation and measurement techniques, Reliability and validity in research, Design of experiments and analysis of results, Data processing and cleaning, Statistical analysis: Descriptive and inferential statistics, Advanced data analysis techniques: Regression, ANOVA, and multivariate analysis, Interpretation of results. Reporting and presenting data	6 Hrs
Unit 4	**Mathematical Modeling in Engineering Research, Use of Computer Technology and Software:** Introduction to mathematical modeling, Types of models: Deterministic and probabilistic, Model development and validation, Applications of mathematical Modeling, Introduction to computational tool, Data analysis software: Usage and applications	6 Hrs

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Unit 5	**Writing and Presenting Research: Writing a thesis and project report:** Structure and content, Writing progress reports and project updates, Structuring a research paper, Writing research proposals and grants, Writing for journals and conferences, Incorporating references and citations: APA, MLA, IEEE styles, Managing references with citation management software (e.g., End Note, Zotero), Preparing and delivering oral presentations, Creating effective visual aids (charts, graphs, tables), Poster presentations: Design and delivery, The publication process and peer review, Communicating research to non-specialists and stakeholders	6Hrs
Unit 6	**Case Studies and Applications:** Case studies of successful engineering research, Application of research methodologies to real-life projects, Problem-solving through interdisciplinary approaches, Integration of ethical, technical, and methodological aspects, Emerging trends in engineering research.	6 Hrs

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Text/Reference Books	
Text Books	
1	C. R. Kothari, Research Methodology, New Age Publishers.
2	Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners
3	Herman Tang, Engineering Research: Design, Methods, and Analysis
4	Douglas C. Montgomery, Design and Analysis of Experiments
5	C. Neal Stewart Jr., Research Ethics for Scientists: A Companion for Students
Reference Books	
1	Cooper, D.R. & Schindler, P.S. – Business Research Methods, McGraw Hill.
2	Montgomery, D.C. – Design and Analysis of Experiments, Wiley.
3	Krishnaswamy, K.N., Sivakumar, A.I., Mathirajan, M. – Management Research Methodology, Pearson.
4	Deborah Rumsey – Statistics for Dummies, Wiley.

Web Resources	
1	MIT OpenCourseWare: Research Methods (https://ocw.mit.edu)
2	NCBI – PubMed Central (https://www.ncbi.nlm.nih.gov/pmc/)
3	https://researcheracademy.elsevier.com/
4	https://link.springer.com/

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Course Title: Mini Project **Course Code: PC252602**		**Course Category: ELC**
Teaching Scheme	**Examination Scheme (As Applicable)**	
Practicals/Sessions: 02 Hours/Week	CA-I	15 Marks
Credits : 01	CA-II	15 Marks
Semester: First Year (Semester-II)	ESE	20 Marks

Course Prerequisite:

Basic understanding of core subjects in specialization, Ability to access, and interpret scientific literature, Exposure to technical report writing and presentation.

Course Description:

The Mini Project course provides students with an opportunity to apply theoretical knowledge gained during coursework to a small-scale practical problem in Computer Science and Engineering. It enables students to experience the process of identifying a problem, reviewing literature, formulating objectives, and developing solutions using experimental, analytical, or simulation-based approaches. The course emphasizes independent learning, teamwork, critical thinking, innovation, and technical communication.

Course Objectives:

1. Develop the ability to identify, analyze, and solve engineering problems using modern tools and techniques.
2. Encourage creativity, innovation, and research aptitude in addressing Computer Science and Engineering challenges.
3. Provide hands-on exposure to design, modeling, analysis, and/or experimental work on a defined problem.
4. Strengthen teamwork, project management, and professional ethics in executing engineering tasks.
5. Enhance technical writing and oral presentation skills through project documentation and seminars.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Identify and define a relevant problem in the domain of Computer Science and Engineering.	Apply L3
CO2	Conduct a literature survey and establish research/technical objectives.	Understand L2
CO3	Apply appropriate engineering methods, tools, and techniques to develop and implement solutions.	Analyze L4
CO4	Work independently or in a team, demonstrating project management, ethical practices, and leadership.	Apply L3
CO5	Demonstrate the ability to answer questions, engage in discussions, and defend ideas confidently.	Understand L2

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CO-PO Mapping

CO-PO Mapping														
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	1	1	1	1	1	1	2	3	3
CO2	2	3	2	3	2	1	1	1	1	2	1	2	2	2
CO3	3	3	3	3	3	1	2	1	2	2	2	3	3	3
CO4	2	2	3	2	2	2	1	2	3	2	3	3	3	2
CO5	1	2	2	1	1	1	1	2	2	3	2	2	2	3

Assessment	
The mini project is worth a total of 50 marks, with 30 marks for the internal assessment and 20 marks for the semester-end examination. The semester-end examination will be conducted by a committee of three faculty members. Students must bring their completed reports, which should be duly authenticated by their guide and the Head of the Department. Each student will individually present their work to the committee, who will then evaluate them and award marks accordingly.	
CA-I (a) (15M)	Review-I: 15 Marks (Concept/knowledge in the topic = 10 marks, Literature-05 marks)
CA-II (b) (15M)	Review-II: 15 Marks (Report writing & Presentation =15 Marks)
Practical/ viva voce (c) (20M)	20 Marks (Individual evaluation through viva voce / test (20 marks)
Total (d)	50 Marks

Course Contents
The mini project is designed to help students identify, analyze, and solve real-world problems in Computer Science and Engineering and management. This project also aims to improve their overall skills and capabilities. Each student should choose a topic they are interested in. The project's content must be relevant to emerging areas within the field, address current issues with a research focus, or be based on industrial visits. Students can also select a practical problem from the field of Computer Science and Engineering to work on. By the end of the semester, each student must submit a final report to the Head of the Department. The report must be authenticated by their guide.

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Course Title: Distributed Systems **Course Code: PC253006**		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs / week	CA-1	10 Marks
Tutorial: -	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: Second Year (Semester III)	ESE	60 Marks

Course Prerequisite:
Operating Systems fundamentals (processes, threads, synchronization), Computer Networks (protocols, communication), Basic programming in C/C++/Java/Python.

Course Description: This course introduces the principles, models, and algorithms of distributed computing systems. It covers communication protocols, process coordination, synchronization, fault tolerance, and distributed applications. Students will gain both theoretical and practical understanding of distributed architectures, middleware, and real-world distributed platforms such as Hadoop, Spark, and Blockchain.

Course Objectives:

1. To understand fundamental concepts and design goals of distributed computing systems
2. To study process models, communication mechanisms, and distributed algorithms.
3. To analyse issues of coordination, synchronization, and consistency in distributed systems.
4. To explore techniques for replication, fault tolerance, and recovery
5. To introduce real-world distributed platforms and applications.

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Describe the architecture, goals, and models of distributed systems.	Remember L1
CO2	Apply communication and synchronization techniques to distributed processes.	Apply L3
CO3	Analyze distributed algorithms for mutual exclusion, leader election, and fault tolerance.	Analyze L4
CO4	Evaluate consistency, replication, and recovery mechanisms in distributed databases and systems.	Analyze L4
CO5	Demonstrate the design and functioning of real-world distributed platforms such as GFS, HDFS, Spark, and Blockchain.	Apply L3

CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	2	-	-	-	2	-	1	-	2	2	2
CO2	1	2	-	2	-	-	-	2	-	1	-	2	2	2
CO3	3	1	-	2	-	-	-	2	-	1	-	2	2	2
CO4	3	2		2				2		1		2	2	2
CO5	2	2	1	2	-	-	-	2	-	1	-	2	2	2

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Assessment	
CA-1 (a) (10M)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10M)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20M)	Subjective Test

Course Contents		
Unit 1	**Unit 1: Fundamentals of Distributed Systems** Definition, Characteristics,and Goals of Distributed Systems: Transparency, Openness, Scalability, Architectures: Centralized, Client–Server, Peer-to-Peer, Hardware Concepts: Multiprocessors, Homogeneous & Heterogeneous Multicomputer Systems, Software Concepts: Distributed OS, Network OS, Middleware. Case Study: Client–Server in Web Applications.	8 Hrs.
Unit 2	**Unit 2: Communication in Distributed Systems** Communication Paradigms: Layered Protocols, Transport Protocols, Middleware, Remote Procedure Call (RPC): Basics, Parameter Passing, Extended Models, Remote Object Invocation: Static vs Dynamic Binding, Message-Oriented Communication: Persistence, Queues, Synchronicity, Stream-Oriented Communication: Continuous Media, QoS, Synchronization, Case Study: REST APIs & gRPC in Microservices.	8 Hrs.
Unit 3	**Unit 3: Processes, Threads, and Naming** Threads and Concurrency in Distributed Systems, Clients and Servers: Transparency Issues, Software Agents and their Role in DS, Naming: Names, Identifiers, and Addressing, Name Resolution and Name Service Implementation, Locating Mobile Entities: Home-Based & Hierarchical Approaches	8 Hrs.
Unit 4	**Unit 4: Coordination and Distributed Algorithms** Logical Clocks: Lamppost, Vector Clocks, Global State and Snapshot Algorithms, Clock Synchronization Techniques, Distributed Mutual Exclusion Algorithms, Leader Election, Deadlock Detection,Termination Detection, Case Study: Apache Zookeeper for Coordination	8 Hrs.
Unit 5	**Unit 5: Fault Tolerance, Replication, and Consistency** Fault Models and Recovery in Distributed Systems, Commit Protocols (2PC, 3PC), Voting Protocols, Replica Management: Data-Centric & Client-Centric Consistency Models, Check pointing and Recovery Methods.	8 Hrs.

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Unit 6	**Unit 6: Distributed Applications and Emerging Systems** Distributed Object-Based Systems: CORBA, DCOM, Globe, Distributed File Systems: GFS, HDFS, Dropbox, Bigtable, RDDs, Distributed Multimedia Systems: Characteristics, QoS, Scheduling, Emerging Distributed Platforms: Map Reduce, Apache Spark, Cloud Architectures	8 Hrs.

Sr. No.	Textbooks
1.	Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems: Principles and Paradigms, Pearson Education.
2.	George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, Pearson Education.
3.	Pradeep K. Sinha, Distributed Operating Systems: Concepts and Design, PHI Learning.
	Reference Books
1.	Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press.
2.	M. L. Liu, Distributed Computing: Principles and Applications, Addison-Wesley.
3.	Andrew S. Tanenbaum, Modern Operating Systems, Pearson Education.
4.	Martin Kleppmann, Designing Data-Intensive Applications, O'Reilly Media.
	Web Resources
1.	GeeksforGeeks – Distributed Systems Tutorials

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Course Title: Dissertation Part I **Course Code: PC253603**	**Course Category: ELC**

Teaching Scheme	**Examination Scheme (As Applicable)**	
Practical's/Sessions:10Hours/Week	CA-I	25Marks
	CA-II	25Marks
Semester: Second Year (Semester-III)	ESE	50Marks

Course Prerequisite:

- Basic understanding of core subjects in specialization, ability access, and interpret scientific literature.
- Exposure to technical report writing and presentation.

Course Description: Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Course Objectives:

1. To enable students to identify and define a research/industrial problem.
2. To develop skills for conducting a comprehensive literature review.
3. To formulate objectives, scope, and methodology for the proposed work.
4. To strengthen technical writing, presentation, and project planning skills.
5. To prepare a well-structured project synopsis in line with research/industry requirements

Course Outcomes:

COs	After Successful Completion of Project-I students should be able to:	**Bloom's Level**
CO1	Identify and define a research/engineering problem relevant to the specialization.	L3 Apply
CO2	Perform a critical literature review and identify research gaps.	L4 Analyze
CO3	Formulate clear objectives, scope, and methodology for the project proposal.	L5 Evaluate
CO4	Develop project planning with milestones, deliverables, and resources.	L3 Apply
CO5	Prepare and present a structured project proposal/synopsis effectively in written and oral formats.	L6 Create

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CO-PO Mapping

CO-PO Mapping													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	1	1	1	1	1	1	2	3	3
CO2	2	3	-	3	2	-	1	1	1	-	1	2	2	2
CO3	3	3	3	3	3	1	2	1	2	2	2	-	3	3
CO4	-	2	3	-	2	-	1	2	3	-	3	3	3	2
CO5	1	2	2	1	1	1	1	-	2	3	2	2	3	2

Assessment	
Project-I will have internal marks of 50 and a Semester-end examination of marks 50. Semester end examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.	
CA-I(a)	Review-I: 25 Marks (Concept/knowledge in the topic = 10 marks, Literature-05 marks)
CA-II(b)	Review-II: 25 Marks (Report writing & Presentation =25 Marks)
Practical / viva voce (c)	50 Marks (Individual evaluation through viva voce / test (50marks)
Total(d)	100Marks

Course Contents

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1. **Identification of Research Area / Problem Statement**
   Selection of topic based on current research trends, industrial problems, or societal needs.
2. **Literature Survey**
   Review of recent and relevant literature from journals, conferences, patents, and standards.
3. **Problem Formulation**
   Statement of objectives, scope, and significance of the problem.
4. **Methodology and Approach**
   Proposed methods, design, tools, software, experimental setup, or simulation plan.
5. **Project Planning**
   Defining project milestones, deliverables, and timelines.
6. **Preparation and Presentation Proposal**
   Writing of a structured synopsis/proposal, including references, and presenting before a review panel.

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Course Title: Dissertation Part II **CourseCode: PC254604**		**Course Category: ELC**
Teaching Scheme	**Examination Scheme(As Applicable)**	
Practical's/Sessions:20Hours/Week	CA-I	50Marks
	CA-II	50Marks
Semester: Second Year(Semester-IV)	ESE	100Marks

Course Prerequisite:

Basic understanding of core subjects in specialization, ability access, and interpret scientific literature, Exposure to technical report writing and presentation

Course Description :M.Tech Project–II (Dissertation) is a culmination of the postgraduate program where students demonstrate their ability to independently identify, formulate, and solve research or industry oriented engineering problems. The dissertation involves systematic literature review, problem definition, research methodology, experimentation/simulation, result analysis, and formulation of conclusions. The course aims to develop presearch aptitude, technical depth, and professional presentation skills aligned with the Program Outcomes (POs).

Course Objectives:

1. To enable students to undertake independent research or applied problem-solving in their domain.
2. To develop analytical and experimental skills through design, simulation, or experimental validation.
3. To strengthen technical communication through research publications and dissertation writing.
4. To encourage innovative thinking, ethical research practices, and professional responsibility.

Course Outcomes:

COs	**After Successful Completion of Project-II students should be able to:**	**Bloom's Level**
CO1	Formulate and define research problem with appropriate objectives and scope.	L3 Apply
CO2	Critically review and analyze literature to identify research gaps.	L4 Analyze
CO3	Develop methodology / experimental /simulation framework for problem- solving.	L5 Evaluate
CO4	Conduct experiments /simulations and analyze results with proper validation.	L5 Evaluate
CO5	Prepare dissertation and communicate technical findings effectively.	L6 Create

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CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	1	1	1	1	1	1	2	2	3
CO2	2	3	-	1	2	-	1	1	1	-	1	2	2	2
CO3	3	2	2	3	3	1	2	1	2	2	2	-	3	3
CO4	2	2	3	2	2	-	1	2	3	-	3	3	3	2
CO5	1	2	2	1	1	1	3	-	2	3	2	2	2	3

Assessment

Project-II will have internal marks 100 and Semester-end examination marks 100.

Internal examination will be conducted by a committee consisting of five faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and internal marks shall be awarded as follows.

1. Review-I:25Marks, Review-25
2. Guide

Evaluation-50Marks
Total-100 Marks

External Examination Marks:

1. Guide-50Marks
2. Externalexaminerevaluation-20Marks

3.DPACEvaluation-
30Marks
Total-100marks

Assessment Criteria:

- Novelty and relevance of problem (10%)
- Depth of literature review and problem definition (15%)
- Methodology and implementation (25%)
- Analysis, validation, and discussion of results (25%)
- Quality of dissertation and presentation (25%)

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Course Contents

1. **Problem Definition & Literature Review**
   - Identification of research problem based on gap analysis.
   - Comprehensive literature survey from journals, patents, and technical reports.
2. **Research Methodology & Design**
   - Development of methodology/experimental setup/modeling/simulation framework.
   - Selection of tools, techniques, and optimization methods.
3. **Implementation &Analysis**
   - Data collection through experiments/simulations/field studies.
   - Analysis, validation, and comparison with existing methods.
4. **Dissertation Documentation &Presentation**
   - Dissertation writing as per standard guidelines.
   - Drafting technical papers from dissertation outcomes.

Final presentation and defense.1

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Course Title: Communication skill and Technical writing **Course Code: PC254701**		**Course Category: CC**
Teaching Scheme	**Examination Scheme**	
Lectures:02hrs/week	**CA-1**	**25 Marks**
Tutorial:-----	**CA-2**	**25 Marks**
Credits:02	MSE	-
Semester: PG Second year (Semester IV)	ESE	-

Course Prerequisite:

Basic English composition or introductory technical communication; familiarity with engineering fundamentals

Course Description:

This course equips engineering students with essential communication skills for professional and academic success, focusing on technical writing and oral presentations. Students learn to craft clear, concise technical reports, research proposals, and documentation, as well as deliver effective presentations tailored to engineering. Topics include audience analysis, research document structure, visual aids, professional correspondence, and ethical communication. Through hands-on practice for drafting technical research papers, peer reviews, and research projects, students would be able to apply skills to
real-world engineering contexts, such as presenting research. The course prepares students for thesis work, industry reports, and collaborative engineering environments.

Course Objectives:

1. Understand the principles, structure, and ethical conventions of research writing to support effective documentation in engineering applications.
2. Formulate research problems and develop structured technical documents, including abstracts, introductions, and methodologies, for engineering contexts.
3. Apply data collection and analysis techniques, such as questionnaires and observation methods, to enhance research writing for engineering projects.
4. Produce professional correspondence and technical papers formatted for submission to engineering platforms

Course Outcomes:

COs	**After completion of the course students should be able to**	**Bloom's Level**
CO1	Explain the principles and conventions of research writing, including its purpose, structure, and ethical considerations, to support engineering applications.	L2 Understand
CO2	Formulate research problems and structure technical documents.	L6 Create
CO3	Apply data collection and analysis techniques, including questionnaire design and observation methods, to support research writing in engineering projects.	L3 Apply
CO4	Produce professional correspondence and prepare technical papers for submission to engineering platforms	L6 Create

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CO-PO Mapping

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	1	1	-	-	-	2	2	3	-	2	-	2	3	3
CO2	2	3	2	2	1	1	2	2	-	2	1	2	3	3
CO3	2	2	2	3	2	1	2	1	1	1	1	1	3	3
CO4	-	1	1	1	2	2	1	1	2	3	1	2	3	3

Assessment	
CA-1(a) (25M)	Paper writing/ Presentations
CA-2(b) (25M)	Paper publication/ Paper submission

Course Contents		
Unit 1	**Fundamentals of Research Writing** Introduction to research writing - Knowing the details of research writing- Planning the purpose and material-Practicing for the audience and content delivery. Different Methods in Research Writing Nature and meaning of research methods-Types of research – pure and applied research - Types of communication research – Quantitative, Qualitative and Rhetorical - Questionnaire and observation methods - Data collection and data analysis - Thesis/Synopsis writing - Structure and importance	6 Hrs
Unit 2	**Mechanics of Research Writing** Research writing in broader spectrum - The tone -The language - Conventions of research – Evidence-based arguments - Thesis-driven analysis – Complexity and higher- order thinking.	4 Hrs
Unit 3	**Components of Research Writing** Formatting a research paper – Title page – Abstract – Introduction – Methodology – Conclusion – Proof reading – Citing sources	2 Hrs

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Unit 4	**Communication and Communication Processes** Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication **Reading Skills:** Introduction to Reading, Types of Readers and Reading, Barriers to Reading, Strategies for Reading, Comprehension. **Listening Skills**: Importance of Listening, Types of Listening, Barriers to Listening. **Speaking &Verbal &Non-verbal Communication**: Use of Language in Spoken Communication ,Principles and Practice of	6 Hrs
	Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-Verbal Communication, Presentation Skills, Extempore, Elocution.	
Unit 5	**Professional Correspondence** Writing emails, memos, and cover letters for engineering contexts	2 Hrs
Unit 6	**Technical Paper Submission Platforms for Engineering** IEEE Xplore (Journals and Conferences), Elsevier Journals (Science Direct), Springer Journals etc	2 Hrs

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Sr. No.	Textbooks
1.	Hamlin, A., Rubio, C., & DeSilva, M.(2017).Technical Writing. Open Oregon Educational Resources.
2.	Last, S., Neveu, C., Smith, M., & Nielsen, D. (2019). Technical Writing Essentials : Introduction to Professional Communications in the Technical Fields. B C campus.
3.	Oshima, A., & Hogue, A.(2006). Writing Academic English (4thed.).Pearson Longman
4.	Introducing Research Methodology : A Beginner's Guide to Doing a Research Project - Uwe Flick
5.	Research Design: Qualitative, Quantitative and Mixed Methods Approaches-J. David Creswell and John W. Creswell
6.	The Craft of Research-Gregory G. Colomb, Joseph M. Williams, and Wayne C Booth
7.	Foundations of Behavioral Research-Fred N. Kerlinge
8.	Technical Writing Styleby–Dan Jones, Sam Dragga
	Reference Books
9.	Work book for Advanced Research and Writing by Dr. L. Kavitha Nair, EFL, SRMIST, KTR.
10.	HandbookofTechnicalWritingby–Walter.E.ollu8.TechnicalWritingProcess by – Kieran Morgan and Sanja Spejic
	Web Resources
11.	https://owl.purdue.edu/
12.	https://researcheracademy.elsevier.com/

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