KISHKINDA UNIVERSITY, BALLARI

COMPUTER SCIENCE AND ENGINEERING

PHD COURSEWORK SYLLABUS-2024

SNO	COURSE CODE	COURSE TITLE	COURSE CODE (M.Tech)
1	24PCS01	Advanced Mathematical Techniques for Computer Science	24MCS11
2	24PCS02	Principles of Data Science and Visualization	24MCS12
3	24PCS03	Artificial Intelligence	24MCS13
4	24PCS04	Advanced Design and Analysis of Algorithms	24MCS14
5	24PCS05	Distributed and Cloud Computing	24MCS15
6	24PCS06	Machine Learning	24MCS21
7	24PCS07	Advanced Computer Networks	24MCS22
8	24PCS08	Wireless Networks & Mobile Computing	24MCS231
9	24PCS09	Big Data Analytics	24MCS232
10	24PCS10	Data Warehouse & Data Mining.	24MCS233
11	24PCS11	Image Processing and Machine Vision	24MCS234
12	24PCS12	Pattern Recognition	24MCS241
13	24PCS13	Learning from Data	24MCS242
14	24PCS14	Distributed Database System	24MCS243
15	24PCS15	Internet of Things	24MCS244
16	24PCS16	Deep Learning	24MCS31
17	24PCS17	Natural Language Processing	24MCS321
18	24PCS18	Speech Processing	24MCS322
19	24PCS19	Virtual Reality	24MCS323
20	24PCS20	DevOps	24MCS324
21	24PCS21	Modern Cryptography	24MCS331
22	24PCS22	Software defined Networks	24MCS332
23	24PCS23	Block Chain Technology	24MCS333
24	24PCS24	Generative AI	24MCS334

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Advanced Mathematical Techniques for Computer Science		
Course Code:24PCS01	**Exam Duration: 3 hours**	**Exam Marks (Maximum): 100**

Course Objectives:

1. Explain the concepts of vector spaces, linear independence, basis, and linear transformations.
2. Apply orthogonality, Gram-Schmidt, and least squares methods to solve problems.
3. Analyse the applications of diagonalization, quadratic forms, Singular Value Decomposition (SVD), and Principal Component Analysis (PCA).
4. Apply correlation, regression, and curve fitting techniques to develop statistical models.
5. Understand and apply probability distributions, sampling theory, and hypothesis testing methods.

Module-1

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices.

Module-2

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).

Module-3

Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis

Module-4

Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non-linear)

Module-5

Probability Theory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by t- test, χ2- test.

Course Outcomes: On completion of this course, students are able to:

1. Use numerical methods to solve equations and find their roots in given examples.
2. Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
3. Apply vector space concepts to understand and analyze magnification and rotation of images.
4. Utilize the statistical tools in multi variable distributions.

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5. Use probability formulations for new predictions with discrete and continuous RV's

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Linear Algebra and its Applications	David C. Lay, Steven R. Lay and J. J. McDonald	Pearson Education Ltd	5th Edition 2015.
2	Numerical methods for Scientific and Engg. Computation	M K Jain, S.R.K Iyengar, R K. Jain	New Age International	6th Ed., 2014
3	Probability, Statistics and Random Process	T. Veerarajan	Tata Mc-Graw Hill Co	3rd Edition 2016

Reference Books:

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Optimization: Theory & Applications Techniques	Rao. S.S	Wiley Eastern Ltd New Delhi.	
2	Signals, Systems, and Inference	Alan V. Oppenheim and George C. Verghese	Spring	2010.
3	Foundation Mathematics for Computer Science	John Vince	Springer International	
4	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Ed.,2017

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Principles of Data Science and Visualization		
Course Code: 24PCS02	**Exam duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Understand core Data Science concepts and decision-making roles.
2. Learn effective data visualization techniques.
3. Create and customize visualizations using Matplotlib and Seaborn.
4. Learn data cleaning, transformation, and feature engineering.
5. Explore advanced techniques like PCA and anomaly detection.

Module-1

Introduction to Data Science: Definition of Data Science and its applications, Historical evolution and significance of Data Science, Key concepts: Big Data, Data Analytics, Ethical considerations in Data Science, Role ofData Scientists in decision-making processes

Module-2

Introduction Data visualization: Introduction to data visualization, Importance of data visualization, types of data visualization, tools for data visualization. Area plots, Histograms, Bar charts, Pie chart, Box plots, Scatter plots, bubble plots.

Module-3

Visualization using Matplotlib and Seaborn: Introduction to matplotlib; creating basic plots with matplotlib, customizing plots with matplotlib, advanced matplotlib features, Waffle charts, Word clouds. Introduction to Seaborn; creating statistical plots with seaborn, Customizing plots with seaborn, advanced seaborn features, and regression

Module-4

Data Management and Preprocessing: Data preprocessing: Techniques for cleaning and transforming raw data, Strategies for handling outliers and anomalies. Feature engineering and transformation to meet analysis requirements, Handling missing data in datasets.

Module-5

Advanced Topics in Data Science: Dimensionality reduction techniques: Overview of techniques such as PCA (Principal Component Analysis), Anomaly detection and outlier analysis, Text mining, and Time series analysis.

Course Outcomes: At the end of the course the student shall be able to

1. Articulate Data Science concepts and assess ethical issues.
2. Apply appropriate visualization tools for data insights.
3. Create and customize visualizations using Matplotlib and Seaborn.
4. Implement pre-processing and handle missing data and outliers.
5. Apply advanced techniques to solve complex data problems.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	An Introduction to Statistical Learning	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani	Springer	1st Edition
2	Data Visualization with Matplotlib and Seaborn	Hasnain Raz, Hasnain Raz		1st Edition

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Data Science from Scratch	Joel Grus	O'Reilly Media	2nd Edition
2	Python for Data Analysis	Wes McKinney	O'Reilly Media	3rd Edition
3	Data Science with Python	Wade Briggs	Pearson	1st Edition

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Artificial Intelligence		
Course Code: 24PCS03	**Exam duration: 3 hours**	**SEE Marks: 100**

Course Objectives:

1. Provide an introduction to Machine Intelligence, Problem Solving, Heuristic Search.
2. Provide an introduction to Game Playing.
3. Provide an introduction to various knowledge representation techniques, Reasoning, and expert systems.
4. Provide an introduction to planning and learning in AI.
5. Understanding, Natural Language Processing, and Robotics – Perception and Action.

Module-1

Introduction: What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environment, And The Structure of Agents.

Module-2

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments.

Module-3

Adversarial Search : Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games .Partially Observable Games, State-of-the-Art Game Programs, Alternative Approaches .Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs , The Structure of Problems.

Module-4

Knowledge and reasoning Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, And Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First Order Inference, Unification and Lifting , Forward Chaining Backward Chaining , Resolution.

Module-5

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State Space Search, Planning Graphs, Other Classical Planning Approaches, and Analysis of Planning Approaches.

Planning and Acting in the Real World : Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains , Multi agent Planning.

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Course Outcomes:

At the end of the course, the student will be able to:

1. Apply various search techniques for solving problems in AI.
2. Write programs to play games.
3. Apply knowledge representation techniques and build algorithms for reasoning with knowledge.
4. Apply planning and learning algorithms to enhance AI problem solving.
5. Identify the AI research and problem areas and choose appropriate problem solving methods.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Artificial Intelligence – A Modern Approach	Stuart Russell and Peter Norvig	Pearson	3rd Edition (Paperback), 2016

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	A First Course in Artificial Intelligence	Deepak Khemani	McGraw Hill	1st Edition, 2013
2	Artificial Intelligence	E Rich and K Knight and Shivashankar Nair	Tata McGraw Hill	3rd Edition, 2009

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Advanced Design and Analysis of Algorithms		
Course Code: 24PCS04	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Explore advanced topics in algorithms and complexity theory.
2. Engage in analysis and design of complex algorithms for real-world problems in current application domains.
3. Study advanced/novel algorithm design strategies and techniques.
4. Interpret sturdy/open problems in algorithms or complexity the or by analyzing known approaches and their limitations.

Module-1

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

Module-2

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.

Module-3

Number-Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA crypto system; Primality testing; Integer factorization.

Module-4

String-Matching Algorithms: Naïve string Matching; Rabin- Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer–Moore algorithms.

Module-5

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

Course Outcomes:

1. Analyze Algorithm Efficiency.
2. Implement and Apply Advanced Graph Algorithms.
3. Develop Number-Theoretic Solutions.
4. Apply String-Matching Algorithms.
5. Utilize Probabilistic and Randomized Algorithms.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Introduction to Algorithms	T.H Cormen, C E Leiserson, RL Rivestand C Stein	PHI	3rd Edition,2010
2	Algorithms	Kenneth A.Berman	CengageLearning	2002

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni, S.Rajasekharan	Universities press.2nd Edition	2007

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Distributed and Cloud Computing

Course Code: 24PCS05	Exam Duration: 3 hours	SEE Marks: 100

Course Objectives:

1. Understand the fundamental concepts and models of distributed and cloud computing.
2. Explore the design and architecture of computer clusters for scalable parallel computing.
3. Analyze various levels of virtualization, including CPU, memory, and I/O devices, and their role in resource management.
4. Study cloud platform architectures and public cloud services, focusing on service models and security.
5. Gain insight into service-oriented architectures and middleware for distributed computing, including workflows, discovery, and database management.

Module-1

Distributed System Models and Enabling Technologies: Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security, and Energy Efficiency

Module-2

Computer Clusters for Scalable Parallel Computing: Clustering for Massive Parallelism, Computer Clusters and MPP Architectures, Design Principles of Computer Clusters, Cluster Job Management Systems, Case Studies of Top Supercomputer Systems.

Module-3

Implementation Levels of Virtualization: Levels of Virtualization Implementation, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

Module-4

Cloud Platform Architecture over Virtualized Data Centers: Cloud Computing and Service Models, Data-Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS, and Azure,Inter-cloud Resource Management. Cloud Security and Trust Management.

Module-5

Service-Oriented Architectures for Distributed Computing: Message-Oriented Middleware. Portals and Science Gateways. Discovery, Registries, Metadata, and Databases. .Workflow in Service-Oriented Architectures.

Course Outcomes:

1. Ability to apply distributed and cloud computing models in real-world scenarios.
2. Proficiency in designing and managing scalable computer clusters for parallel computing tasks.
3. Expertise in implementing virtualization technologies for efficient resource management in data centers.

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4. Understanding of cloud platform architectures and the capability to evaluate and utilize public cloud platforms like AWS, Azure, and GAE. 5. Enhanced skills in developing service-oriented architectures and using middleware for distributed computing applications.
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Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Distributed and Cloud Computing From Parallel Processing to the Internet of Things	Kai Hwang Geoffrey C. Fox Jack J. Dongarra		

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Cloud Computing: Theory and Practice	Dan C Marinescu Elsevier (MK)		2013
2	Computing Principles and aradigms	Rajkumar Buyya, James Broberg, Andrzej Goscinsk	Willey	2014
3	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	CRC Press	2013

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Machine Learning		
Course Code: 24PCS06	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Describe the Fundamentals of Machine Learning and Concept Learning
2. Implement and Analyze Artificial Neural Networks and Genetic Algorithms
3. Apply Bayesian Learning and Instance-Based Learning Techniques
4. Explore Analytical and Reinforcement Learning Approaches
5. Develop Skills in Clustering Techniques for Unsupervised Learning

Module-1

Machine Learning: Well posed learning problems, Designing a Learning System.

Concept Learning: Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm.

Classification: Decision Tree Learning - Introduction, Decision tree representation, Appropriate problems, ID3 algorithm, Hypothesis Search Space, Inductive Bias and Issues in Decision Tree Learning

Module-2

Prediction: Artificial Neural Network - Introduction, NN representation, Appropriate problems, Perceptron's, Back propagation algorithm & its Remarks. RBF Network, Design issues in ANN, Recurrent Network.

Genetic Algorithms: – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning

Module-3

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Naive Bayes classifier (NBC, m-estimate & Text classification).

Instance based learning: k-Nearest Neighbor Learning, Locally weighted regression.

Module-4

Analytical Learning & Reinforced Learning: Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

Module-5

Clustering: Overview- Types of clustering, Types of clusters, K-Means, Agglomerative Hierarchical, Clustering, Density-Based Clustering, Graph-Based Clustering, Cluster evaluation.

Course Outcomes:

1. Demonstrate proficiency in Machine Learning and Concept Learning
2. Design and Implement Artificial Neural Networks and Genetic Algorithms
3. Apply Bayesian and Instance-Based Learning Techniques for Classification
4. Analyze and Implement Analytical Learning and Reinforcement Learning
5. Implement and Evaluate Clustering Algorithms for Unsupervised Learning

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
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- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Machine Learning	Tom M Mitchel	McGraw-Hill Science	
2	Data Mining: Concepts & Techniques	Jiawei Han & Micheline Kamber, Jian Pei	The Morgan Kaufmann Series,	3rd Edition.

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Advanced Computer Networks

Course Code: 24PCS07	Exam Duration: 3 hours	SEE Marks: 100

Course Objectives:

1. Understand Networking Fundamentals.
2. Explore Internetworking and IP Protocols.
3. Study Advanced Routing Techniques.
4. Examine End-to-End Protocols.
5. Learn Congestion Control and Network Services.

Module-1

Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay XBand width Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait, Sliding Window, Concurrent Logical Channels.

Module-2

Internetworking I: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges andLAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, DatagramForwarding in IP,sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels.

Module-3

Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, TheGlobalInternet,RoutingAreas,RoutingamongAutonomoussystems(BGP),IPVersion6(IPv6),Mobilityand Mobile IP

Module-4

End-to-End Protocols: Simple Demultiplexer (UDP),Reliable Byte Stream(TCP),End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion. Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery

Module-5

Congestion Control and Resource Allocation: Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System(DNS), Electronic Mail:(SMTP,POP,IMAP,MIME), World Wide Web(HTTP),Network Management (SNMP)

Course Outcomes:

1. Describe the fundamental concepts and components of computer networks.
2. Apply internetworking techniques to design and configure interconnected networks.
3. Analyze various routing protocols and their impact on network performance.
4. Evaluate end-to-end protocols to ensure reliable data transmission across networks.
5. Explore and assess congestion control mechanisms and network services for efficient

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data flow.
Question paper pattern: • The question paper will have ten questions. • Each full question is for 20 marks. • There will be 2 full questions (with a maximum of four sub questions in one full question) from each module. • Each full question with sub questions will cover the contents under a module. • Students will have to answer 5 full questions, selecting one full question from each module.

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Wireless Networks and Mobile Computing

Course Code: 24PCS08	Exam Duration: 3 hours	SEE Marks: 100

Course Objectives:

1. Understand mobile communication, system architecture, devices, network management, and security challenges.
2. Analyze GSM services, radio interfaces, protocols, and advanced wireless technologies like 3G, 4G, and beyond.
3. Learn IP networking in mobile environments, focusing on packet delivery, handover, and mobile TCP/IP protocols.
4. Explore data organization and database management with power-aware and context-aware computing.
5. Understand data dissemination and synchronization using tools and standards for efficient communication.

Module-1

Fundamentals of Mobile Communication and Computing: Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices Mobile System Networks, Data Dissemination, Mobility Management, Security Cellular Networks and Frequency Reuse, Mobile Smartphone, Smart Mobiles, and Systems Handheld Pocket Computers, Handheld Devices, Smart Systems, Limitations of Mobile Devices Automotive Systems

Module-2

GSM and Advanced Wireless Communication Technologies: GSM-Services and System Architecture, Radio Interfaces of GSM, Protocols of GSM Localization, Call Handling Handover, Security, New Data Services, General Packet Radio Service High-speed Circuit Switched Data, DECT, Modulation, Multiplexing, Controlling the Medium Access Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS),Coding Methods, Code Division Multiple Access, IMT-2000 3G Wireless Communication Standards, WCDMA 3G Communications Standards ,CDMMA2000 3G Communication Standards, Imode, OFDM, High Speed Packet Access (HSPA) 3G Network Long-term Evolution, WiMaxRel 1.0 IEEE 802.16e, Broadband Wireless Access,4G Networks, Mobile Satellite Communication Networks.

Module-3

IP Networking and Protocols in Mobile Environments :IP and Mobile IP Network Layers, Packet Delivery and Handover Management Location Management, Registration, Tunnelling and Encapsulation, Route Optimization Dynamic Host Configuration Protocol, VoIP, IPsec Conventional TCP/IP Transport Layer Protocols, Indirect TCP, Snooping TCP Mobile TCP, Other Methods of Mobile TCP-layer Transmission ,TCP over 2.5G/3G Mobile Networks

Module-4

Data Management and Organization in Mobile Computing: Data Organization, Database Transactional Models – ACID Rules, Query Processing Data Recovery Process, Database Hoarding Techniques , Data Caching, Client-Server Computing for Mobile Computing and Adaptation Adaptation Software for Mobile Computing, Power-Aware Mobile Computing, Context-aware Mobile Computing.

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Module-5
Data Dissemination and Synchronization in Mobile Computing: Communication Asymmetry, Classification of Data-delivery Mechanisms, Data Dissemination Broadcast Models, Selective Tuning and Indexing techniques, Digital Audio Broadcasting (DAB), Digital Video Broadcasting Synchronization, Synchronization Software for Mobile Devices, Synchronization Software for Mobile Devices SyncML-Synchronization Language for Mobile Computing,Sync4J (Funambol), Synchronized Multimedia Markup Language (SMIL).
Outcomes: At the end of the course the student will be able to 1. Explain the fundamentals of mobile communication, system architecture, network design, and device limitations. 2. Describe and compare GSM services and advanced wireless standards, including 3G and 4G technologies. 3. Manage and configure IP networks in mobile environments, focusing on packet delivery and handover processes. 4. Apply data management strategies such as database hoarding and power-aware computing in mobile systems. 5. Implement data dissemination and synchronization techniques using appropriate tools and standards.
Question paper pattern: • The question paper will have ten questions. • Each full question is for 20 marks. • There will be 2 full questions (with a maximum of four sub questions in one full question) from each module. • Each full question with sub questions will cover the contents under a module. Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Mobile Computing	Raj kamal	Oxford University Press	2ND EDITION 2007/2012.
2	Mobile and Wireless Design Essentials	MartynMallik	Wiley India	2003

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Mobile Computing, Technology, Applications and Service Creation,	Ashok Talukder, RoopaYavagal,	Tata McGraw Hill	2nd Edition , 2010.

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		Hasan Ahmed		
2	Wireless Communications and Networks, 3G and Beyond	ItiSaha Misra	Tata McGraw Hill	2009.

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Big Data Analytics

Course Code: 24PCS09	Exam Duration: 3 hours	SEE Marks: 100

Course Objectives

1. Introduce alternative techniques to perform big data processing
2. Introduce applications of Big Data Processing
3. Use tools and techniques to analyze a large data corpus
4. Technologies for performing processing at large scale
5. Perform a group-based activity to apply tools and techniques learnt to a real-world problem.

Module-1

Introduction and MapReduce: Introduction, Hadoop ecosystem overview, HDFS overview, formats, MapReduce architecture, YARN, limitations of MapReduce, Algorithms: Page Rank.

Module-2

In Memory processing: Alternatives to Map Reduce – Iterative, Workflow processing - PIG, Graph Processing, In-memory computation., Workflow model case study – Apache Spark – RDDs, Scala Performance advantages

Module-3

Models and algorithms: Graph model case study – Pregel/Graph. Computation model. Introduction to machine learning. Machine learning with Spark, Clustering, and Collaborative filtering Algorithms applied to Big Data. Case study – Tensorflow, Watson.

Module-4

Timeseries analysis: Business applications of timeseries data, challenges/tools to process timeseries data. Searching/Matching algorithms.

Module-5

Multimedia –Speech Processing: Variety in Big data, Business cases for Multimedia-Speech processing. Hidden Markov Models, Case study: Sphinx. Video Processing

Course Outcomes: At the end of the course the student will be able to:

1 Motivate and explain trade-offs in big data processing technique design and analysis in written and oral form.
2 Demonstrate the usage of tools to design Big Data applications.
3 Demonstrate development of analytics applications using alternative technologies to Hadoop.
4 Demonstrate ability to work in a small team to solve a real world problem with applications to the society
5 Communicate the design through a presentation and build a prototype to showcase the design

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. "Big Data Analytics Beyond Hadoop": Real-Time Applications with Storm, Spark, and More Hadoop Alternatives, Vijay Srinivasa Agneeswaran PhD, 1st Edition, Pearson, 2014

Reference Books:

1. "Mining of Massive Datasets", Anand Rajaraman, Jure Leskovec, Jerey D. Ullman, 2 nd Edition, Cambridge University Press, 2014

2. Abu-El-Haija, Sami, Nisarg Kothari, Joonseok Lee, Paul Natsev, George Toderici, Balakrishnan Varadarajan, and SudheendraVijayanarasimhan. "Youtube-8m: A large-scale video classification benchmark." arXiv preprint arXiv:1609.08675 (2016).

3. Huang, Qi, Petchean Ang, Peter Knowles, Tomasz Nykiel, IaroslavTverdokhlib, Amit Yajurvedi, Paul Dapolito IV et al. "SVE: Distributed video processing at Facebook scale." In Proceedings of the 26th Symposium on Operating Systems Principles, pp. 87-103. ACM, 2017

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Data Warehouse & Data Mining

Course Code: 24PCS10	Exam Duration: 3 hours	SEE Marks: 100

Course Objectives:

1. Introduction to general issues of Data Warehouse and Data Mining.
2. Understanding of the different architectures and mining techniques
3. The role and functions of Data Warehouse and Data Mining
4. Explain the stages and process different data mining techniques.
5. Learn mining and warehouse techniques through the use of different tools

Module-1

Data Warehouse: Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction Transformation-Loading, Logical (Multi- Dimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; Fact Less-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP

Module-2

Introduction to Data Mining: Introduction, what is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and Dissimilarity-Basics.

Module-3

Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns.

Module-4

Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.

Module-5

Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms.

Course Outcomes: At the end of the course the student will be able to:

1 Explain data warehousing architectures and tools for strategic decision-making.
2 Apply the KDD process to find patterns in data warehouses.
3 Analyze patterns discovered through association rule mining.
4 Evaluate patterns for predictions and classification from large datasets.
5 Design and select suitable methods for data mining and analysis.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1 Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch,

Pearson Education.

2 Data Mining-Concepts and Techniques- Jiawei Han, Micheline Kamber, Morgan

Kaufmann Publishers, Elsevier, 2 Edition, 2006.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.

2. Data Ware Housing Fundamentals, Pualraj Ponnaiah, Wiley Student Edition.

3. The Data Ware House Life Cycle Toolkit- Ralph Kimball, Wiley Student Edition.

4. Data Mining, Vikaram Pudi, P Radha Krishna, Oxford University

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Image Processing & Machine Vision		
Course Code: 24PCS11	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course Objectives:

1. Understand the basics of digital image processing and pixel relationships.
2. Learn image enhancement techniques in spatial and frequency domains.
3. Explore image restoration, noise reduction, and compression methods.
4. Master image segmentation and morphological processing techniques.
5. Introduce computer vision techniques and advanced algorithms for practical applications.

Module-1

Introduction and Digital Image Fundamentals: Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels.

Module-2

Image Enhancement in the Spatial and Frequency Domain: Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Gray Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

Module-3

Image Restoration and Image Compression: Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

Module-4

Image Segmentation and Morphological Image Processing: Discontinuity based segmentation, similarity based segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, some basic Morphological Algorithms.

Module-5

Object Representation and description and Computer Vision Techniques: Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications.

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Course Outcomes: At the end of the course the student will be able to:

1 Explain the fundamentals of image processing and computer vision.
2 Illustrate the image enhancement techniques.
3 Illustrate Image restoration and image compression technique.
4 Tell about image segmentation morphological image processing.
5 Summarize computer vision techniques and its uses

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Digital Image Processing	Rafael C. Gonzalez & Richard E. Woods	Pearson Education	3rd edition
2	Computer Vision: A Modern Approach	A Modern Approach David A. Forsyth, Jean Ponce	Prentice Hallv	
3	Fundamental of Digital Image Processing	A.K. Jain	PHI	

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Digital Image Processing	W.K. Pratt		

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Pattern Recognition

Course Code: 24PCS12	Exam Duration: 3 hours	SEE Marks: 100

Course objectives:

1. Explain pattern recognition principles
2. Able to implement algorithms for Pattern Recognition.
3. Ability to analyze decision trees.

Module-1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation Minimum risk estimators, problems.

Module-2

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation

Module-3

Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error a classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naïve Bayes classifier, Bayesian belief network.

Module-4

Naïve Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Overfitting & Pruning, Examples, Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM.

Module-5

Clustering: Hierarchical (Agglomerative, single / complete/ average linkage, wards, Partitional (Forgy's, k means, Iso data), clustering large datasets, examples, An application: Hand written Digit recognition.

Course Outcomes: At the end of the course the student will be able to:

1. Explain pattern recognition principals
2. Develop algorithms for Pattern Recognition.
3. Develop and analyze decision tress.
4. Design the nearest neighbor classifier.
5. Apply Decision tree and clustering techniques to various applications

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Introduction to Pattern Recognition and Machine Learning	M Narsimha Murthy Der V Susheela Devi	Universities Press	2011
2	Pattern Recognition & Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost	PH	1996

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Pattern Classification	Richard O.Duda,Peter E.Hart,David G.Strok	Wiley and sons	2000

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Learning from Data		
Course Code: 24PCS13	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Understand the fundamentals of learning problems
2. Explore the theory of generalization in machine learning
3. Learn the application of linear classification, regression and explore non-linear transformations
4. Identify and address overfitting
5. Understand key principles guiding learning

Module-1

The Learning Problem: Problem Setup, Types of Learning, Is Learning Feasible, Error and Noise, Problems

Module-2

Training vs Testing: Theory of generalization, Interpreting the Generalization Bound, Approximation and Generalization Tradeoff, Problems

Module-3

The Linear Model: Linear Classification, Linear Regression, Logistic Regression, Non Linear Transformation, Problems.

Module-4

Outfitting: When does outfitting Occur?, Regularization, Validation, Problems.

Module-5

Three Learning Principles: Occams's Razor, Sampling Bias, Data Snooping, Problems.

Course Outcomes: Students will be able to

1. Explain various types of learning problems and assess the feasibility of learning under different conditions.
2. Differentiate between training and testing datasets, and effectively interpret generalization bounds for making reliable predictions.
3. Build and apply linear and logistic regression models, including handling non-linear transformations when needed.
4. Detect overfitting, apply regularization techniques, and perform validation to improve the model's generalization ability.
5. Apply foundational learning principles, recognize potential biases, and ensure robustness in their model evaluation process.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Learning From Data	Abu-Mostafa Yaser S., Malik Magdon-Ismail, Hsuan-Tien Lin		2012

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Distributed Database Systems

Course Code: 24PCS14	Exam Duration: 3 hours	SEE Marks: 100

Course objectives:

1. Understand Distributed Data Processing and Databases.
2. Analyze Distributed Database Architecture.
3. Learn Query Processing and Optimization.
4. Master Transaction and Concurrency Management.
5. Examine Reliability and Object-Oriented Distributed Databases.

Module-1

Introduction: Distributed Data Processing, Distributed Database System, Promises of DDBSs, Problem areas. **Distributed DBMS Architecture:** Architectural Models for Distributed DBMS, DDMBS Architecture.

Distributed Database Design: Alternative Design Strategies, Distribution Design issues Fragmentation, Allocation.

Module-2

Query processing and Decomposition: Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data.

Distributed query Optimization: Query optimization, centralized query optimization, distributed query optimization algorithms

Module-3

Transaction Management: Definition, properties of transaction, types of transactions, distributed concurrency control: serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms, deadlock Management.

Module-4

Distributed DBMS Reliability: Reliability concepts and measures, fault-tolerance in distributed systems, failures in Distributed DBMS, local & distributed reliability protocols, site failures and network partitioning.

Parallel Database Systems: Parallel database system architectures, parallel data placement, parallel query processing, load balancing, database clusters.

Module-5

Distributed object Database Management Systems: Fundamental object concepts and models, object distributed design, architectural issues, object management, distributed object storage, object query Processing.

Course Outcomes:

1. Explain DDBMS architectures and apply fragmentation techniques to solve problems.
2. Analyze semantic integrity control costs and understand query processing steps.
3. Apply and optimize query algorithms to improve distributed database performance.
4. Evaluate transaction management and concurrency control approaches in distributed systems.
5. Apply algorithms for deadlock prevention, detection, and recovery in distributed databases.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Principles of Distributed Database Systems	M. Tamer OZSU and Patuck Valduriez	Pearson Edn. Asia,	2001.
2	Distributed Databases	Stefano Ceri and Giuseppe Pelagatti	McGraw Hill	

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Database Systems: The Complete Book",	Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom		Second Edition, Pearson International Edition

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Internet of Things		
Course Code: 24PCS15	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Understand IoT Concepts: Grasp the fundamentals, definitions, and frameworks of IoT.
2. Learn Key IoT Technologies: Study identification, structure, and evolving standards in IoT.
3. Explore Connectivity Solutions: Understand wireless and IPv6 technologies for IoT.
4. Analyze IoT Applications: Review case studies in home automation, smart cities,and agriculture.
5. Master Data Analytics: Learn to apply tools like Hadoop, Spark, and Storm for IoT data analysis.

Module-1

Internet of Things: What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation. Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication Examples-Overview, Smart Metering/Advanced Metering InfrastructureHealth/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad OtherApplications.

Module-2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO

Module-3

Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M, Layer 3 Connectivity: IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.

Module-4

Case Studies :illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture Productivity Applications

Module-5

Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Realtime Data Analysis, Structural Health Monitoring Case Study.

Course Outcomes:

1. Define IoT: Ability to explain IoT concepts, motivations, and applications.
2. Identify IoT Technologies: Understand key technologies and standards driving IoT evolution.

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3. Apply Connectivity: Implement IoT solutions using wireless and IPv6 technologies. 4. Design IoT Solutions: Develop IoT systems for various real-world applications. 5. Analyze IoT Data: Perform data analysis using Hadoop, Spark, and other frameworks
Question paper pattern: • The question paper will have ten questions. • Each full question is for 20 marks. • There will be 2 full questions (with a maximum of four sub questions in one full question) from each module. • Each full question with sub questions will cover the contents under a module. • Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications	Daniel Minoli	Wiley	2013
2	Internet of Things: A Hands-on Approach	Arshdeep Bahga , Vijay Madisetti	Universities Press	2015

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Designing the Internet of Things	Adrian McEwen, Hakim Cassimally	willey	1st Edition.
2	Getting Started with the Internet of Things	Cuno Pfister	O'Reilly	1st Edition.

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Deep Learning		
Course Code: 24PCS16	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course Objectives:

1. Understand neural networks and deep learning concepts.
2. Gain hands-on knowledge of neural network architectures and deep learning techniques.
3. Explore and tune parameters for deep learning models.
4. Learn optimization strategies for training deep models.
5. Apply deep learning to practical problems like vision, NLP, and speech.

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Over fitting and Under fitting, Hyper parameters and Validation Sets, Estimator, Biasand Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms,Stochastic Gradient DeMCSnt, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feed forward Networks: Gradient-Based Learning ,Hidden Units, Architecture Design, Back Propagation. Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.

Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision,NLP, Speech.

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Course Outcomes:

1. Explain neural networks and deep learning fundamentals.
2. Implement and configure neural network architectures effectively.
3. Optimize deep learning models using various strategies.
4. Apply sequence modelling techniques such as RNNs and LSTMs.
5. Evaluate and apply deep learning in real-world applications.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
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- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Deep Learning	Lan Good fellow and Yoshua Bengio	MITPress	
2	Neural Networks: Asystematic Introduction	RaúlRojas		1996
3	Pattern Recognition and machine Learning	Chirstopher Bishop		2007

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Natural Language Processing		
Course Code: 24PCS17	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Understand the Fundamental Concepts of NLP
2. Develop Skills in Word and Syntactic Analysis
3. Master Semantic Analysis and Text Mining
4. Explore Information Retrieval Techniques
5. Hands-on Experience with NLP Tools

Module-1

OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLPLanguage and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model

Module-2

WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes Part-of Speech Tagging. Syntactic Analysis: Context- free Grammar-Constituency- Parsing-Probabilistic Parsing

Module-3

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case studying Natural Language Based Web Search: In Fact System Overview, The Global Security. Org Experience.

Module-4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite- State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Module-5

INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

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Course Outcomes:

1. Analyze and process natural language text using fundamental NLP techniques.
2. Generate natural language output by applying language modeling and syntactic analysis methods.
3. Demonstrate the ability to perform text mining for extracting meaningful information from large datasets.
4. Apply information retrieval techniques to process and retrieve relevant linguistic information.
5. Implement various algorithms and models for semantic analysis, text classification, and relation extraction in natural language processing applications.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U.S. Tiwary,	Oxford University Press	2008
2	Natural Language Processing and Text Mining	Anne Kao and Stephen R. Poteet	Springer-Verlag London Limited	2007
3	Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition	Daniel Jurafsky and James H Martin	Prentice Hall	2008, 2nd Edition
4	Natural Language Understanding	James Allen Benjamin / Cummings	Publishing Company	1995, 2nd Edition

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Speech Processing

Course Code: 24PCS18	Exam Duration: 3 hours	SEE Marks: 100

Course Learning objectives:

1. To provide an understanding of the fundamental concepts in speech signal processing, including digital models and time-domain models for speech signals.
2. To introduce students to the digital representation of speech waveforms and methods such as short-term Fourier analysis for analyzing speech signals.
3. To explore advanced speech processing techniques like homomorphic speech processing and their applications in speech analysis.
4. To develop a thorough understanding of linear predictive coding (LPC) of speech, including its principles, methods, and computation.
5. To familiarize students with the practical applications of speech processing in man machine communication, such as speech recognition and synthesis.

Module-1

Introduction, Fundamentals of Digital Speech Processing

Module-2

Digital models for the speech signals, Time domain models for speech processing

Module-3

Digital representation of the speech waveform, short term Fourier analysis

Module-4

Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Comutation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.

Module-5

Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications Digital speech for man machine communication by voice

Course Outcomes:

1. Analyze and model speech signals using time-domain techniques and digital models for speech processing.
2. Identify and apply digital representation techniques, including short-term Fourier analysis, for analyzing speech waveforms.
3. Apply advanced speech processing methods, such as homomorphic analysis, to realworld speech processing scenarios.
4. Perform linear predictive coding (LPC) analysis, compute LPC parameters, and solve LPC equations effectively.
5. Apply speech processing techniques to modern applications, including man-machine communication and speech recognition systems.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
Textbook(s):				
SNO	**Title of the book**	**Author Name**	**Publisher's Name**	**Publication Year**
1	Digital Processing of Speech Signals	Lawrence R. Rabiner , Ronald W. Schafer	Pearson education,	2004
Reference Book(s):				
SNO	**Title of the book**	**Author Name**	**Publisher's Name**	**Publication Year**
1	Digital Speech Processing, and Recognition	Sadoaki Furui	Mercel Dekker	Second Edition, 2002.
2	Designing with speech processing chips	Ricardo Jimenez	, Academic press	INC 1991.

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Virtual Reality		
Course Code: 24PCS19	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. To introduce the fundamental concepts of Virtual Reality (VR) including hardware, software, and perceptual psychology.
2. To understand the optical systems and human sensory systems and their implications for VR experiences.
3. To explore graphical rendering techniques and physics simulations in VR environments.
4. To provide knowledge on tracking systems, sensor fusion, and interaction mechanisms in VR.
5. To analyze sound propagation, auditory perception, and advanced interfaces like brainmachine interfaces in VR systems.

Module-1

Introduction: Definition of VR, modern experiences, historical perspective. Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics. Geometric modelling, transforming rigid bodies, yaw, pitch, roll, axis-angle representation, quaternions, 3D rotation inverses and conversions, homogeneous transforms, transforms to displays, look-at and eye transforms, canonical view and perspective transforms, viewport transforms

Module-2

Visual Perception: Light propagation, lenses and images, diopters, spherical aberrations, optical distortion; more lens **aberrations**; spectral properties; the eye as an optical system; cameras; visual displays. Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, and other implications of physiology on VR. Depth perception, motion perception, vection, stroboscopic apparent motion, color perception, combining information from multiple cues and senses, implications of perception on VR.

Module-3

Graphical rendering :ray tracing, shading, BRDFs, rasterization, barycentric coordinates, VR rendering problems, anti-aliasing, distortion shading, image warping (time warp), panoramic rendering. Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion, vection

Module-4

Tracking systems- estimating rotation, IMU integration, drift errors, tilt and yaw correction, estimating position, camera-feature detection model, perspective n-point problem, sensor fusion, lighthouse approach, attached bodies, eye tracking, inverse kinematics, map building, SLAM, Remapping, locomotion, manipulation, social interaction, specialized interaction mechanisms

Module-5

Sound propagation, ear physiology, auditory perception, auditory localization; Fourier analysis; acoustic modelling, HRTFs, rendering, naturalization. Perceptual training, recommendations for developers, best practices, VR sickness, experimental methods that involve human subjects Touch, haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.

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Course Outcomes

1. Describe basic VR system components, including hardware, sensors, and software.
2. Explain how human vision, depth perception, and sensory physiology affect VR design.
3. Apply VR rendering techniques and simulate motion, collision, and physics.
4. Implement tracking systems and develop interaction mechanisms in VR.
5. Demonstrate knowledge of sound rendering, auditory perception, and advanced VR interfaces like haptics and telepresence.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Virtual Reality	Steven M. LaValle	Cambridge University Press	2016
2	HANDBOOK OF VIRTUAL ENVIRONMENTS: Design, Implementation, and Applications	Kelly S. Hale Kay M. Stanney	CRC Press 2nd Edition	2015

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DevOps		
Course Code: 24PCS20	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course Objectives:

1. To introduce DevOps terminology, definition & concepts
2. To understand the different Version control tools like Git, Mercurial
3. To understand the concepts of Continuous Integration/ Continuous Testing / Continuous Deployment.
4. To understand Configuration management using Ansible.

Module-1

INTRODUCTION TO DEVOPS: Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

Module-2

COMPILE AND BUILD USING MAVEN & GRADLE: Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

Module-3

CONTINUOUS INTEGRATION USING JENKINS: Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace

Module-4

CONFIGURATION MANAGEMENT USING ANSIBLE: Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

Module-5

BUILDING DEVOPS PIPELINES USING AZURE: Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines. yaml file

Course Outcomes:

1. Describe actions performed using version control tools like Git.
2. Implement Continuous Integration, Testing, and Deployment with Jenkins, Maven, and Gradle.
3. Execute automated Continuous Deployment processes.
4. Manage configurations using Ansible.
5. Utilize cloud-based DevOps tools with Azure DevOps.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises"	Roberto Vormittag	Second Edition, Kindle Edition, .138	2016
2	Linux for Beginners: An Introduction to the Linux Operating System and Command Line	Jason Cannon	Kindle Edition`	2014

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure		Paperback – 1 January 2020	
2	Ansible for DevOps: Server and configuration management for humans	Jeff Geerling		First Edition, 2015.
3	https://www.jenkins.io/user-handbook.pdf			
4	https://maven.apache.org/guides/getting-started/			

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Modern Cryptography

Course Code: 24PCS21	Exam Duration: 3 hours	SEE Marks: 100

Course objectives:

1. To learn about Modern Cryptography.
2. To focus on how cryptographic algorithms and protocols work and how to use them.
3. To build a Pseudo random permutation.
4. To construct Basic cryptanalytic techniques.
5. To provide instruction on how to use the concepts of block ciphers and message authentication codes.

Module-1

INTRODUCTION: Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

Module-2

FORMAL NOTIONS OF ATTACKS: Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model.

Module-3

RANDOM ORACLES: Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

Module-4

BUILDING A PSEUDORANDOM PERMUTATION: The Luby Rack off Construction: Formal Definition, Application of the Luby Rack off Construction to the construction of Block Ciphers, The DES in the light of Luby Rack off Construction.

Module-5

MESSAGE AUTHENTICATION CODES: Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols

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Course Outcomes: By the end of this course, students will be able to:

1. Interpret the basic principles of cryptography and cryptanalysis.
2. Explain symmetric encryption and authentication concepts.
3. Identify public key encryption, digital signatures, and key establishment methods.
4. Articulate and analyze cryptographic algorithms to build simple cryptographic solutions.
5. Explain the use of Message Authentication Codes (MACs).

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Introduction to Cryptography: Principles and Applications	Hans Delfs and Helmut Knebl	Springer Verlag.	
2	Modern Cryptography, Theory and Practice	Wenbo Mao	Pearson Education (Low Priced Edition)	

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Lecture Notes on Cryptography	ShaffiGoldwasser and MihirBellare	Available at http://citeseerx.ist.psu.edu/. 158	
2	Foundations of Cryptography	OdedGoldreich	CRC Press	
3	Cryptography and Network Security: Principles and Practice	William Stallings	PHI	3rd Edition, 2006.

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Software Defined Networks		
Course Code: 24PCS22	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. To understand the evolution of Software Defined Networking (SDN) and the key principles behind control and data plane separation.
2. To explore the architecture and functionality of SDN controllers such as Open Daylight (ODL) and Open Network Operating System (ONOS).
3. To provide knowledge on network programmability and its role in enabling flexible network management.
4. To understand the concepts of data center virtualization and Network Function Virtualization (NFV) within the SDN framework.
5. To learn how to troubleshoot and verify SDN implementations, and explore real-world use cases for SDN in bandwidth management and traffic monitoring.

Module-1

Introduction-Centralized and Distributed Control and Data Planes, Open Flow.

Module-2

SDN Controllers, Network Programmability.

Module-3

Data Center Concepts and Constructs, Network Function Virtualization.

Module-4

Network Topology and Topological Information Abstraction, Building an SDN Framework

Module-5

Use Cases for Band width Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions.

Course Outcomes: By the end of this course, students will be able to:

1. Explain SDN concepts, architecture, control and data plane separation, and the OpenFlow protocol.
2. Demonstrate SDN controllers, network programmability, and their impact on network management.
3. Analyze SDN integration with data centers and the role of NFV.
4. Design and implement SDN frameworks focusing on topological abstraction and network scalability.
5. Apply SDN principles to real-world scenarios like bandwidth scheduling, traffic classification, and network monitoring, and troubleshoot SDN environment

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
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- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
Textbook(s):				
SNO	**Title of the book**	**Author Name**	**Publisher's Name**	**Publication Year**
1	SDN: Software Defined Networks	KenGray ThomasD.Nadeau	O'Reilly	2013
2	Software Defined Networks	Paul Goransson,Chuck	Elsevier	2016

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Block chain Technology

Course Code: 24PCS23	Exam Duration: 3 hours	SEE Marks: 100

Course Objectives:

1. Learn blockchain fundamentals, consensus, and decentralization.
2. Understand Bitcoin, alternative coins, and smart contracts.
3. Explore the Ethereum ecosystem, Ether transactions, and development.
4. Learn Web3, smart contracts, and Hyper ledger frameworks.
5. Study new platforms, scalability, and research trends.

Module-1

INTRODUCTION TO BLOCKCHAIN: Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization

Module-2

INTRODUCTION TO CRYPTOCURRENCY: Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

Module-3

ETHEREUM: Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

Module-4

WEB3 AND HYPERLEDGE: Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda

Module-5

EMERGING TRENDS : Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

Course Outcomes:

1. Explain the concepts of blockchain and decentralization.
2. Describe cryptocurrencies and implement smart contracts.
3. Identify Ethereum components and configure Ethereum networks.
4. Deploy smart contracts and utilize Hyperledger.
5. Evaluate new blockchain platforms and explore research trends.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books

Textbook(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained	Imran. Bashir	Packt Publishing	2nd Edition, 2018
2	Blockchain Application in Finance, Blockchain Driven	Peter Borovykh		2nd Edition, 2018
	Blockchain Applications: A Hands On Approach	ArshdeepBahga, Vijay Madisetti	VPT	2017

Reference Book(s):

SNO	Title of the book	Author Name	Publisher's Name	Publication Year
1	Blockchain Basics:ANon-Technical Introduction in 25 Steps	Daniel Drescher,	Apress,	First Edition,2017
2	Mastering Bitcoin: Unlocking Digital Cryptocurrencies	Andreas M.Antonopoulos	O'Reilly Media	FirstEdition,2014

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Generative AI		
Course Code: 24PCS24	**Exam Duration: 3 hours**	**SEE Marks: 100**

Course objectives:

1. Introduce the concept of generative AI and its applications.
2. Provide hands-on experience in building generative models using TensorFlow and Keras.
3. Explore various generative model architectures (RBMs, VAEs, GANs, LSTMs, Transformers).
4. Understand the challenges and limitations of generative models.
5. Develop skills in applying generative models to real-world problems.

Module-1

An Introduction to Generative AI: "Drawing" Data from Models, Applications of AI, the rules of probability, why use generative models? Style transfer and image transformation, Unique challenges of generative models. Setting Up a Tensor Flow Lab: Deep neural network development and Tensor Flow, VS Code Docker: A lightweight virtualization solution, Kubernetes: Robust management of multi-container applications, Kube flow: an end-to-end machine learning lab, A brief tour of Kube flow's components, Kube flow pipelines Using Kube flow Katib to optimize model hyper parameters.

Module-2

Building Blocks of Deep Neural Networks: Perceptrons – a brain in a function, Multi-layer perceptrons and backpropagation, Varieties of networks: Convolution and recursive, Networks for sequence data, Building a better optimizer. Teaching Networks to Generate Digits: The MNIST database, Restricted Boltzmann Machines: generating pixels with statistical mechanics, Stacking Restricted Boltzmann Machines to generate images: the Deep Belief Network 117 Creating an RBM using the Tensor Flow Keras layers API 120 Creating a DBN with the Keras Model API

Module-3

Painting Pictures with Neural Networks Using VAEs: Painting Pictures with Neural Networks Using VAEs Creating separable encodings of images The variational objective, Inverse Autoregressive Flow, Importing CIFAR, Creating the network from TensorFlow Image Generation with GANs: The taxonomy of generative models Generative adversarial networks, Vanilla GAN Improved GANs, Progressive GAN, and Challenges.

Module-4

The Rise of Methods for Text Generation: Representing text, Text generation and the magic of LSTMs, LSTM variants and convolutions for text NLP 2.0: Using Transformers to Generate Text: Attention, Contextual embedding's, Self-attention, Transformers, GPT 1, 2, 3...

Module-5

Composing Music with Generative Models: Getting started with music generation, Music generation using LSTMs, Music generation using GANs, Muse GAN – polyphonic music generation. Emerging Applications in Generative AI: Introduction Finding new drugs with generative models, Solving partial differential equations with generative modeling Few shot learning for creating videos from images Generating recipes with deep learning.

Course Outcomes

1. Explain the underlying principles of generative AI.

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2. Implement various generative models using TensorFlow and Keras.
3. Evaluate and compare the performance of different generative models.
4. Apply generative models to image generation, text generation, and music composition.
5. Analyze the potential and limitations of generative AI in various applications.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook/Reference Books				
Textbook(s):				
SNO	**Title of the book**	**Author Name**	**Publisher's Name**	**Publication Year**
1	Generative AI with Python and TensorFlow 2	Joseph Babcock Raghav Bali	Packt Publishing Ltd.	April 2021

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