MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(Deemed to be University)

(Declared Under Distinct Category by Ministry of Education, Government of India)

NAAC Accredited with A++ Grade

Department of Computer Science and Engineering

DATABASE SYSTEMS
620111/630111

COURSE OBJECTIVES

- To understand database concepts and architecture.
- To explore transaction management and concurrency control.
- To analyze different types of distributed database systems.

UNIT I:
Review of Databases Characteristics & Implications of Database Approach. Data Models, Architectures, Database Languages & Interfaces. Classification of DBMS. Data Independence. ER-Models, High Level Conceptual Data Models. Relationships. ER-Diagrams, Design Issues

UNIT II:
Object Oriented and Extended Relational Databases: Concepts of Object-Oriented Databases, Object Identity, Object Structure and Type Constructors. Encapsulation of Operations. Methods & Persistence. Type Hierarchies and Inheritance. Object Database Standards. Object Definition Language. Object Query Language and Object Database Conceptual Design

UNIT III:
Distributed Databases Concepts Fragmentation, Replication, Allocation Techniques for Distributed Database Design. Types of Distributed Database Systems. Query Processing. Concurrency Control and Recovery. Distributed Databases in Oracle

UNIT IV:
Transaction Processing Introduction. Transaction and System Concepts. Properties of Transactions. Schedules & Recoverability, Serializability of Schedules. Transaction Support in SQL, Concurrency Control Techniques, Locking Techniques, Time Stamp Ordering. Multi Version Concurrency, Validation Concurrency, Locks for Concurrency Control

UNIT V:
Image and Multimedia Databases: Modeling and Storage of Image and Multimedia Data. Data Structures- R-Tree k-d Tree. Quad Trees. Content Based Retrieval Color Histograms, Textures etc. Image Features. Spatial and Topological Relationships. WEB Database Accessing Databases through WEB. WEB Servers XML Databases. Commercial Systems. Mobile Databases. Case Study: Oracle Xi

Recommended Books:

1. Elmarsi. Navathe, Somayajulu, Gupta, "Fundamental of Database Systems", 4th Edition, Pearson Education, 2007
2. R Ramakrishanan, "Database Management Systems", McGraw Hill International Editions, 1998
3. Date, Kannan, Swaminathan, "An Introduction to Database Systems", 8th Edition Pearson Education, 2007.
4. Silberscatz, Korth, Sudarshan, "Database System Concepts", McGraw Hill 6th Edition. 2006

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1: recall the fundamental of DBMS, RDBMS, and data models.

CO2: illustrate the basic concepts of Object-Oriented data model, Extended Relational Databases, and Object Query Language

CO3: describe the Distributed Databases Concepts and Concurrency Control and Recovery

CO4: apply the Transaction Processing concepts, Concurrency Control Techniques in database system

CO5: use the Image and Multimedia Databases, Commercial Systems, Mobile Databases

CO-PO mapping:

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

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Department of Computer Science and Engineering

Distributed Computing

(DC)

COURSE OBJECTIVES

- To provide students contemporary knowledge of distributed systems.
- To equip students with skills to analyze and design distributed applications.
- To gain experience in the design and testing of a large software system, and to be able to communicate that design to others.

UNIT I:
Introduction To Distributed System, Communication Layered Protocols. Client Server Protocols, RPC. Group Communication Coordination, Synchronization & Consistency: Logical Clocks, Physical Clocks. Mutual Exclusion, Election Algorithms, Atomic Broadcast. Sequential Consistency Transaction Distributed Consensus. Threads, Thread Synchronization, Implementation Issues and Threads Vs RPC

UNIT II:
Models Of Distributed Computing Client Server and RPC. RPC Architecture. Exceptions. Underlying Protocols. IDL, Marshalling Etc. Group Models and Peer to Peer Groups for Service Replication/ Reliability. Groups For Parallelism/ Performance, Chent Server Vs Peer-To-Peer, Multicast, Atomic Broadcast

UNIT III:
Distributed File System Security, Naming/ Location Transparency, R/W Semantics, Cache Coherence, Replication Distributed Shared Memory DSM Architecture. Consistency Models and Relation to Caching. Release Consistency. Comparison with Message Passing and RPC.

UNIT IV:
Fault Tolerant Distributed Systems Introduction, Dependability, Faults Vs Errors Vs Failure, Space Time and Value Redundancy, Fault Tolerant Architecture. Failure Detection Algorithms Partitioning, FT Consensus

UNIT V:
Distributed Multimedia System. Introduction, Characteristics. And Resource Management Stream Adaptation, Security. Introduction, Security Techniques. Cryptographic Algorithms. Authentication and Access Control, Case Study: CORBA, MACH.

Recommended Books:

1. Andrew S Tanenbaum, Distributed Systems Principles and Paradigms. Pearson
2. Pradeep K. Sinha, Distributed Operating Systems, PHI

COURSE OUTCOMES

After completion of this course, the students would be able to:

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1. **Tell** the basic elements and concepts related to distributed system Technologies.
CO2. **Demonstrate** knowledge of the core architectural aspects of distributed systems.
CO3. **Identify** how the resources in a distributed system are managed by algorithm.
CO4. **Examine** the concept of distributed file system and distributed shared memory.
CO5. **Compare** various distributed system algorithms for solving real world problems.

CO-PO mapping

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

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Department of Computer Science and Engineering

HIGH-SPEED NETWORKS

Course Objectives:

- **Master Networking Models and Protocols**: Understand the TCP/IP and OSI models, Internet protocols, and addressing in high-speed networks.
- **Analyze Network-Layer Functions:** Learn routing, internetworking, congestion control, and IPv4/IPv6 addressing with multicasting protocols.
- **Understand Transport Layer Protocols:** Explore TCP, UDP, mobile transport protocols, congestion control, and network applications.
- **Explore Optical Networks and WDM Systems**: Study optical networking technologies, including WDM, optical switches, routers, and wavelength allocation.
- **Examine ATM and Wireless Networks:** Investigate ATM services, wireless/mobile ATM, VPNs, and routing in mobile ad-hoc and wireless sensor networks.

UNIT I:

Networking Fundamentals and Protocols: Review of Networking and Core Networking Protocols, TCP/IP Model, OSI Model, and Internet Protocols with Addressing. In-depth study of Routing and Internetworking, Network-Layer Routing, and Congestion Control at the Network Layer. Logical Addressing: IPv4 Addresses, IPv6, and Multicasting Techniques with relevant Protocols.

UNIT II:

Transport Layer and Application Protocols: Comprehensive overview of Transport and End-to-End Protocols, including the Transport Layer. Detailed exploration of Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). Focus on Mobile Transport Protocols and TCP Congestion Control. Application Layer with emphasis on Principles of Network Applications: Web and HTTP, and File Transfer Protocol (FTP). Study Electronic Mail in the Internet, and Domain Name System (DNS).

UNIT III:

Optical Networks and WDM Systems: Detailed examination of Optical Networks, including Basic Optical Networking Devices. Study of Large-Scale Optical Switches and Optical Routers. Understanding Wavelength Allocation in Networks, WDM Network elements, and Optical Line Terminals with Amplifiers.

UNIT IV:

ATM-based Services and Advanced Networking: In-depth study of ATM-based Services and Applications, ATM Switching, and ATM Transmission. Exploration of Wireless ATM and Mobile ATM, including Security in ATM Networks. Introduction to VPNs with Tunneling Concepts and Overlay Networks. Examination of Virtual Private Networks (VPNs) and Overlay Networks including VoIP.

UNIT V:

Mobile Ad-Hoc and Sensor Networks: Thorough understanding of Mobile Ad-Hoc Networks. Overview and study of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, and Routing Protocols for Ad-Hoc Networks. Exploration of Wireless Sensor Networks, including Sensor Networks and Protocol Structures.

Recommended Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition, Tata McGraw Hill, 2007
2. Computer Networks. Andrew S. Tanenbaum, Fourth Edition. Prentice Hall
3. Adhoc Wireless Networks Architecture & protocols. Sivaram Murthy PHI
4. Optical Networks. Third Generation Transport Systems. Uyless Black, Pearson
5. Optical Networks A Practical Perspective. Rajeev Ramaswami and N. Sivarajan, Morgan Kaufmann
6. ATM Networks: Concepts, Protocols, Applications, Rainer Handel, Huber and Schroder, Pearson

COURSE OUTCOMES

After completion of this course, the students would be able to:

- CO1: **Recall** the principles of network engineering necessary for managing network systems and services.
- CO2: **Classify** theoretical and practical concepts involved in designing multi-constrained applications and understanding the need for service integration.
- CO3: **Apply** knowledge of advanced network engineering, including design, routing, management, security, and performance, with the ability to utilize industry-standard tools.
- CO4: **Solve** problems related to network design, routing, management, security, and performance.
- CO5: **Analyze** the concepts underlying various protocols, QoS architectures, mechanisms, and their key characteristics and functionalities.

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Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

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Image Processing & Computer Vision

(DC)

UNIT I:
Introduction to Image Processing Systems, Digital Image Fundamentals, Imaging Geometry, Image model, Types of Image, Image representation, Image Digitization, Digital Image Properties, 2D Convolution and correlation, Histogram.

UNIT II:
Image Preprocessing, Images Transformations, Geometric Transformations, Brightness Transformation Image Smoothing, Contrast Stretching, Basic Gray Level Function Neighborhood Averaging, Median Filtering, Low Pass Filters, Average of Multiple Images, Image Sharpening, Histogram Specification, Histogram Equalization

UNIT III:
Image Restoration and Denoising, Image Degradation, Types of Image Blur, Image Denosing, Classification of Noise in Images, Classification of Image Restoration Techniques, Image Restoration Models, Gray Level Interpolation, Inverse & Weiner Filter, Performance Metrics in Image Restoration
Image Segmentation, Region Representation, Region Growing, Region Splitting and Merging,
Detection of Discontinuation, Point Detection, Line Detection. Edge Detection, Lines, curves, Shape Representation, Hough transform

UNIT IV:
Object Recognition, Pattern Recognition, Knowledge Representation, Statistical Pattern Recognition, Classification Principles, Classifier Learning, Neural Nets, Syntactic Pattern Recognition, Recognition as Graph Matching.

UNIT V:
Mathematical Morphology Basic Morphological Concepts, Morphological Principles, Binary Dilation and Erosion, Opening, Closing, Properties of Morphological Operation, Boundary Detection, Region Filling, Thinning, Thickening and homotopic Skeleton

Recommended Books:

1. "Digital Image Processing" by Gonzalez & Wood
2. "Digital Image Processing" by A. K. Jain.
3. "Digital Image Processing and Computer Vision" by Sonka, Hlavac,Boyle
4. "Digital Image Processing'' by S Jayaraman

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COURSE OUTCOMES

After completion of this course the students would be able to:

CO1: recall the fundamental concepts Digital Image Processing system.
CO2: evaluate the techniques for image enhancement and restoration
CO3: analyzing the techniques for image segmentation
CO4: interpret object detection and pattern recognition techniques.
CO5: develop application using computer vision techniques

CO-PO Mapping

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

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Department of Computer Science and Engineering

(SP-1)

COURSE OBJECTIVES

- To provide a comprehensive introduction to the fundamental concepts of machine learning and pattern recognition, including supervised, unsupervised, and reinforcement learning techniques.
- To equip students with the skills to implement and apply various supervised learning algorithms, neural networks, and unsupervised learning methods for real-world problems.
- To explore advanced topics such as deep learning, Bayesian methods, hidden Markov models, and their applications in various domains like speech recognition and bioinformatics.

Unit 1: Introduction to Machine Learning and Pattern Recognition

Fundamental concepts of machine learning, Types of machine learning: supervised, unsupervised, reinforcement learning, Pattern recognition problem formulation,

Unit 2: Supervised Learning Algorithms and Bayesian Methods

Linear regression and logistic regression, Decision trees and random forests, Support vector machines (SVMs), Naive Bayes, K-Nearest Neighbors (KNN), Bayesian learning and probabilistic graphical models

Unit 3: Neural Networks and Deep Learning

Introduction to artificial neural networks, Feedforward neural networks and backpropagation, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Autoencoders and generative models, Bayesian deep learning (optional)

Unit 4: Unsupervised Learning, Clustering, and Dimensionality Reduction

Clustering algorithms (k-means, hierarchical clustering), Dimensionality reduction (PCA, t-SNE), Association rule mining, Anomaly detection

Unit 5: Pattern Recognition and Applications Sequential Data, HMMs, and Advanced Topics

Hidden Markov Models (HMMs): structure, inference, and learning, Machine learning for HMM training (EM algorithm), Approximate inference techniques (variational Bayes), Applications of HMMs in speech, bioinformatics, and other domains, Reinforcement learning (optional)

RECOMMENDED BOOKS

- C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
- R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
- S. Theodoridis and K. Koutroumbas, Pattern Recognition, Academic Press, 2009
- E. Alpaydin, Introduction to Machine Learning, Prentice-Hall of India, 2010

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1: Differentiate between various types of machine learning and formulate pattern recognition problems.
CO2: Implement and evaluate supervised learning algorithms.
CO3: Understand and apply artificial neural networks to solve complex problems.
CO4: Apply unsupervised learning methods to solve real world problems
CO5: Implement and utilize various models in various domains engineering.

CO-PO Mapping

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

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Big Data and Cloud Computing

SP1

COURSE OBJECTIVES

- Develop a comprehensive understanding of big data concepts and cloud computing technologies.
- Familiarize students with big data processing frameworks and cloud service models.
- Introduce advanced data analytics and machine learning concepts for big data.
- Prepare students for designing and implementing big data solutions in cloud environments.

Unit-I

Introduction to Big Data and Cloud Computing: Definition of Big Data, 3 V's of Big Data (Volume, Velocity, Variety), Additional V's (Veracity, Value), Big Data challenges, Introduction to Cloud Computing, Cloud service models (IaaS, PaaS, SaaS), Cloud deployment models (Public, Private, Hybrid, Community), Advantages and challenges of cloud computing.

Unit-II

Big Data Processing Frameworks: Hadoop ecosystem, HDFS architecture, MapReduce programming model, YARN, Apache Spark - RDDs, Spark SQL, Spark Streaming, GraphX, Introduction to NoSQL databases - MongoDB, Cassandra, HBase.

Unit-III

Cloud Platforms and Services: Amazon Web Services (AWS) - EC2, S3, RDS, Google Cloud Platform (GCP) - Compute Engine, Cloud Storage, BigQuery, Microsoft Azure - Virtual Machines, Blob Storage, Azure SQL Database, Comparison of cloud providers, Cloud security and privacy concerns.

Unit-IV

Big Data Analytics and Machine Learning: Data preprocessing techniques for big data, Distributed machine learning algorithms, Apache Mahout, Spark MLlib, Deep learning frameworks for big data - TensorFlow, PyTorch, Big data visualization techniques and tools - Tableau, Apache Zeppelin.

Unit-V

Big Data and Cloud in Practice: Real-time big data processing with Apache Kafka and Storm, Containerization and orchestration with Docker and Kubernetes, Serverless computing for big data, Case studies of big data applications in various domains (e.g., healthcare, finance, social media), Ethical considerations in big data analytics.

RECOMMENDED BOOKS

- Tom White, "Hadoop: The Definitive Guide", O'Reilly Media.
- Matei Zaharia, Bill Chambers, "Spark: The Definitive Guide", O'Reilly Media.
- Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", VPT.
- Rajkumar Buyya, Satish Narayana Srirama, "Fog and Edge Computing: Principles and Paradigms", Wiley.
- Dan C. Marinescu, "Cloud Computing: Theory and Practice", Morgan Kaufmann.

COURSE OUTCOMES

After completion of the course students would be able to:

CO1. Explain the fundamental concepts of big data and cloud computing, including their characteristics, challenges, and service models.

CO2. Describe and **use** various big data processing frameworks and NoSQL databases for handling large-scale data.

CO3. Analyse and **compare** different cloud platforms and their services for big data applications.

CO4. Apply advanced data analytics and machine learning techniques to big data problems using cloud-based tools and frameworks.

CO5. Design and **implement** big data solutions using cloud services, addressing real-world problems and ethical considerations.

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

1 - Slightly; 2 - Moderately; 3 – Substantially