MCA104T – ADVANCED DATABASE MANAGEMENT SYSTEM

UNIT – I: Introduction to DBMS **14 Hours**

Objectives, characteristics, advantages over traditional file systems. Database System Architecture: Levels of abstraction, data independence, DBMS components, system environment. Data Models: Relational, hierarchical, network, Entity–Relationship (ER), and Enhanced ER (EER) models. Relational Model Concepts: Attributes, tuples, relations, keys, constraints. Relational Algebra and Calculus: Basic operations, query formulation, tuple and domain relational calculus. Structured Query Language(SQL): DDL, DML, integrity constraints, simple and nested queries, joins, aggregate functions, views. Case Study: Schema design for a university database.

UNIT – II: Database Design and Recovery **14 Hours**

Functional dependencies, multivalued dependencies, normalization (1NF, 2NF, 3NF, BCNF, 4NF, 5NF). ER/EER-to-Relational Mapping: Design methodology with examples. Transaction Management: ACID properties, transaction states, concurrent executions, schedules. Concurrency Control: Lock-based protocols, two-phase locking, deadlock handling, timestamp ordering, optimistic concurrency control. Recovery System Design: Log-based recovery, checkpoints, shadow paging, ARIES algorithm.

UNIT – III: Query Processing and Optimization **14 Hours**

Steps in query processing, query compilation, query cost estimation, join algorithms, heuristic and cost-based optimization. Distributed Databases: Fragmentation and replication strategies, data transparency, distributed query processing, distributed transaction management, two-phase commit protocol. Parallel Databases: Intra-query and inter-query parallelism, partitioning techniques, parallel join strategies. Data Warehousing and OLAP: Data warehouse architecture, star and snowflake schemas, ETL process, OLAP operations (roll-up, drill-down, slice, dice, pivot). Case Study: Data warehouse design for a retail or banking system.

UNIT – IV: Advanced Data Models **14 Hours**

Object-oriented databases, object-relational databases, XML databases, temporal and spatial databases. NoSQL Databases: Introduction, CAP theorem, data models – key-value stores, column-oriented stores, document-oriented stores, and graph databases. MongoDB: Data model, CRUD operations, indexing, aggregation framework, replication and sharding. Big Data Systems: Introduction to Hadoop ecosystem, HDFS, MapReduce, Spark SQL overview. Database Security and Protection: Discretionary access control, mandatory access control, role-based security, database auditing. Emerging Trends: In-memory databases, cloud databases, blockchain databases, NewSQL systems.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan – Database System Concepts, 7th Edition, McGraw Hill, 2020.
2. RamezElmasri, Shamkant B. Navathe – Fundamentals of Database Systems, 7th Edition, Pearson, 2017.
3. Raghu Ramakrishnan, Johannes Gehrke – Database Management Systems, 3rd Edition, McGraw Hill, 2003.
4. Jiawei Han, MichelineKamber, Jian Pei – Data Mining: Concepts and Techniques, 3rd Edition, Elsevier, 2011 (for Data Warehousing & OLAP).
5. Kristina Chodorow – MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, 2019.