KARNAVATI UNIVERSITY | UIT

Unitedworld Institute Of Technology

शिक्षणतः सिद्धि

B.Tech. Computer Science & Engineering

Semester-3rd

Introduction to

Database Management Systems (DBMS)

Course Code: 71203002003

Unit 1

Mapped with CO-1

Prepared By:
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Vision of Department

To be known globally as a School of Excellence that provides transformative educational experience, creating positive societal impact through establishment of global centers of higher learning in emerging technology areas of computational intelligence in pursuit of academic excellence.

Mission of Department

1. **Foster critical thinking and instill values, skills, and attitudes in students to become lifelong learners and effective problem solvers.**
2. **Ensure seamless integration of academics, research, and innovation to nurture professional excellence and entrepreneurship.**
3. **Create an environment for holistic development by enhancing student-centric welfare activities, aiming to build socially responsible citizens.**

Course Outcome

- CO1 : Understand Database System Architecture concepts and the underlying concepts of its technologies, installation and instance setup containing a sample database.
- CO2 : Create ER Diagrams as per problem statement, implement normal forms for designing a database and utilize DML & DDL commands.
- CO3 : Solve any given practical database problem by implementing DML commands of SQL and PL/SQL including subqueries, joins, views, stored procedures and triggers.
- CO4 : Analyze transactions processing, control concurrency techniques and locking protocols and implement the DCL & TCL commands.
- CO5 : Evaluate Database Security, NoSQL Database technologies and create a working database application for a suitable use case by applying the project-based learning.

Syllabus

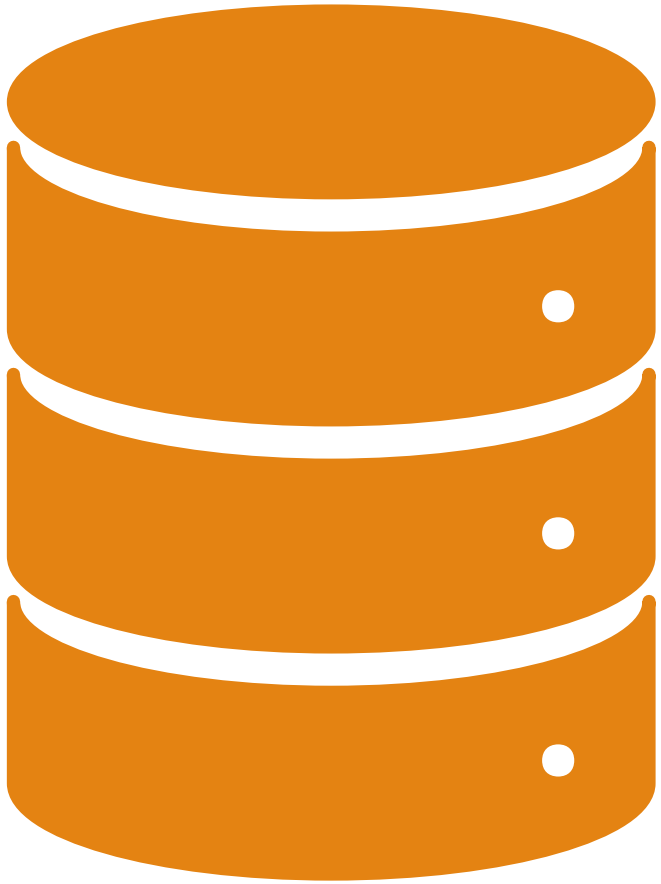
Course code	Course Name	Hours/week			Credit	Max. Marks
		L	T	P	C	
71203002003	Database Management Systems	3	0	1	4	100
Prerequisite	Basic programming skills					
Evaluation Scheme	Theory & Practical				Hours	Marks
	End Semester Examination				2	50
	Internal 1) Midterm – 10 Marks 2) CIA (Assignment/Certification/Quiz)-15 Marks 3) Attendance -5 Marks 4) Practical - 20 Marks					50
UNIT-I	INTRODUCTION TO DBMS					4
Introduction: An overview of database management system, Advantages and Applications, Database system vs Conventional File system, Database system Architecture, 3 Levels of Abstraction, Data models, Schema and Instance.						
UNIT-II	ER MODELLING AND NORMALISATION FORMS					12
Data Modelling using Entity Relationship Model: ER model concepts, Notations for ER diagram, Mapping cardinalities, Keys and Constraints, Concepts of Super Key, Candidate key, Primary key and foreign key, Extended ER model, Generalization & Specialization, Aggregation, Reduction of ER diagrams to tables. Basics of SQL - DDL, and DML commands. Functional dependencies, Armstrong's axioms, Normalization and its benefits, Normal forms, First Normal Form, Second Normal Form, Third Normal Form, BCNF, Fourth Normal Form, Fifth Normal Form, Dependency preserving decompositions, Lossless join decompositions.						

Syllabus

UNIT-III	STRUCTURED QUERY LANGUAGE - SQL AND PL/SQL	12
Table creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, Functions, Aggregate functions, Built-in functions: Numeric, Date, String functions, set operations, Sub-queries, Nested queries, Use of group by and order by, Joins and its types. Views in SQL, Transaction control commands: Commit, Rollback, Savepoint. PL/SQL Concepts: Cursors, PL/SQL Data types, Variables, Literals, Constants, Stored Procedures, Functions, Triggers.		
UNIT-IV	**TRANSACTIONS, CONCURRENCY CONTROL AND DEADLOCKS**	**11**
Transactions: ACID Properties, State Diagram, Serializability of schedules in database transactions, Consistent and Inconsistent state, Recoverable and Non-Recoverable Schedules, Cascading Rollback and Cascadeless Schedule, Recovery from transaction failures, Log based recovery, Checkpoints. Implementation of DCL and TCL commands. Concurrency control: Lock based techniques, Shared and Exclusive Locks, Two-Phase locking Protocol, Role of concurrency control manager, lock manager. Deadlocks: Deadlock Detection using wait-for-graph, Deadlock Recovery Schemes.		
UNIT-V	**DATABASE SECURITY AND NoSQL DATABASES**	**6**
Database Security: Overview, Discretionary access control, Mandatory Access Control, Data Encryption. NoSQL Databases: Overview, history and applications of NoSQL Databases, Advantages of NoSQL, Distributed Systems, Benefits: Data Availability, Fault tolerance and Load balancing, BASE Properties, Four Types of NoSQL Databases, Difference between Relational and Non-Relational Databases, Column-Family Data Store Features. Database Project development.		

UNIT-1

- Introduction: An overview of database management system,
- Advantages and Applications,
- Database system vs Conventional File system



What is a Database?

- A database is a well-organized collection of data that is stored and accessed electronically.
- The purpose of a database is to store data in a way that it can be easily retrieved, manipulated, and updated efficiently.
- Data in a database can represent real-world entities such as students, employees, products, etc.
- Modern databases support large volumes of data and multiple simultaneous users.

What is a DBMS?

A Database Management System (DBMS) is software that allows users to define, create, maintain, and control access to databases.

It ensures that the data is consistently organized and remains easily accessible. Examples include Oracle, MySQL, PostgreSQL, Microsoft SQL Server, etc.

DBMS provides tools and functionalities for querying data, performing transactions, creating reports, and ensuring data security and integrity.

Advantages of DBMS

1. Redundancy Control: Minimizes data duplication by centralizing data storage.

2. Data Consistency: Ensures data is updated in all locations simultaneously.

3. Improved Security: Allows access control and permissions based on user roles.

4. Backup and Recovery: Automated backup and recovery options prevent data loss.

5. Data Integrity: Enforces rules to ensure the accuracy and reliability of data.

Applications of DBMS

1. **Banking Systems**:
   Manage accounts, transactions, customer information.
2. **Universities**:
   Handle student records, attendance, exams, results.
3. **E-commerce**:
   Store product catalogs, customer details, order tracking.
4. **Airlines**:
   Reservation systems, scheduling, fare management.
5. **Social Media**:
   Store user profiles, messages, connections, feeds.

File System vs DBMS

File System is a traditional method of storing data in files. It lacks inter-file relationships and does not support sophisticated data manipulation.

DBMS, in contrast, supports complex data relationships, efficient querying, backup/recovery, and multi-user access.

Key differences include: Better data consistency, query capabilities, integrity constraints, and access control in DBMS.

File System vs DBMS

Basis	DBMS	File System
Storage	DBMS stores structured data in its storage system.	File system stores unstructured data in its storage system.
Function	DBMS, it's main function is to convert raw data into processed information, gain knowledge and accomplish the desired task and goals.	The file system is responsible for basic tasks such as file management, file naming, and access control.
Structure	Manages Database, data of data.	Manages and organizes the files in a storage medium within a compute.
Recovery	It provides backup or recovery if there's a loss of data.	It doesn't provide backup or recovery if there's a loss of data.
Security	DBMS is more secure for data storage than File system.	File system is comparatively less secure to store data.
Complexity	DBMS is complex than File System.	File System is quite simple when compared to DBMS.

Database Architecture (1-tier, 2-tier, 3-tier)

1-Tier:

Database is accessed directly without middleware (e.g., local development).

2-Tier:

Application connects to DBMS directly (Client-Server Model).

3-Tier:

Includes Presentation Layer (UI), Application Layer (logic), and Database Layer (DBMS) for better scalability and maintenance.

Three Levels of Data Abstraction

1. **Physical Level:** Describes how data is physically stored in the system.

2. **Logical Level:** Describes what data is stored and the relationships among the data.

3. **View Level:** Describes only part of the entire database to a user (user interface).

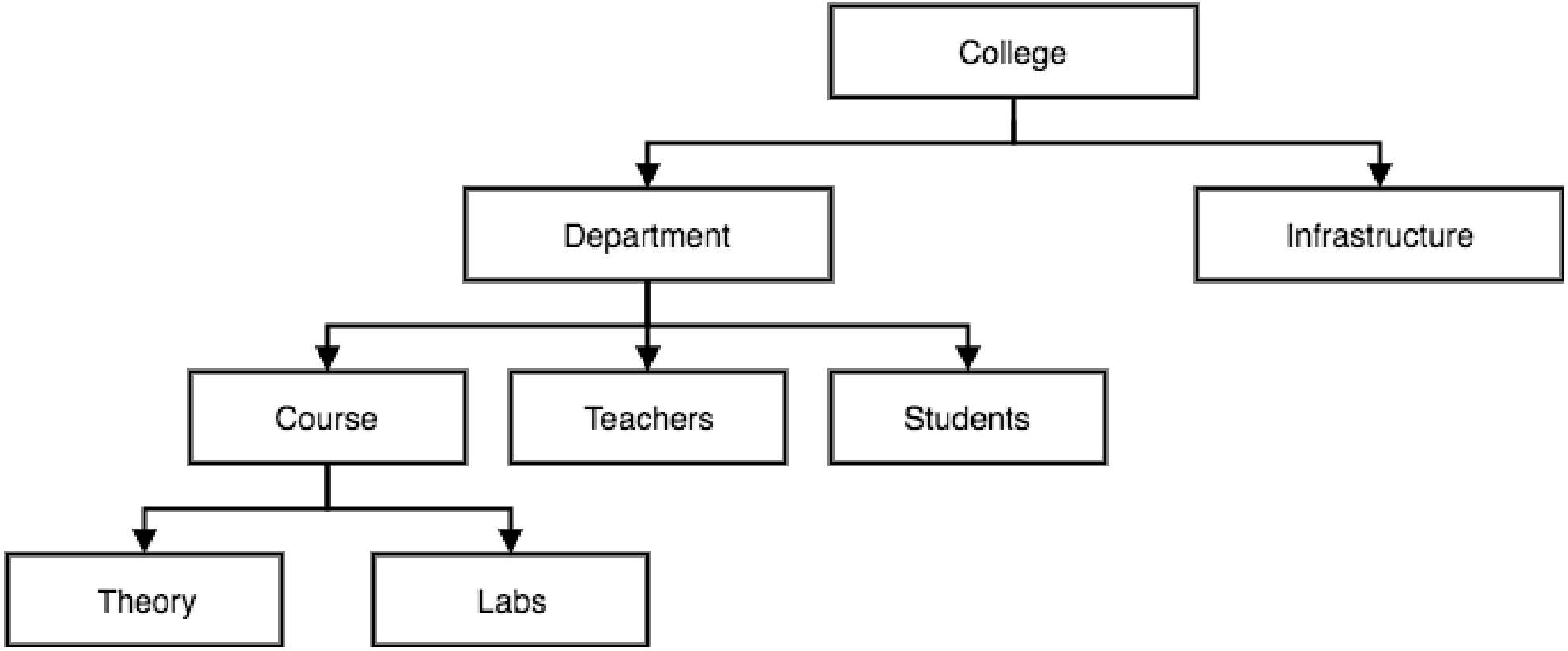
Data Models in DBMS

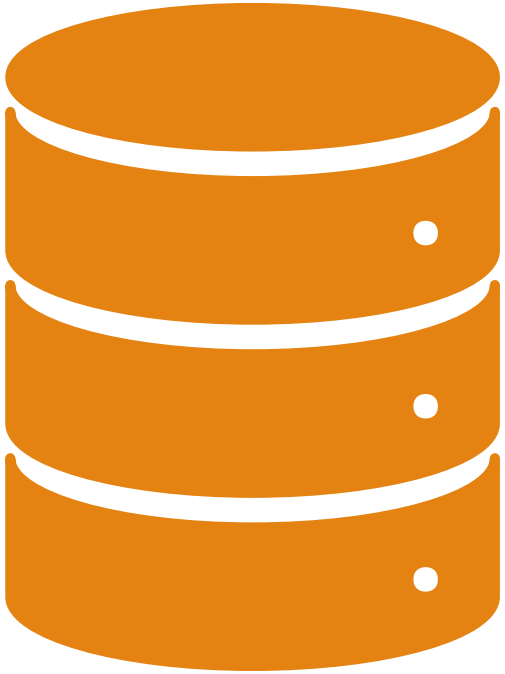
A data model defines how data is logically structured and how data can be manipulated.

Types of Data Models:

- **Hierarchical Model** – Data is organized in a tree-like structure.
- **Network Model** – More flexible with multiple parent-child relationships.
- **Relational Model** – Uses tables to represent data and relationships.
- **Object-Oriented Model** – Integrates object-oriented principles.
- **ER Model** – Represents data entities and relationships graphically.

Data Models in DBMS





Schema and Instance

Schema is the logical design of the database structure and defines the structure and constraints of data. It is stable over time.

Instance is a snapshot of the data in the database at a particular moment in time. It can change frequently.

Example: The structure of a student table is schema; the records inserted are instances.

Summary

DBMS provides an efficient way to store, retrieve, and manage data.

It offers numerous benefits over traditional file systems including consistency, security, and multi-user support.

Schema, instance, and data models are the core of DBMS theory.

Quiz / Discussion Questions

1. Differentiate between DBMS and file systems.
2. Explain the three levels of data abstraction with suitable examples.
3. Describe the advantages of using a DBMS.
4. What are the different types of data models used in DBMS?