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Tribhuvan University
Institute of Science and Technology
BSc.CSIT 4th Semester
Micro Syllabus of Database Management System
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Credit hours: 3 hrs.   **Full Marks: 60+20+20**
Course no.:(CSC 253)   **Pass Marks: 24+8+8**

Course Description: This is a first database course for B.Sc. Computer Science and Information Technology students. It introduces the fundamentals of database technology. Topics covered include: database concepts, Database System Architecture, E-R model, relational model, database design theory, database languages, transaction management, concurrency control and database recovery.

Course Objectives: There are two principle objectives for this course.

- To introduce the fundamental concepts and methods necessary for the design and use of a database systems.
- To provide practical experience in applying these concepts and methods using commercial database management systems.

Unit – 1   19 hrs

· Why Data Management is Important

· When Data Becomes Information

· Database Management System

  – Definition
  – Primary goal of DBMS: is to store and manage data
  – Related Data
  – Integrated Data
· Database Management Systems and Database Systems

· Example Usages of Database Management systems

· History

· Simplified Database System Organization

· Example of Relational Database: Student Records (any)

· Approaches to management of data

  – Database approach
  – File system approach
· File layout for the student records (any)

· Database Vs. File Systems Approaches

  – Data Abstraction

- – Reliability
- – Efficiency/Performance
- Data Models (in chronological order)

  - – Hierarchical
  - – Network
  - – Relational
  - – Entity Relationship
  - – Object Oriented
- Database Schema & Instances
- Data Abstraction…Views
- 3-level Architecture (ANSI/APARC Architecture
- Advantages of the 3 schema representation
- Mapping
- Data independence
- Drawbacks of using file systems to store data
- Advantages of Database Processing
  - – Extracting Information from Data
  - – Sharing of Data
  - – Standards
  - – Controlled Redundancy
  - – Integrity Control
  - – Security
  - – Economy of Scale
  - – Data Independence
- Additional Advantages of DB approach
  - – Expandability/Flexibility
  - – Reduce applications development time
  - – Economy of scale
  - – Centralized control by the DBA
- Applicability
  - – When a DBMS is needed?
  - – When a DBMS is Inappropriate?
- DBMS Languages
- Database System Components
  - – Data
  - – Hardware
  - – Software
  - – Users
- Data Administration and Database Administration
- Tasks of DBA
- DB End Users
- DB Developers
- Database System Structure

- Update Operations on Relations
  - INSERT a tuple
  - DELETE a tuple
    MODIFY a tuple
- Relational Algebra
  - Unary Relational Operations
  - Relational Algebra Operations From Set Theory, Type Compatibility
  - Binary Relational Operations
  - Additional Relational Operations
  - Examples of Queries in Relational Algebra
- Relational Calculus
  - Tuple Relational Calculus
    - Well-formed Formula
    - Safety of Expressions
    - Equivalent Expressions
    - Examples of Queries in Tuple Relational (Basic operations only)
  - Domain Relational Calculus (Basic operations only)
- Overview of the QBE language
- Relational Commercial Languages
  - SQL (DDL, DML, Views)
- ER-to-Relational Mapping Algorithm
  - Step 1: Mapping of Regular Entity Types
  - Step 2: Mapping of Weak Entity Types
  - Step 3: Mapping of Binary 1:1 Relation Types
  - Step 4: Mapping of Binary 1:N Relationship Types.
  - Step 5: Mapping of Binary M:N Relationship Types.
  - Step 6: Mapping of Multivalued attributes.
  - Step 7: Mapping of N-ary Relationship Types.

Unit – 2   12 hrs

- Constraints in SQL
  - Key constraints
  - Attribute constraints
  - Tuple constraints
  - Trigger and assertions
  - ECA rules
- Authorization and Privileges
- GRANT and REVOKE authorizations
- Data encryption (basic concept only)
- Functional Dependencies (FD)
- Trivial and non-trivial FDs, closure of a set of FDs, attribute closure FDs, irreducible set of FDs
- First, Second, and Third normal forms
- Transitivity, Reflexivity and Augmentation properties of FDs

- BCNF and decomposition into BCNF

Unit – 3   14 hrs

- Introduction to Transaction Processing
- Transaction and System Concepts
- Desirable Properties of Transactions (ACID)
- Characterizing Schedules based on Recoverability
- Characterizing Schedules based on Serializability
- Transaction Support in SQL
- Databases Concurrency Control
    - Purpose of Concurrency Control
    - Two-Phase locking
    - Limitations of CCMs
    - Timestamp-based protocols
    - Commit protocols
    - Index Locking
    - Lock Granularity
    - Time stamp ordering multi version concurrency control,
    - Deadlock handling - detection and resolution
- Databases Recovery
    - Purpose of Database Recovery
    - Types of Failure
    - The Storage Hierarchy
    - Buffer Management
    - Transaction Log
    - Data Updates
    - Data Caching
    - Transaction Roll-back (Undo) and Roll-Forward
    - Check pointing, shadow paging
    - Recovery schemes (WAL Write-Ahead Logging protocol)
    - Failure with Loss of Non-volatile storage (general concepts)
    - Recovery in Multidatabase System

Prerequisite: Be familiar with at least one high-level programming language such as C, C++ or Java. Introduction to Operating Systems, Data Structures and Algorithms.

Textbooks: A. Silberschatz, H.F. Korth, and S. Sudarshan, *Database System Concepts*, 4th edition, McGraw Hill

References: 1.C. J. Date, *An Introduction to Database Systems* , 8th edition, Addison Wesley

2. Raghu Ramakrishnan, and Johannes Gehrke, *Database Management Systems*, McGraw-Hill, 2003. (ISBN: 0-07-246563-8)

3. Ramez Elmasri and Shamkant B. Navathe, *Fundamentals of Database Systems*, Fourth Edition, Pearson Addison Wesley; 2003, (ISBN: 0321122267)

Laboratory Projects: The course involves a mini project using any one of the popular

Commercial database packages like Oracle, MySql, MS SQL Server, MS Access etc.

Homework
Homework assignments can be given according to the course **Assignments:** covered throughout the semester.

Computer Usage:
Windows or Linux based PC or workstation, Commercial database package installed in the Database server.

Category Content:
Science Aspects: 60%

Design Aspects: 40%