

Module Data Storage and Analysis

School of Electrical and Computer Engineering Addis Ababa University, Addis Ababa Institute of Technology	
Course Number	ECEG-4191
Course Title	Database Systems: 5 (2,1,2)
Degree Program	“Electrical Engineering (Computer)”, Bachelor of Science
Module	Data Storage and Analysis
Module Coordinator	N.N.
Lecturer	-
ECTS Credits	5
Contact Hours (per week)	5
Course Objectives & Competences to be Acquired	<p>Up on completion of this course, students will have g gained knowledge of database system concepts and the ability to:</p> <ul style="list-style-type: none">• understand user requirements/views• analyze existing and future data processing needs• develop an enterprise data model that reflects the organization's fundamental business rules• develop and refine the conceptual data model, including all entities, relationships, attributes, and business rules• integrate and merge database views into conceptual model• apply normalization techniques• derive a physical design from the logical design taking into account application, hardware, operating system, and data communications networks requirements

Course Description/Course Contents

1. Introduction

- Manual file handling systems and limitations
- Traditional File based systems
- Database approach
- Database management system (DBMS)
- DBMS and Components of DBMS Environment
- Database Development Life Cycle
- Some common uses of database
- ANSI-SPARC Architecture
- Multi –user DBMS

2. Relational model

- Data models
- Relational data model
- Relational database
- Database terminology
- Relational constraints
- Schema and instances

3. Conceptual Database Design, E-R modeling

- Database design phase
- Conceptual database design
- Basic concepts of E-R model
- Graphical representation of E-R diagram
- Structural constraints on relationship
- Participation constraints of a relationship

- EER (Enhanced ER or Extended ER) Model Concepts
 - ✓ subclasses/superclasses
 - ✓ specialization/generalization
 - ✓ categories (UNION types)
 - ✓ attribute and relationship inheritance
- Case study: company database

4. Logical Database Design

- **ER-to-Relational Mapping Algorithms**
 - ✓ 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.
- **Mapping EER Model Constructs to Relations**
 - ✓ Step 8: Options for Mapping Specialization or Generalization.
 - ✓ Step 9: Mapping of Union Types (Categories).
- **Informal Design Guidelines for Relational Databases**
 - ✓ Semantics of the Relation Attributes
 - ✓ Redundant Information in Tuples and Update Anomalies
 - ✓ Null Values in Tuples
 - ✓ Spurious Tuples
- **Functional Dependencies (FDs)**
 - ✓ Definition of FD
 - ✓ Inference Rules for FDs
 - ✓ Equivalence of Sets of FDs

✓ Minimal Sets of FDs

- **Normal Forms Based on Primary Keys**

- ✓ Normalization of Relations
- ✓ Practical Use of Normal Forms
- ✓ Definitions of Keys and Attributes Participating in Keys
- ✓ First Normal Form
- ✓ Second Normal Form
- ✓ Third Normal Form

- **General Normal Form Definitions (For Multiple Keys)**

- **BCNF (Boyce-Codd Normal Form)**

5. The Relational Algebra and Calculus (Query processing)

- **Relational Algebra**

- Unary Relational Operations
- Relational Algebra Operations from Set Theory
- Binary Relational Operations
- Additional Relational Operations
- Examples of Queries in Relational Algebra

- **Relational Calculus**

- Tuple Relational Calculus
- Domain Relational Calculus

- **Example Database Application (COMPANY)**

6. Structured Query Language (Schema Definition, Basic Constraints, and Queries)

- **Objectives of SQL**

- **Data Definition Language (DDL)**

- CREATE, ALTER, DROP, for database and relation
- Referential integrity options

- **Data Manipulation Language (DML)**
 - Retrieval Queries in SQL
 - Simple SQL Queries: SELECT, PROJECT, JOIN
 - Aliases, * and DISTINCT, Empty WHERE-clause
 - Set operations: UNION, INTERSECTION, MINUS
 - Nesting of Queries
 - JOINED Relations Feature
 - AGGREGATE functions
 - GROUPING
 - The HAVING clause
 - ORDER BY
 - Summary of SQL Queries
 - Specifying Updates in SQL
 - INSERT, DELETE, and UPDATE
 - The EXISTS function
 - Explicit sets
 - NULLs in SQL queries
 - SUBSTRING comparison

7. Disk Storage, Basic File Structures, and Hashing

- Disk Storage Devices
- Files of Records
- Operations on Files
- Unordered Files
- Ordered Files
- Hashed Files
 - ✓ Dynamic and Extendible Hashing Techniques
- RAID Technology

Pre-requisites	Object Oriented Programming(Co-requisite or Pre-requisite)
Semester	VII/7
Status of Course	Compulsory
Teaching & Learning Methods	Lectures, tutorials, lab exercises, project, etc
Assessment/Evaluation & Grading System	Project and Assignment (30%), Tests (30%), and Final Exam (40%)
Attendance Requirements	Minimum Attendance 75 %
Literature	<p><i>Textbook:</i></p> <ul style="list-style-type: none"> ▪ Elmasri, Navathe: Fundamentals of Database Systems <p><i>References:</i></p> <ul style="list-style-type: none"> ▪ Silbershatz, Korth, Sudarshan: Database system concepts ▪ Raghu Ramakrishnan, Johannes Gehrke: Database management systems ▪ H.C. Mollina, J.D. Ullman, J. Widom: Database system, the complete book ▪ Pervasive Software Inc., Database design guide