Document Contents

Course Overview

Course Objectives

Course Syllabus

Lesson 1: Database Overview
Lesson 2: Database objectives
Lesson 3: Data Modeling Using the Entity-Relationship (ER) Model
Lesson 4: Relational Data Model
Lesson 5: Relational Database constraints
Lesson 6: The Relational Algebra
Lesson 7: The Relational Algebra Part 2
Lesson 8: SQL: Schema Definition, Basic Constraints, and Queries
Lesson 9: Functional Dependencies
Lesson 10: Normalization
Course Overview

Course Name: Introduction to Database Concepts

Credit Hours: 3
Weekly Lectures: 3
Weekly Tutorials: 1
Weekly Labs: 0

This course aims at giving the students a broad foundation in the fundamental concepts of database. This should allow students to design and implement real life databases, in addition to evaluate existing ones. Students will be able to use query of different types of complexity.

Students should be able to use the most common types of database management systems. The skills and understanding developed in this course should give necessary background for designing and implementing databases of different complexity and on different platform single-user (or desktop-based) or web-based database.

Students should be able to know the existing commercial DBMSs, their capabilities, their services and their complexity.

On successful completion of this course, students should be able to:

- Design a database using the ER data model (ERD)
- Map a designed ERD into a relational data model
- Implement a relational database schema using SQL
- Update a database
- Write queries of different type of complexity
- Design relational database using normal forms
Course objectives:

Upon completion of this course a student will be able to:

1. Understand the basic database concepts architecture and the different components of a DataBase Management System (DBMS).
2. Master some data models mainly the entity-relationship and the relational data models.
3. Get acquainted with the relational algebra and its related language.
4. Design and implementing real database schemas along with their related constraints
5. Write different types of queries using SQL.
6. Manipulate a database in term of inserting, deleting and modifying data.
7. Analysis real world company constraints and designing databases using formal methodologies
8. Demonstrate an awareness of computer viruses and ways to protect a computer from viruses.
9. Evaluate and enhance any given database design schema
10. Understand the novel data models such as the object-relational data model
Course Syllabus:

Lesson 1: Database overview
- Types of Databases and Database Applications
- Basic Definitions
- Typical DBMS Functionality
- Example of a Database
- Main Characteristics of the Database Approach
- Levels of Abstraction
- View of Data
- Instances and Schemas
- Database Users
- Categories of End-users
- Advantages of Using the Database Approach
- Historical Development of Database Technology
- Extending Database Capabilities
- Overall System Structure
- Application Architecture

Lesson 2: Database objectives
- Offering different levels of abstraction
- Physical Data Independence
- Logical Data Independence
- Data Redundancy Control
- Users of different levels
- Data Integrity
- Data Sharing
- Data Security
- Optimizing The Data Access

Lesson 3: Data Modeling Using the Entity-Relationship (ER) Model
- Database Design Steps
- ER Model Concepts
  - Entity Types and Key Attributes
  - Attribute types
  - Relationships and Relationship Types
  - Weak Entity Types
  - Constraints on Relationships
  - Structural Constraints
- Alternative notation
- Examples

Lesson 4: The Relational Data Model
- The Relational Model Concepts
  - Tuple, domain, instance, schema, role
- The Relational Model Constraints and Relational Database Schemas
- Dealing with Constraint Violations
Lesson 5: The Relational Database constraints
- Relational integrity constraints
- Key constraints
- Entity integrity
- Referential integrity
- Other types of constraints
- Example
- ER to Relational mapping algorithm

Lesson 6: The Relational Algebra
- Relational Algebra
- Unary Relational Operations
  - Select, project, rename,
- Relational Algebra Operations From Set Theory
  - Union, difference, intersection, Cartesian-product
- Binary Relational Operations
- Additional Relational Operations
- Examples of Queries in Relational Algebra
- Example of Queries

Lesson 7: The Relational Algebra Part 2
- Additional Relational Operations
- Aggregate functions
- Recursive Closure
- Outer join
- Outer union
- Examples of Queries in Relational Algebra

Lesson 8: SQL: Schema Definition, Basic Constraints, and Queries
- Data Definition Language
- Features Added in SQL2 and SQL-99
- Basic Structure and retrieval queries in SQL
- Set Operations
- Aggregate Functions
- Nested Sub-queries
- Derived Relations
- Views
- Modification of the Database (Data Manipulation Language)
- Joined Relations
- Embedded SQL, ODBC and JDBC

Lesson 9: Functional Dependencies
- Informal Design Guidelines for Relational Databases
- Semantics of the Relation Attributes
- Redundant Information in Tuples and Update Anomalies
- Spurious Tuples
- Functional Dependencies (FDs)
- Inference Rules for FDs
- Equivalence of Sets of FDs
Lesson 10: Normalization

- Normal Forms Based on Primary Keys
- Normalization of Relations
- Definitions of Keys and Attributes Participating in Keys
- First Normal Form
- Second Normal Form
- Third Normal Form
- BCNF (Boyce-Codd Normal Form)
- Overall Database Design Process