

Course number and name: **CS 04430: Database Systems: Theory and Programming**
Credits and contact hours: 3 credits / 3 contact hours
Instructor's or course coordinator's name: Jack Myers
Text book, title, author, and year: Fundamentals of Database Systems, 7th Edition - Ramez Elmasri

Specific course information

Catalog description: This course focuses on the design of DBMS and their use to create databases. The course covers both the theoretical concepts and the implementation aspects of database systems with a special emphasis on relational database systems, SQL, programming (in a modern programming language such as C++ or Java) using a real database Application Programming Interface (such as JDBC or ODBC)

Prerequisites: CS 04222 Data Structures and Algorithms

Type of Course: Required Elective Selected Elective

Specific Goals for Course

By the end of the course, students should be able to:

1. Define the terminology, features, classifications, and characteristics embodied in database systems.
2. Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.
3. Demonstrate an understanding of the relational data model.
4. Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
5. Formulate, using SQL, solutions to a broad range of query and data update problems.
6. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
7. Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
8. Understand the value of NoSQL databases, and how to implement and query them
9. Use a desktop database package to create, populate, maintain, and query a database.
10. Demonstrate a rudimentary understanding of programmatic interfaces to a database and be able to use the basic functions of one such interface.
11. Be familiar with the basic issues of transaction processing and concurrency control.
12. Understand security issues associated with database development.

Required list of topics to be covered:

1. Overview of database types with advantages and disadvantages
2. Database concepts (indexing, inference, aggregation, polyinstantiation)
3. Data Modeling
4. Relational Model – Types of Keyx
5. From Basic to Advanced Queries
6. DDL and DML
7. Using variables and inner joins
8. Aggregation queries
9. Subqueries
10. Functional dependencies and data normalization
11. Query optimization and indexes
12. Programming at DB level: procedures and triggers
13. Programming at web server level
14. NoSQL Databases
15. Database Administration (user creation/deletion, permissions and database access controls such as DAC, MAC, RBAC, Clark-Wilson)
16. Database Security
 - a. How to protect data (confidentiality, integrity and availability in a DBMS context)
 - b. Vulnerabilities (e.g., SQL injection)
 - c. Inference
 - d. Aggregation
 - e. Hashing and encryption
 - f. Data corruption
 - g. Unauthorized access

Optional list of topics to be covered:

1. Java EE and Java Persistence API
2. Transactions and Locking