

CS 4611: Database Management Systems (4)**Catalog Description:**

Study of database management fundamentals focusing on the relational data model. Topics include database organization, file organization, query processing, concurrency control, recovery, data integrity, optimization and view implementation.

Textbook: Ramez Elmasri and Shamkant Navathe, *Fundamentals of Database Systems*, 5th Ed., Addison Wesley, 2006.

References:**Course Goals:**

This course presents a comprehensive introduction to database management systems from several perspectives. Students will be introduced to methods for designing a database, query languages used in modern databases (as well as the theoretical query languages these languages are based on), methods for implementing applications including databases, and fundamental issues in the implementation of databases (such as file organization, page organization, query implementation, and transaction management) and how these issues affect the overall performance of a database system. The course emphasizes significant implementation projects that give students experience with databases from these multiple perspectives. The overall goal of the course is to familiarize students with database essentials and to arm them with the knowledge and experience necessary to address database management as a database user, a database administrator, or as a database software engineer.

Prerequisites by Course & Topic

CS 2511: Software Design and Analysis – software engineering, object-oriented design, software testing and debugging, team implementation

CS 2521: Computer Organization and Architecture – basics of computer organization, data structure and representation (machine level)

Major Topics Covered in the Course

- Database Design and Organization (ER diagrams, the Relational Model)
- Query Languages (Relational Algebra, Relational Calculus, SQL)
- Database Application Implementation (Three Tier Architecture)
- Physical DBMS Representation (Files, Indexes)
- Query Evaluation (External Sorting, Joins, Optimization)
- Transaction Management (Concurrency Control, Crash Recovery)

Class/Laboratory Schedule: Lecture: 3 hours per week, Laboratory: 1

Course Outcomes

1. Proficiency with query languages for database systems.
 - a. Understand the basics of relational algebra and relational calculus and construct queries using them.
 - b. Understand the basics of SQL and construct queries using SQL.
 - c. Understand the interactions of relational algebra, calculus, and SQL.
2. Proficiency with database file organization.
 - a. Understand basic file, tuple and page organizations.
 - b. Implement a basic file organization.
 - c. Understand a variety of indexing methods including both tree and hash based indexes.
 - d. Implement an indexing method for file reference.
 - e. Understand the elements of a system catalog.
 - f. Implement a systems catalog.
3. Familiarity with query evaluation methods.
 - a. Understand the basics of query plan generalization and optimization.
 - b. Understand evaluation methods for single query plans, join plans, set operations, projection and external sorting.

4. Familiarity with issues in management of transactions.
 - a. Understand the basics issues of concurrency and serialization.
 - b. Understand the basic issues of logging and crash recovery.
5. Further proficiency with software design in high-level languages.
 - a. Design and develop a DBMS system
 - b. Develop SQL solutions for given problems.

Relationship to Program Outcomes

CS 4611 is an elective course that requires software analysis and design and computer organization and architecture as prerequisites. This course contributes to meeting the following program outcomes:

2. *Students can design, develop, and analyze significant software systems.*

This course deepens a student’s knowledge of problem analysis and software design. Their program assignments are evaluated in part on overall design and programming methodology. The students gain experience both in understanding existing software systems and in designing extensions to that software. Students also gain significant experience with debugging tools as part of this course. Course outcomes 1-5 map to this program outcome.

3. *Students understand the fundamentals of computer organization and architecture, data structures and related algorithms, and programming languages.*

Students significantly increase their proficiency in programming languages As part of the database project they use significant algorithms and data structures. Students gain further experience with the interactions of the various levels of a computing system. Students also learn the database programming language SQL and PL/SQL. Course outcomes 1-5 map to this program outcome.

4. *Students can apply computer science principles and practices to a variety of problems.*

The students have the opportunity to implement a complete DBMS. Students also design and implement sample SQL queries. Course outcomes 1-5 map to this program outcome.

Assessment Plan for Course:

This course is assessed every third year by the instructor and a course assessment document covering all of the course outcomes and their effect on the program outcomes is prepared.

Estimate CSAB Category Content

	CORE	ADVANCED		CORE	ADVANCED
Data Structures		1	Computer Organization and Architecture Concept of Programming Languages		
Algorithms		1			1
Software Design		1			

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