COURSE DESCRIPTION

<table>
<thead>
<tr>
<th>Dept., Number</th>
<th>CS 387</th>
<th>Course Title</th>
<th>Database Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester hours</td>
<td>4</td>
<td>Course Coordinators</td>
<td>Malerba, Scharff</td>
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</tbody>
</table>

2004-2006 Catalog Description

This course will include the study of data models, data normalization, data description languages and their design and form, query facilities including relational algebras, relational calculus, and query functions.

New Course Description

This course presents the fundamental concepts of database design and use. It provides a study of data models, data description languages, and query facilities including relational algebra and SQL, data normalization, transactions and their properties, physical data organization and indexing, security issues and object databases. It also looks at the new trends in databases. The knowledge of the above topics will be applied in the design and implementation of a database application using a target database management system as part of a semester-long group project.

Textbook  Faculty may choose the latest edition of one of the following:

C. J. Date;  *An Introduction to Database Systems*;  Addison Wesley

Philip M. Lewis, M. Kifer, and Arthur J. Bernstein;  *Database and Transaction Processing: An Application-Oriented Approach*;  Addison & Wesley

Abraham Silberschatz, Henry F. Korth, and S. Sudarshan;  *Database System Concepts*;  McGraw Hill

Jeffrey D. Ullman and Jennifer Widom;  *A First Course in Database Systems*;  Prentice Hall
Course Goals

**Objective 1:** To introduce databases concepts and terminology

Outcome: Students will demonstrate the ability to:

- explain and describe the general notions and terminology associated with database and database management systems

**Objective 2:** To explain the meaning of database design and its significance

Outcomes: Students will demonstrate the ability to:

- design and draw an entity-relationship model
- derive a relational model from an entity-relationship model
- use SQL as a data description language
- explain the degrees of normalization and normalize relations

**Objective 3:** To introduce the use of a database management system.

Outcomes: Students will demonstrate the ability to:

- use a database management system such as Oracle, MySQL, DB2, SQL Server or PostgreSQL
- discuss and apply database management systems’ performance and query processing
- Write queries in the Relational Algebra
- Write simple and sophisticated SQL queries (sophisticated SQL queries are based on the set, IN, GROUP BY, HAVING and EXISTS operators)
- Transform simple queries from relational algebra to SQL, and from SQL to relational algebra

**Objective 4:** To develop skills in the construction and the life-cycle use and maintenance of a production-quality database as part of a semester-long group project

Outcomes: Students will demonstrate the ability to:

- explain the issues associated with each phase of the development and use of a database application
- define transactions and the ACID properties (Atomicity, Consistency, Isolation, Durability)
**Objective 5:** To raise awareness of contemporary issues and new trends in database management systems

Outcomes: Students will demonstrate the ability to:

- discuss security issues in databases
- explain the structure and utility of an object database
- explain the nature of data mining
- explain the role of XML in database applications

**Prerequisites by Topic**

- Ability to compose statements in formal logic, both propositional and predicate.
- Ability to explain and analyze important mathematical discrete structures
- Familiarity with data structures and their allied algorithms.
- Ability to program in a high-level language programming

**Major Topics Covered in the Course**

- Discrete structures (sets and relations definitions)
- Data models (entity-relationship diagrams, the relational model, transformation of an ERD to a set of relations)
- SQL as a data description languages (CREATE TABLE and constraints including those introduced by PRIMARY KEY, CHECK, UNIQUE, and FOREIGN KEY)
- Query facilities in relational algebra (presentation of the project, select, Cartesian product, equi-join, theta-join, and natural join operators)
- Query facilities in SQL (including aggregates, set, IN, GROUP BY, HAVING and EXISTS operators.)
- Data normalization (1NF, 3NF, and BCNF forms, normalization algorithms)
- Transactions and the ACID properties (Atomicity, Consistency, Isolation, Durability)
- SQL in applications
- Physical data organization and indexing (including primary, secondary, clustered, and unclustered indexes)
• Object databases and ODBMS (Object DataBase Management Systems)

• Security issues (including the SQL injection vulnerabilities)

• New trends in databases (e.g. data mining, XML)

**Laboratory Project**

Students will undertake a semester long project. Given a set of requirements, students analyze, design, implement, and test a database application. Entity-relationship diagrams and database schemas are designed. SQL tables and queries are produced. Depending on the instructor, the database application is implemented as transactions using Java, JDBC, HTML forms, and Java Servlets in a group project, or implemented as an individual project in a relational database management system making use of sophisticated SQL queries.