



COURSE TITLE	: Database Systems
COURSE PREREQUISITE	: Data Structures
COURSE DURATION	: 16 weeks (3 hours/week)
COURSE METHODOLOGY:	Lecture, Laboratory Exercises and Case Study

### Course Description

This course introduces students to the underlying concepts and theory of database systems. Topics include database system architectures, data models, query languages, conceptual and logical design, physical organization and transaction management. The entity-relationship model and relational model are discussed in detail for the basis of developing the conceptual model. The mapping from the conceptual level to the logical level, integrity constraints, dependencies and normalization are studied as a basis for formal design. Theoretical languages such as the relational algebra and the relational calculus are described, and high-level languages such as SQL are discussed. File organization and access methods are provided as a basis for discussion of query optimization techniques. Transaction processing techniques are presented with a specific emphasis on concurrency control and database recovery.

JavaDB, Sun's supported distribution of the open source Apache Derby (100% Java technology database) will be used to learn database concepts.

### Course Outline

Week	Topics
1	Introduction to Database Systems <ul style="list-style-type: none"> <li>● The Database Environment               <ul style="list-style-type: none"> <li>○ Information Resource Management</li> <li>○ The Database Approach</li> <li>○ Components of the Database Environment</li> </ul> </li> <li>● The Database Development Process               <ul style="list-style-type: none"> <li>○ Information Systems Life Cycles</li> <li>○ Main Phases of Database Development                   <ul style="list-style-type: none"> <li>■ Conceptual</li> <li>■ Logical and Physical Design</li> <li>■ Implementation</li> <li>■ Administration</li> </ul> </li> </ul> </li> </ul>

## Course Outline

Week	Topics
2-3	<p>The Entity-relationship Modeling</p> <ul style="list-style-type: none"><li>● Situation Analysis</li><li>● Entity-relationship Model Constructs<ul style="list-style-type: none"><li>○ Entities</li><li>○ Attributes<ul style="list-style-type: none"><li>■ Simple vs. Composite Attributes</li><li>■ Single-valued vs. Multi-valued Attributes</li><li>■ Stored vs. Derived Attributes</li></ul></li><li>○ Relationships<ul style="list-style-type: none"><li>■ Attributes on Relationship</li><li>■ Associative Entities</li><li>■ Degree of Relationship</li><li>■ Cardinality Constraints</li></ul></li><li>○ Enhanced ERD Modeling<ul style="list-style-type: none"><li>■ Representing Supertypes and subtypes</li><li>■ Specifying Constraints</li></ul></li><li>○ Business Rules<ul style="list-style-type: none"><li>■ Structural Constraints</li><li>■ Operational Constraints</li></ul></li></ul></li></ul>
4-5	<p>The Logical Database Design and Relational Model</p> <ul style="list-style-type: none"><li>● The Relational Data Model</li><li>● Relational Algebra and Relational Calculus</li><li>● Transforming EER Diagrams into a Relational Model</li><li>● Normalization<ul style="list-style-type: none"><li>○ Steps in Normalization</li><li>○ Functional Dependencies and Keys</li><li>○ Normal Forms</li></ul></li><li>● Integrity Constraints</li></ul>
6-7	<p>The Physical Database Design</p> <ul style="list-style-type: none"><li>● Business Rules and Integrity Constraints<ul style="list-style-type: none"><li>○ Domain Constraints<ul style="list-style-type: none"><li>■ Data Types and Allowable Values</li><li>■ Format and Code Design</li><li>■ Entity Integrity</li><li>■ Referential Integrity</li><li>■ Triggering Operations</li></ul></li></ul></li><li>● File Organization and File Access Methods</li><li>● Indexes</li><li>● Denormalization</li></ul>

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Week	Topics
8-13	<p>Structured Query Language (SQL)</p> <ul style="list-style-type: none"> <li>● The Relational Language</li> <li>● Structured Query Language Preliminaries</li> <li>● Data Definition Language                             <ul style="list-style-type: none"> <li>○ Table Statements</li> <li>○ Index Statements</li> <li>○ View Statements</li> </ul> </li> <li>● Data Manipulation Language                             <ul style="list-style-type: none"> <li>○ Selection Statement</li> <li>○ Insert Statement</li> <li>○ Delete Statement</li> <li>○ Update Statement</li> </ul> </li> <li>● Triggers</li> </ul> <p>Java Database Connectivity (JDBC) Concepts and API</p> <ul style="list-style-type: none"> <li>● JDBC Design Pattern</li> <li>● JDBC API</li> <li>● JavaDB Server-side Programming                             <ul style="list-style-type: none"> <li>○ JDBC Stored Procedures</li> <li>○ JDBC Stored Functions</li> </ul> </li> </ul>
14-15	<p>Transaction Management</p> <ul style="list-style-type: none"> <li>● Transaction Support                             <ul style="list-style-type: none"> <li>○ ACID Properties</li> <li>○ Database Architecture</li> </ul> </li> <li>● Concurrency Control                             <ul style="list-style-type: none"> <li>○ Serializability and Recoverability</li> <li>○ Concurrency Control Techniques                                     <ul style="list-style-type: none"> <li>■ Deadlocks</li> <li>■ Timestamping</li> </ul> </li> <li>○ Optimistic Techniques</li> <li>○ Granularity of Data Items</li> </ul> </li> <li>● Database Recovery                             <ul style="list-style-type: none"> <li>○ Transactions and Recovery</li> <li>○ Recovery Facilities</li> <li>○ Recovery Techniques</li> </ul> </li> <li>● JDBC Transaction Support</li> </ul>
16	<p>Query Processing</p> <ul style="list-style-type: none"> <li>● Query Decomposition</li> <li>● Heuristic Approach to Query Optimization                             <ul style="list-style-type: none"> <li>○ Transformation Rules for Relational Algebra Operations</li> <li>○ Heuristic Processing Strategies</li> </ul> </li> <li>● Cost Estimation                             <ul style="list-style-type: none"> <li>○ Selection Operation</li> <li>○ Join Operation</li> <li>○ Projection Operation</li> <li>○ Set Operation</li> <li>○ Aggregate Operation</li> </ul> </li> <li>● Pipelining</li> </ul>

## Requirements

### Supported Operating Systems

The NetBeans IDE 6.0.1 runs on operating systems that support the Java VM.

- Microsoft Windows XP Professional SP2 or newer
- Microsoft Windows Vista
- Mac OS X 10.4.9 or newer
- Ubuntu 7.x
- Red Hat EL 4
- Solaris™ 10 Operating System Update 1 (SPARC® and x86/x64 Platform Edition)

**Note:** The NetBeans IDE's minimum screen resolution is 1024x768 pixels.

Operating System	Processor	Memory	Disk Space
Microsoft Windows	800 MHz Intel Pentium III or equivalent	512 MB	750 MB of free disk space
Linux	800 MHz Intel Pentium III workstation or equivalent	512 MB	650 MB of free disk space
Solaris OS (SPARC)	UltraSPARC II 450 MHz	512 MB	650 MB of free disk space
Solaris OS (x86/x64 Platform Edition)	AMD Opteron 100 Series 1.8 GHz	512 MB	650 MB of free disk space
Macintosh OS X operating system	PowerPC G4 or Dual Core Intel	512 MB	650 MB of free disk space

### Recommended Hardware Configuration

Operating System	Processor	Memory	Disk Speed
Microsoft Windows	2.6 GHz Intel Pentium III workstation or equivalent	1 GB	1 GB of free disk space
Linux	2.6 GHz Intel Pentium III workstation or equivalent	1 GB	850 MB of free disk space
Solaris OS (SPARC)	UltraSPARC IIIi 1 GHz	1 GB	850 MB of free disk space
Solaris OS (x86/x64 Platform Edition)	AMD Opteron 100 Series 1.8 GHz	1 GB	850 MB of free disk space
Macintosh OS X operating system	PowerPC G5 or Dual Core	1 GB	850 MB of free disk space

### Required Software

NetBeans IDE runs on the J2SE (Java SE Development Kit) JDK 5.0 Update 12 and higher (including JDK 6.0), which consists of the Java Runtime Environment plus developer tools for compiling, debugging, and running applications written in the Java language. You can download the JDK for your platform from one of the sites listed below:

**Solaris:** <http://java.sun.com/j2se/1.5.0/download.html>

**Windows:** <http://java.sun.com/j2se/1.5.0/download.html>

**Linux:** <http://java.sun.com/j2se/1.5.0/download.html>

**Mac OS X:** <http://www.apple.com/support/downloads/javaformacosx104release5.html> (Mac OS X 10.4.8 or later). Java upgrades for Mac OS-X are also available via Apple's Software Update mechanism.

**Open VMS:** <http://h18012.www1.hp.com/java/download/index.html>

For more information, please visit: <http://www.netbeans.org/community/releases/60/relnotes.html>

Java™ DB is supported on the Solaris, Linux and Windows operating systems and Sun Java 1.4 or later.