uCertify

Course Outline

Fundamentals of Database Systems

04 Aug 2025

1. Course Objective
2. Pre-Assessment
3. Exercises, Quizzes, Flashcards & Glossary

   Number of Questions
4. Expert Instructor-Led Training
5. ADA Compliant & JAWS Compatible Platform
6. State of the Art Educator Tools
7. Award Winning Learning Platform (LMS)
8. Chapter & Lessons

   Syllabus

   Chapter 1: Introduction

   Chapter 2: Databases and Database Users

   Chapter 3: Database System Concepts and Architecture

   Chapter 4: Data Modeling Using the Entity–Relationship (ER) Model

   Chapter 5: The Enhanced Entity–Relationship (EER) Model

   Chapter 6: The Relational Data Model and Relational Database Constraints

   Chapter 7: SQL Data Definition and Data Types

   Chapter 8: More SQL: Complex Queries, Triggers, Views, and Schema Modification

   Chapter 9: The Relational Algebra and Relational Calculus

   Chapter 10: Relational Database Design by ER- and EER-to-Relational Mapping

   Chapter 11: Introduction to SQL Programming Techniques

   Chapter 12: Web Database Programming Using PHP

   Chapter 13: Object and Object-Relational Databases

   Chapter 14: XML: Extensible Markup Language

   Chapter 15: Basics of Functional Dependencies and Normalization for Relational Databases

   Chapter 16: Relational Database Design Algorithms and Further Dependencies

   Chapter 17: Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures

   Chapter 18: Indexing Structures for Files and Physical Database Design

Chapter 19: Strategies for Query Processing

Chapter 20: Query Optimization

Chapter 21: Introduction to Transaction Processing Concepts and Theory

Chapter 22: Concurrency Control Techniques

Chapter 23: Database Recovery Techniques

Chapter 24: Distributed Database Concepts

Chapter 25: NOSQL Databases and Big Data Storage Systems

Chapter 26: Big Data Technologies Based on MapReduce and Hadoop

Chapter 27: Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases

Chapter 28: Introduction to Information Retrieval and Web Search

Chapter 29: Data Mining Concepts

Chapter 30: Overview of Data Warehousing and OLAP

Chapter 31: Database Security

Chapter 32: Appendix A: Alternative Diagrammatic Notations for ER Models

Chapter 33: Appendix B: Parameters of Disks

Chapter 34: Appendix C: Overview of the QBE Language

Videos and How To

9. Practice Test

   Here's what you get

   Features

10. Live labs

    Lab Tasks

    Here's what you get

11. Post-Assessment

1. Course Objective

The Fundamentals of Database Systems course covers the core concepts and skills needed to design, implement, and manage efficient databases. Gain a solid understanding of database architecture, data modeling techniques like entity-relationship diagrams, and SQL for querying and manipulating data. Explore database normalization, indexing, transactions, and security best practices. Through interactive labs and hands-on exercises, you'll practice creating, populating, and optimizing databases using popular database management systems like MySQL, SQL Server, and Oracle.

2. Pre-Assessment

Pre-Assessment lets you identify the areas for improvement before you start your prep. It determines what students know about a topic before it is taught and identifies areas for improvement with question assessment before beginning the course.

3. Exercises

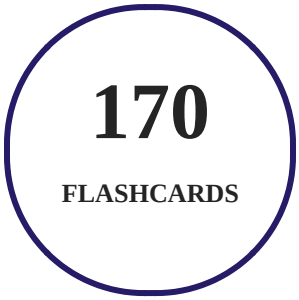
There is no limit to the number of times learners can attempt these. Exercises come with detailed remediation, which ensures that learners are confident on the topic before proceeding.

4. Quiz

Quizzes test your knowledge on the topics of the exam when you go through the course material. There is no limit to the number of times you can attempt it.

5. flashcards

Flashcards are effective memory-aiding tools that help you learn complex topics easily. The flashcard will help you in memorizing definitions, terminologies, key concepts, and more. There is no limit to the number of times learners can attempt these. Flashcards help master the key concepts.



6. Glossary of terms

uCertify provides detailed explanations of concepts relevant to the course through Glossary. It contains a list of frequently used terminologies along with its detailed explanation. Glossary defines the key terms.

7.  Expert Instructor-Led Training

uCertify uses the content from the finest publishers and only the IT industry's finest instructors. They have a minimum of 15 years real-world experience and are subject matter experts in their fields. Unlike a live class, you can study at your own pace. This creates a personal learning experience and gives you all the benefit of hands-on training with the flexibility of doing it around your schedule 24/7.

8.  ADA Compliant & JAWS Compatible Platform

uCertify course and labs are ADA (Americans with Disability Act) compliant. It is now more accessible to students with features such as:

- Change the font, size, and color of the content of the course
- Text-to-speech, reads the text into spoken words
- Interactive videos, how-tos videos come with transcripts and voice-over
- Interactive transcripts, each word is clickable. Students can clip a specific part of the video by clicking on a word or a portion of the text.

JAWS (Job Access with Speech) is a computer screen reader program for Microsoft Windows that reads the screen either with a text-to-speech output or by a Refreshable Braille display. Student can easily navigate uCertify course using JAWS shortcut keys.

9.  State of the Art Educator Tools

uCertify knows the importance of instructors and provide tools to help them do their job effectively. Instructors are able to clone and customize course. Do ability grouping. Create sections. Design grade scale and grade formula. Create and schedule assessments. Educators can also move a student from self-paced to mentor-guided to instructor-led mode in three clicks.

10.  Award Winning Learning Platform (LMS)

uCertify has developed an award winning, highly interactive yet simple to use platform. The SIIA CODiE Awards is the only peer-reviewed program to showcase business and education technology's finest products and services. Since 1986, thousands of products, services and solutions have been

recognized for achieving excellence. uCertify has won CODiE awards consecutively for last 7 years:

- **2014**
    1. Best Postsecondary Learning Solution

- **2015**
    1. Best Education Solution
    2. Best Virtual Learning Solution
    3. Best Student Assessment Solution
    4. Best Postsecondary Learning Solution
    5. Best Career and Workforce Readiness Solution
    6. Best Instructional Solution in Other Curriculum Areas
    7. Best Corporate Learning/Workforce Development Solution

- **2016**
    1. Best Virtual Learning Solution
    2. Best Education Cloud-based Solution
    3. Best College and Career Readiness Solution
    4. Best Corporate / Workforce Learning Solution
    5. Best Postsecondary Learning Content Solution
    6. Best Postsecondary LMS or Learning Platform
    7. Best Learning Relationship Management Solution

- **2017**
    1. Best Overall Education Solution
    2. Best Student Assessment Solution
    3. Best Corporate/Workforce Learning Solution
    4. Best Higher Education LMS or Learning Platform

- **2018**
    1. Best Higher Education LMS or Learning Platform

2. Best Instructional Solution in Other Curriculum Areas
3. Best Learning Relationship Management Solution

- **2019**
  1. Best Virtual Learning Solution
  2. Best Content Authoring Development or Curation Solution
  3. Best Higher Education Learning Management Solution (LMS)

- **2020**
  1. Best College and Career Readiness Solution
  2. Best Cross-Curricular Solution
  3. Best Virtual Learning Solution

11. Chapter & Lessons

uCertify brings these textbooks to life. It is full of interactive activities that keeps the learner engaged. uCertify brings all available learning resources for a topic in one place so that the learner can efficiently learn without going to multiple places. Challenge questions are also embedded in the chapters so learners can attempt those while they are learning about that particular topic. This helps them grasp the concepts better because they can go over it again right away which improves learning.

Learners can do Flashcards, Exercises, Quizzes and Labs related to each chapter. At the end of every lesson, uCertify courses guide the learners on the path they should follow.

Syllabus

Chapter 1: Introduction

Chapter 2: Databases and Database Users

- Introduction

- An Example
- Characteristics of the Database Approach
- Actors on the Scene
- Workers behind the Scene
- Advantages of Using the DBMS Approach
- A Brief History of Database Applications
- When Not to Use a DBMS
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 3: Database System Concepts and Architecture

- Data Models, Schemas, and Instances
- Three-Schema Architecture and Data Independence
- Database Languages and Interfaces
- The Database System Environment
- Centralized and Client/Server Architectures for DBMSs

- Classification of Database Management Systems
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 4: Data Modeling Using the Entity–Relationship (ER) Model

- Using High-Level Conceptual Data Models for Database Design
- A Sample Database Application
- Entity Types, Entity Sets, Attributes, and Keys
- Relationship Types, Relationship Sets, Roles, and Structural Constraints
- Weak Entity Types
- Refining the ER Design for the COMPANY Database
- ER Diagrams, Naming Conventions, and Design Issues
- Example of Other Notation: UML Class Diagrams
- Relationship Types of Degree Higher than Two
- Another Example: A UNIVERSITY Database
- Summary

- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

Chapter 5: The Enhanced Entity–Relationship (EER) Model

- Subclasses, Superclasses, and Inheritance
- Specialization and Generalization
- Constraints and Characteristics of Specialization and Generalization Hierarchies
- Modeling of UNION Types Using Categories
- A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions
- Example of Other Notation: Representing Specialization and Generalization in UML Class Diagrams
- Data Abstraction, Knowledge Representation, and Ontology Concepts
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

Chapter 6: The Relational Data Model and Relational Database Constraints

- Relational Model Concepts
- Relational Model Constraints and Relational Database Schemas
- Update Operations, Transactions, and Dealing with Constraint Violations
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 7: SQL Data Definition and Data Types

- SQL Data Definition and Data Types
- Specifying Constraints in SQL
- Basic Retrieval Queries in SQL
- INSERT, DELETE, and UPDATE Statements in SQL
- Additional Features of SQL
- Summary
- Review Questions

- Exercises
- Selected Bibliography

Chapter 8: More SQL: Complex Queries, Triggers, Views, and Schema Modification

- More Complex SQL Retrieval Queries
- Specifying Constraints as Assertions and Actions as Triggers
- Views (Virtual Tables) in SQL
- Schema Change Statements in SQL
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 9: The Relational Algebra and Relational Calculus

- Unary Relational Operations: SELECT and PROJECT
- Relational Algebra Operations from Set Theory
- Binary Relational Operations: JOIN and DIVISION
- Additional Relational Operations
- Examples of Queries in Relational Algebra

- The Tuple Relational Calculus
- The Domain Relational Calculus
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

Chapter 10: Relational Database Design by ER- and EER-to-Relational Mapping

- Relational Database Design Using ER-to-Relational Mapping
- Mapping EER Model Constructs to Relations
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

Chapter 11: Introduction to SQL Programming Techniques

- Overview of Database Programming Techniques and Issues
- Embedded SQL, Dynamic SQL, and SQL J
- Database Programming with Function Calls and Class Libraries: SQL/CLI and JDBC
- Database Stored Procedures and SQL/PSM
- Comparing the Three Approaches
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 12: Web Database Programming Using PHP

- A Simple PHP Example
- Overview of Basic Features of PHP
- Overview of PHP Database Programming
- Brief Overview of Java Technologies for Database Web Programming
- Summary
- Review Questions
- Exercises

- Selected Bibliography

Chapter 13: Object and Object-Relational Databases

- Overview of Object Database Concepts
- Object Database Extensions to SQL
- The ODMG Object Model and the Object Definition Language ODL
- Object Database Conceptual Design
- The Object Query Language OQL
- Overview of the C++ Language Binding in the ODMG Standard
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 14: XML: Extensible Markup Language

- Structured, Semistructured, and Unstructured Data
- XML Hierarchical (Tree) Data Model
- XML Documents, DTD, and XML Schema
- Storing and Extracting XML Documents from Databases

- XML Languages
- Extracting XML Documents from Relational Databases
- XML/SQL: SQL Functions for Creating XML Data
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 15: Basics of Functional Dependencies and Normalization for Relational Databases

- Informal Design Guidelines for Relation Schemas
- Functional Dependencies
- Normal Forms Based on Primary Keys
- General Definitions of Second and Third Normal Forms
- Boyce-Codd Normal Form
- Multivalued Dependency and Fourth Normal Form
- Join Dependencies and Fifth Normal Form
- Summary

- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

Chapter 16: Relational Database Design Algorithms and Further Dependencies

- Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover
- Properties of Relational Decompositions
- Algorithms for Relational Database Schema Design
- About Nulls, Dangling Tuples, and Alternative Relational Designs
- Further Discussion of Multivalued Dependencies and 4NF
- Other Dependencies and Normal Forms
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

Chapter 17: Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures

- Introduction
- Secondary Storage Devices
- Buffering of Blocks
- Placing File Records on Disk
- Operations on Files
- Files of Unordered Records (Heap Files)
- Files of Ordered Records (Sorted Files)
- Hashing Techniques
- Other Primary File Organizations
- Parallelizing Disk Access Using RAID Technology
- Modern Storage Architectures
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 18: Indexing Structures for Files and Physical Database Design

- Types of Single-Level Ordered Indexes
- Multilevel Indexes
- Dynamic Multilevel Indexes Using B-Trees and B+-Trees
- Indexes on Multiple Keys
- Other Types of Indexes
- Some General Issues Concerning Indexing
- Physical Database Design in Relational Databases
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 19: Strategies for Query Processing

- Translating SQL Queries into Relational Algebra and Other Operators
- Algorithms for External Sorting
- Algorithms for SELECT Operation
- Implementing the JOIN Operation
- Algorithms for PROJECT and Set Operations

- Implementing Aggregate Operations and Different Types of JOINs
- Combining Operations Using Pipelining
- Parallel Algorithms for Query Processing
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 20: Query Optimization

- Query Trees and Heuristics for Query Optimization
- Choice of Query Execution Plans
- Use of Selectivities in Cost-Based Optimization
- Cost Functions for SELECT Operation
- Cost Functions for the JOIN Operation
- Example to Illustrate Cost-Based Query Optimization
- Additional Issues Related to Query Optimization
- An Example of Query Optimization in Data Warehouses
- Overview of Query Optimization in Oracle

- Semantic Query Optimization
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 21: Introduction to Transaction Processing Concepts and Theory

- Introduction to Transaction Processing
- Transaction and System Concepts
- Desirable Properties of Transactions
- Characterizing Schedules Based on Recoverability
- Characterizing Schedules Based on Serializability
- Transaction Support in SQL
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 22: Concurrency Control Techniques

- Two-Phase Locking Techniques for Concurrency Control
- Concurrency Control Based on Timestamp Ordering
- Multiversion Concurrency Control Techniques
- Validation (Optimistic) Techniques and Snapshot Isolation Concurrency Control
- Granularity of Data Items and Multiple Granularity Locking
- Using Locks for Concurrency Control in Indexes
- Other Concurrency Control Issues
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 23: Database Recovery Techniques

- Recovery Concepts
- NO-UNDO/REDO Recovery Based on Deferred Update
- Recovery Techniques Based on Immediate Update
- Shadow Paging
- The ARIES Recovery Algorithm

- Recovery in Multidatabase Systems
- Database Backup and Recovery from Catastrophic Failures
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 24: Distributed Database Concepts

- Distributed Database Concepts
- Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design
- Overview of Concurrency Control and Recovery in Distributed Databases
- Overview of Transaction Management in Distributed Databases
- Query Processing and Optimization in Distributed Databases
- Types of Distributed Database Systems
- Distributed Database Architectures
- Distributed Catalog Management
- Summary
- Review Questions

- Exercises
- Selected Bibliography

Chapter 25: NOSQL Databases and Big Data Storage Systems

- Introduction to NOSQL Systems
- The CAP Theorem
- Document-Based NOSQL Systems and MongoDB
- NOSQL Key-Value Stores
- Column-Based or Wide Column NOSQL Systems
- NOSQL Graph Databases and Neo4j
- Summary
- Review Questions
- Selected Bibliography

Chapter 26: Big Data Technologies Based on MapReduce and Hadoop

- What Is Big Data?
- Introduction to MapReduce and Hadoop
- Hadoop Distributed File System (HDFS)

- MapReduce: Additional Details
- Hadoop v2 alias YARN
- General Discussion
- Summary
- Review Questions
- Selected Bibliography

Chapter 27: Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases

- Active Database Concepts and Triggers
- Temporal Database Concepts
- Spatial Database Concepts
- Multimedia Database Concepts
- Introduction to Deductive Databases
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 28: Introduction to Information Retrieval and Web Search

- Information Retrieval (IR) Concepts
- Retrieval Models
- Types of Queries in IR Systems
- Text Preprocessing
- Inverted Indexing
- Evaluation Measures of Search Relevance
- Web Search and Analysis
- Trends in Information Retrieval
- Summary
- Review Questions
- Selected Bibliography

Chapter 29: Data Mining Concepts

- Overview of Data Mining Technology
- Association Rules
- Classification
- Clustering
- Approaches to Other Data Mining Problems

- Applications of Data Mining
- Commercial Data Mining Tools
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 30: Overview of Data Warehousing and OLAP

- Introduction, Definitions, and Terminology
- Characteristics of Data Warehouses
- Data Modeling for Data Warehouses
- Building a Data Warehouse
- Typical Functionality of a Data Warehouse
- Data Warehouse versus Views
- Difficulties of Implementing Data Warehouses
- Summary
- Review Questions
- Selected Bibliography

Chapter 31: Database Security

- Introduction to Database Security Issues
- Discretionary Access Control Based on Granting and Revoking Privileges
- Mandatory Access Control and Role-Based Access Control for Multilevel Security
- SQL Injection
- Introduction to Statistical Database Security
- Introduction to Flow Control
- Encryption and Public Key Infrastructures
- Privacy Issues and Preservation
- Challenges to Maintaining Database Security
- Oracle Label-Based Security
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 32: Appendix A: Alternative Diagrammatic Notations for ER Models

12. Practice Test

Here's what you get

58	60
PRE-ASSESSMENTS QUESTIONS	POST-ASSESSMENTS QUESTIONS

Features

Each question comes with detailed remediation explaining not only why an answer option is correct but also why it is incorrect.

Unlimited Practice

Each test can be taken unlimited number of times until the learner feels they are prepared. Learner can review the test and read detailed remediation. Detailed test history is also available.

Each test set comes with learn, test and review modes. In learn mode, learners will attempt a question and will get immediate feedback and complete remediation as they move on to the next question. In

test mode, learners can take a timed test simulating the actual exam conditions. In review mode, learners can read through one item at a time without attempting it.

13. Live Labs

The benefits of live-labs are:

- Exam based practical tasks
- Real equipment, absolutely no simulations
- Access to the latest industry technologies
- Available anytime, anywhere on any device
- Break and Reset functionality
- No hardware costs

Lab Tasks

Databases and Database Users

- Understanding the Basic Database System Environment
- Using the Exist and Not Exist Operators

Database System Concepts and Architecture

- Understanding the Schema Architecture

Data Modeling Using the Entity–Relationship (ER) Model

- Understanding Physical Schema - ER Model

SQL Data Definition and Data Types

- Inserting Data into a Table

- Updating Data in a Table
- Creating and Updating a View
- Creating a Table in SQL
- Using the CHECK Constraint
- Using Attribute Constraints
- Using Arithmetic Operations
- Using Asterisk in SQL
- Using the ORDER BY Clause
- Using Aliases
- Using the DISTINCT Keyword
- Using the Substring Pattern Matching
- Enforcing Referential Integrity Constraints
- Deleting a Record from a Table

More SQL: Complex Queries, Triggers, Views, and Schema Modification

- Using Aggregate Functions
- Retrieving Data Using WITH and CASE Clauses
- Retrieving Data Using a Nested Query
- Using the EXISTS and NOT EXISTS Operators
- Using GROUP BY and HAVING Clauses
- Using Triggers in SQL
- Modifying a Table
- Using the UNION, INTERSECTION, and EXCEPT Operations

The Relational Algebra and Relational Calculus

- Using Unary Relational Operations
- Using the CROSS JOIN Operation
- Using the JOIN Operation
- Using the DIVISION Operation

Introduction to SQL Programming Techniques

- Using Embedded SQL in C
- Embedding SQL Commands in Java

- Connecting to a Database Using Visual Studio Code

Object and Object-Relational Databases

- Creating UDTs

XML: Extensible Markup Language

- Generating XML Data Using SQL Functions

Basics of Functional Dependencies and Normalization for Relational Databases

- Normalizing the Unnormalized Model to 1st Normal Form I
- Normalizing the Unnormalized Model to 1st Normal Form II
- Normalizing the 1st Normal Form to 2nd Normal Form
- Normalizing the 2nd Normal Form to 3rd Normal Form
- Normalizing the 3rd Normal Form to BCNF

Relational Database Design Algorithms and Further Dependencies

- Solving the Problems with NULL Values
- Solving the Problems with Dangling Tuples

Indexing Structures for Files and Physical Database Design

- Creating Function-Based Indexes

Strategies for Query Processing

- Retrieving Data Using Semi-join and Anti-join

Query Optimization

- Using the View-Merging Operation
- Unnesting a Query

Introduction to Transaction Processing Concepts and Theory

- Understanding Transaction States and Additional Operations

Database Recovery Techniques

- Creating a Backup and Restoring Data

NOSQL Databases and Big Data Storage Systems

- Performing CRUD Operations in MongoDB
- Building the Sample Data in MongoDB
- Using Basic Cypher Queries

Big Data Technologies Based on MapReduce and Hadoop

- Understanding the Hive System Architecture

Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases

- Using Triggers in Oracle Notation
- Performing Basic Operations in Oracle

Data Mining Concepts

- Creating a Decision-Tree Model
- Performing k-Means Clustering
- Using the Apriori Algorithm

Overview of Data Warehousing and OLAP

- Understanding the General Architecture of a Data Warehouse

Database Security

- Granting and Revoking Privileges

Here's what you get

59	53	01:35
LIVE LABS	VIDEO TUTORIALS	HOURS

14. Post-Assessment

After completion of the uCertify course Post-Assessments are given to students and often used in conjunction with a Pre-Assessment to measure their achievement and the effectiveness of the exam.

You can’t stay away! Get

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