

Database Systems

ITCS 6160-080

Welcome to *ITCS 6160 – Database Systems*! This graduate course offers a rigorous treatment of database systems, integrating theoretical foundations with substantial hands-on practice. This syllabus contains the policies and expectations established for the course. Please read the entire syllabus carefully before continuing in this course. These policies and expectations are intended to create a productive learning atmosphere for all students. Unless you are prepared to abide by these policies and expectations, you risk losing the opportunity to participate further in the course. Any modifications will be communicated through in-class announcements and/or updates on Canvas.

Course Description

This course provides a rigorous and comprehensive treatment of database systems, covering the full spectrum from conceptual modeling to physical implementation. The course topics were carefully selected to develop both the theoretical foundations and the practical skills required to understand, design, and reason about modern database systems, with a focus on relational databases and their central role in information systems.

The course employs a balanced approach, integrating theoretical concepts with hands-on practical exercises. Students are expected to engage critically with the material and apply what they learn to analyze and solve database problems independently, at a depth appropriate for graduate-level study.

Learning Outcomes

Upon completion, students will be able to: (1) design and evaluate conceptual and relational database schemas using the Entity-Relationship model and normalization theory; (2) write complex SQL queries involving joins, subqueries, aggregation, views, and constraints; (3) analyze and apply transaction management principles, including ACID properties and concurrency control mechanisms; (4) explain and compare the internal implementation of database systems, including storage structures, indexing techniques, and query execution and optimization strategies; and (5) critically assess design trade-offs in real-world database applications.

Location and Time

This course is offered fully online and asynchronously. All materials, quizzes, and hands-on activities are available on *Canvas*. The course concludes with a required live defense session (via Zoom; exact date TBD).

Instructor

Marco Vieira

Email: marco.vieira@charlotte.edu

Office Hours (via Zoom): Thursday, 4:00 pm to 5:00 pm + on-demand (just send an email)

Teaching Assistant (*see Canvas for details*)**Textbook(s)**

Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, 7th Edition, McGraw Hill Education, 2019.

Carlos Coronel, Steven Morris, “Database Systems: Design, Implementation, and Management”, 13th Edition, Cengage Learning, 2018.

Course Topics (tentative)

Overview of databases and their importance, data models, and Database Management Systems (DBMS). Principles of the relational model and introduction to SQL.

SQL: Study how to use SQL for querying the database and manipulating data, in particular, complex joins, sub-queries, and data aggregation.

Entity-Relationship Model: Study of the Entity-Relationship Model for conceptualizing and designing database structures. How to translate ER diagrams into relations.

Functional Dependencies and Normalization: Understanding functional dependencies and their role in normalization. Normal forms to ensure data integrity and reduce redundancy.

Transactions and Concurrency Control: Concepts of database transactions, the importance of concurrency control, and the ACID properties.

Storage and Indexing: How databases store data on disk and in memory, including heap files, page layouts, and buffer management. Indexing structures such as B+ trees and hash indexes, and their impact on query performance.

Query Processing and Optimization: How the database engine executes queries, including operator algorithms for selection, join, and aggregation. Cost-based query optimization, query plans, and the role of statistics in plan selection.

Grading

Students will be evaluated through a combination of quizzes, hands-on activities, and a live defense session (via Zoom).

Quizzes (18 points) – For each lecture, students complete a short 10-minute timed quiz on *Canvas*, which collectively accounts for 18 points out of 100. Quizzes are designed to assess understanding of the preparation materials and must be completed within the weekly window published in the course schedule. Makeup quizzes will not be permitted unless prior arrangements have been made or exceptional circumstances are documented and approved.

Hands-on Activities (50 points) – Each lecture includes an individual hands-on activity directly related to the lecture topic. These activities, which collectively account for 50 of 100 points, must be completed individually and submitted on *Canvas* within the defined time period. Points will be awarded based on the quality and completeness of the submission. The hands-on activities are cumulative (later activities may build on concepts and skills developed in earlier ones), and selected submissions will be discussed during the live defense session.

Live Defense (32 points) – The course concludes with a required live synchronous defense (via Zoom), which accounts for 32 of 100 points. Given the size of the class, defenses are scheduled individually over the final week of the course (exact dates and booking instructions will be published on *Canvas*). Each student books a 10-minute Zoom slot and participates individually. The defense has two parts: a **hands-on review** (~5 minutes), in which the instructor discusses one or two items from the student's submitted hands-on work and asks the student to explain their reasoning and design choices; and a **concept defense** (~5 minutes), in which the instructor asks two or three questions drawn at random from a topic list published at the start of the course. The topic list covers all course topics and is available from day one, so students can prepare throughout the semester. Attendance is mandatory; students who cannot attend their scheduled slot must contact the instructor in advance to arrange an alternative.

Standard grading –

90%-100%: A

80%-90%: B

70%-80%: C

60%-70%: D

<60%: F

Hands-on Submissions

Canvas will be used for assignment and project submissions. Regularly check Canvas for important dates, materials, and class announcements.

Late submissions of hands-on activities will result in a reduction in the grade, unless authorized by the course instructor. Given the compressed pace of the summer course, the penalty will be as follows: 10% per day late, with 0 credit after 5 days. No late submissions will be accepted after the last day of the course.

Students may request to be regraded. Regrading of hands-on activities can be requested by posting a message on Canvas. Regrading of the live defense must be requested by email to the instructor.

Policies

I. Course Materials

All lectures and course material will be available in Canvas. Lectures and course materials, including presentations, assignments, exams, outlines, and similar materials, are protected by copyright. You are encouraged to take notes and make copies of course materials for your own educational use. However, you may not, nor may you knowingly allow others to reproduce or distribute lecture notes and course materials publicly without my express written consent. This includes providing materials to commercial course material suppliers such as CourseHero, Chegg, and other similar services. Students who publicly distribute or display or help others publicly distribute or display copies or modified copies of an instructor's course materials may be in violation of University Policy 406, The Code of Student Responsibility, or University Policy 407, Code of Student Academic Integrity. Similarly, you own copyright in your original papers and exam essays.

II. Classroom Conduct

I will conduct this class in an atmosphere of mutual respect. I encourage your active participation in class discussions. Each of us may have strongly differing opinions on the various topics of class discussions. The conflict of ideas is encouraged and welcome. The orderly questioning of others' ideas, including my own, is similarly welcome. However, I will exercise my responsibility to manage the discussions so that ideas and arguments can proceed in an orderly fashion. You should expect that if your conduct during class discussions seriously disrupts the atmosphere of mutual respect I expect in this class, you will not be permitted to participate further.

III. Attendance and Absences

This is a fully asynchronous course, and students are expected to engage consistently with all course materials each week. Failure to complete quizzes or hands-on activities on time may affect your ability to achieve the course objectives and your grade. An absence from a deadline, excused or unexcused, does not relieve a student of any course requirement. Attendance at the live defense session is mandatory. Students who cannot attend either of the two offered time slots must contact the instructor in advance to arrange an accommodation.

The instructor has the authority to excuse a student's class absence(s) and to grant a student an academic accommodation (turn in a late assignment, provide extra time on an assignment, reschedule an exam, etc.). However, under the Academic Affairs Policy on Course Attendance and Participation, University-sanctioned events or activities are considered excused absences. A University-sanctioned event or activity is one in which a student formally represents the University to external constituencies in athletic or academic activities. This policy does not supersede individual program attendance and/or participation requirements that are aligned with accreditation or licensure. For more information and student responsibilities to account for such an absence, see provost.charlotte.edu/policies-procedures/academic-policies-and-procedures/course-attendance-and-participation.

IV. Non-Discrimination

All students and the instructor are expected to engage with each other respectfully. Unwelcome conduct directed toward another person based upon that person's actual or perceived race; color; religion (including belief and non-belief); sex; sexual orientation; gender identity; age; national origin; physical or mental disability; veteran status; genetic information; or for any other reason, may constitute a violation of University Policy 501, Nondiscrimination. Any student suspected of engaging in such conduct will be referred to the Office of Civil Rights & Title IX.

V. University Policy on Withdrawals

Students are expected to complete all courses for which they are registered at the close of the add/drop period. If you are concerned about your ability to succeed in this course, it is important to schedule an appointment with me as soon as possible. The University policy on withdrawal allows students only a limited number of opportunities to withdraw from courses. It is important for you to understand the financial and academic consequences that may result from withdrawing from the course. See: provost.charlotte.edu/policies-procedures/academic-policies-and-procedures/withdrawal-and-cancellation-enrollment-policy

VI. Syllabus Policies, Academic Integrity, Plagiarism

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code and on the Student Accountability & Conflict Resolution website. The Code is available from the Dean of Students Office or online at legal.charlotte.edu/policies/up-407. Additional resources are available on the Student Accountability & Conflict Resolution website.

Violation of these syllabus policies may result in appropriate academic penalties, including a reduction of grade in the relevant assignment, project, or exam. If a violation of these syllabus policies also implicates the Code of Student Academic Integrity due to alleged academic misconduct, I will follow the process outlined in the Code to address such cases.

VII. Reporting Expectations

UNC Charlotte is committed to maintaining an environment conducive to learning for all students and a professional workplace for all employees. The University takes active measures to create or restore a respectful, safe, and inclusive environment for community members, free from discrimination, discriminatory harassment, and interpersonal violence. If you (or someone you know) has experienced any of these incidents, know that you are not alone. UNC Charlotte has staff members trained to support you in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, helping with civil protective orders, and more.

Please be aware that all UNC Charlotte employees, including faculty members, are expected to relay any information or reports of discrimination, discriminatory harassment, or sexual and interpersonal misconduct they receive to the Office of Civil Rights and Title IX. This means that if you tell me about a situation involving these matters, I am expected to report the information. Although I am expected to report the situation, you will still have options regarding how your case will be handled, including whether you wish to pursue a formal complaint. Our goal is to make sure you are aware of the range of options available to you and have access to the resources you need.

If you wish to speak to someone confidentially, you can contact the following on-campus resources, who are not required to report the incident to the Office of Civil Rights and Title IX: (1) Center for Counseling and Psychological Services (CAPS) (caps.charlotte.edu, 7-0311); or (2) Student Health Center (studenthealth.charlotte.edu, 7-7400). Additional information about your options is also available at civilrights.charlotte.edu under the “Students” tab.