**Official Calendar:** Databases from a user's perspective: querying with SQL, designing with UML, and using programs to analyze data. Construction of database-driven applications and websites and experience with current database technologies. Completion of COSC 121 is recommended. **Prerequisite:** One of COSC 111, COSC 123, COSC 210. Third-year standing. **Specific description:** This course provides an introduction to database systems including database querying, design, and programming. The course consists of three major components. The first component explains databases from a user perspective including how to query using SQL and relational algebra. The second component involves designing relational databases using Entity-Relationship (ER) diagrams and UML. The last part involves database and web programming with Java, JDBC, JSP, Python, and PHP. Students completing the course have experience with current database technologies, and the ability to use and develop databases and associated applications. Learning Outcomes: Describe how databases provide data abstraction and simplify writing programs to store and manipulate data. Create relational algebra queries on relational databases using selection, projection, join, and set operators. Construct SQL CREATE TABLE, INSERT, UPDATE, DELETE, and SELECT statements including queries with multiple joins, aggregation, grouping, and subqueries. Explain the translation of a SQL query into relational algebra operators. Analyze and understand existing database designs, design new databases using ER/UML modeling, and convert designs to the relational model including proper modeling of primary and foreign keys. Develop programs and web sites that access a database to read data, perform analysis, and display output. Use JSON and XML for data exchange and representation. Execute and deploy databases on a computer using virtualization/containerization technology such as Docker. Topics include First day of classes. Introduction to course; Introduction to databases, Relational Model - Schemas, Keys, Constraints, Integrity, Relational Algebra - Select, Project, Set Ops, Outer Joins, SQL DDL – Create table/index, Insert/Delete/Update, SQL - Queries, LIKE operator, Set Operations, Order By, SQL - Group By, Aggregate Functions, SQL - Subqueries, Outer joins, Database Design – General Approach, ER and UML Modeling, ER and UML Modeling examples and questions, EER Design - Specialization, Generalization, Aggregation, ER/EER Mapping to Relational model, Database Programming using Java/JDBC Sample Java Code, JDBC Tutorial, Database Programming using Python and R Sample Python Code, SQL Server and pyodbc, pyodbc, pyodbc Getting Started, Python Database API, Python sqlite3, Database Web Programming – Web servers, JSP/PHP, Sample JSP/PHP Code, Advanced SQL DDL – Triggers, Advanced SQL DDL – Views, Advanced SQL – Security, Advanced SQL – Transactions, Recursion, MySQL Recursive Query, XML and XPath, JSON, NoSQL Databases, Normalization and Design Verification, Database hosting and data cleansing/wrangling, Data warehousing and Data Mining