**W22-CSC 430/530 Database Management Systems (DBMS) [11:00-12:15 PM]**

**Venue:** UNVH 111

**Prerequisite:** CSC 220 –for CSC430 and CSC430 – for CSC 530

**Instructor:** Dr. Pradeep Chowriappa ([pradeep@latech.edu](mailto:pradeep@latech.edu))

**Office:** Nethken Hall 235

**Office Hours: MWF** - 9:00-10:30 am & 1:00 to 2:30 pm; **T**-10:00 am to 11:00; **H** – *by appointment*

1. **Course Purpose**

The course aims at introducing the student to the theory, design, and implementation of Relational Data Base Management Systems (DBMS). The objective of the course is to expose students to database concepts of effective storage, security, and allied applications of legacy storage. The course emphasizes on the practical steps towards the creation of effective database management systems and the implementation of a simple database. The in-class experience for students is tailored specifically to supervised practical lab sessions and exercises.

**Recommended Textbook:** R. Elmasri, S. B. Navathe “Fundamentals of Database Systems”, Seventh Edition, 2011. ISBN: 9780136086208

**COVID - Instructional Methods to be utilized:** The course will follow the hybrid model of instruction – with mandatory labs in UNIV 111 on designated Fridays through the quarter. There would be lectured presentations, , in class discussion (across platforms), paper reviews, and project presentations.

1. **Tentative Course Outline and Calendar**

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Date | Activity/ Topic | Sub topics |
| **1** | **1 & 3 Dec** | Introduction | Introduction to Databases and Database Users |
| **2** | **6, 8, & 10 Dec** | Conceptual Design and Architecture | Database System Concepts and Architecture |
| Relational Modeling using ER Model |
| **3** | **13, 15, & 17 Dec** | Enhanced ER Modeling | EER Modeling Constructs; *Assignment 1* |
| **4** | **20 Dec** |  | *Lab 1: Relational Data Models and Constraints* |
|  | **21 Dec – 3 Jan** | **CHRISTMAS BREAK** | |
| **5** | **5 & 7 Jan** | Constraints, SQL and Relational Algebra | Relational Algebra: Constraints and Operators |
| Schema Definition, Constraints, Views, and Queries |
| *Lab 2: SQL Programming Techniques* |
| *Assignment 2* |
| **6** | **10, 12, & 14 Jan** | **Midterm Examination / Project Proposals** | |
| **7** | **19 & 21 Jan** | Normal Forms and Functional Dependencies | Functional Dependencies, and Normalization |
| Practical Database Design Methodology and Use of UML |
| Disk storage, File Structure, and Hashing |
| *Hands on Lab 3: Advance operators and Joins* |
| **8** | **24, 26 & 28 Jan** | Database Indexing Techniques & Triggers | Indexing Techniques Single Level |
| Indexing Techniques Multi Level, Constraints and Triggers |
| **9** | **31 Jan, 2 & 4 Feb** | Query Processing | Iterators and Database Access Algorithms |
| Unary and Binary Operators and Strategies |
| *Hands on Lab 4 and Exercise: Triggers and Views* |
| **10** | **7, 9, & 11 Feb** | Query Optimization | Duplicate Elimination and Sorting – One pass Algorithms |
| Duplicate Elimination and Sorting –Two pass Algorithms |
| **11** | **14, 16, & 18 Feb** | Concurrency Control | Foundations of Concurrency Control |
| *Final Project presentation submissions* |
|  | **21 Feb** | **Final Examinations** | |

1. **Final Grade Assessment System**

|  |  |
| --- | --- |
| Undergraduate Students | |
| ACTIVITY | GRADE (%) |
| Exercises | 20 |
| Lab Quizzes | 10 |
| Midterm | 20 |
| Final Examination | 30 |
| Final Project | 20 |
| **TOTAL** | **100** |

|  |  |
| --- | --- |
| Graduate Students | |
| ACTIVITY | GRADE (%) |
| Exercises | 20 |
| Lab Quizzes | 10 |
| Midterm | 15 |
| Final Examination | 20 |
| ***Final Paper Review*** | **15** |
| Final Project | 20 |
| **TOTAL** | **100** |

**Grades:**

|  |  |
| --- | --- |
| A | 100 - 90 |
| B | 89 - 80 |
| C | 79 - 70 |
| D | 69 - 60 |

1. **General Course Policies**

**Reason for going Hybrid:**

1. **Participation:** The goal of going hybrid is not to discourage online participation, but on the contrary to facilitate those students who encounter technical difficulties during the quarter. Note there are limited seats in assigned classroom. Those students who have accommodations filed at the Office of Testing and Disabilities Services will be encouraged not to attend physically. (refer section on Attendance and Accommodations for details).
2. **Equity in the learning environment:**  We all are different and we each have our strengths and weaknesses. As part of this course and its evaluation, it’s important for me as the instructor to understand every students’ need. This is difficult to gauge in an online environment. Therefore, I would like the students to avail the classroom time to meet me and discuss challenges you encounter.

**Use of Moodle & Emails:** Course announcements, documents, and submissions shall be done over Moodle and via the @latech.edu e-mail account. It is the student’s responsibility to ensure that they have access to Moodle and the students are encouraged to check for regular updates at least once every 24 hours. Failure to act as a result of not reading announcements and emails is NOT an acceptable justification.

**No Plagiarism:** Individual efforts are strictly enforced and rewarded in this course during examinations and presentations. Individuals wishing to collaborate must do so prior to examination sessions, and such must be done intelligently.

**Missed Activity Policy:** All scheduled examinations must not be missed without a university-approved excuse, pre-approved by the instructors. A ZERO grade will be assigned for any unapproved missed session. The instructor will decide with the student on the procedure to make up for all officially approved missed sessions.

**Late Assignment Submission:** Assignments and reports received after 24 hours of the stipulated deadline will be graded with a 50% penalty. All submissions beyond 24 hours of the deadline automatically attract a zero grade.

**Academic Honor Code:** The Louisiana Tech University Honor Code is available at: [**http://www.latech.edu/documents/honor-code.pdf**](http://www.latech.edu/documents/honor-code.pdf)**.** Students accordingly pledge - That being a student of higher standards, I pledge to embody the principles of academic integrity.

**Emergency Notification System (ENS):** All Louisiana Tech students are strongly encouraged to enroll and update their contact information in the ENS. It takes just a few seconds to ensure you’re able to receive important text and voice alerts in the event of a campus emergency. For more information on the ENS, please visit[**http://www.latech.edu/administration/ens.shtml**](http://www.latech.edu/administration/ens.shtml)**.**

1. **Attendance and Accommodations**

* Class attendance regulations (University Policy 2206 – Class Attendance). *Permanent attendance records will be kept for each class*.
* Students who are feeling ill with COVID-19 symptoms, have been exposed to or testing positive for COVID-19, should not come to class and should contact **Tech Care at 318-257-4866**.
* Students who miss face-to-face class for COVID-19 related reasons will have access to course materials and grad opportunities while away from face-to-face class.
* Students needing testing or classroom accommodations based on a disability are encouraged to discuss those needs with me as soon as possible. Students who do not present an accommodations memo from the Office of Testing & Disability Services are referred to that office or to <https://www.latech.edu/current-students/student-advancement-affairs/disability-services/> for assistance.

1. **COVID-19 related information**
   * Students can access COVID-19-related information, guidelines, FAQs, and policies at Louisiana Tech’s website: [latech.edu/coronavirus](https://www.latech.edu/coronavirus/)
   * Louisiana Tech’s [Return to Campus Plan](https://www.latech.edu/coronavirus/return-to-campus-plan/) is located at [latech.edu/return-to-campus](https://www.latech.edu/coronavirus/return-to-campus-plan/).  **Masks are required to be worn indoors on campus**. Every member of the Tech Family will need to take personal responsibility for their behavior, which includes wearing masks, maintaining physical distancing, washing hands regularly, using proper sneeze and cough practices, helping maintain clean academic and office areas, and monitoring for symptoms of COVID-19
   * The direct link to the reporting protocol for students is located at [latech.edu/coronavirus/return-to-campus-plan/for-students/](https://www.latech.edu/coronavirus/return-to-campus-plan/for-students/).  Students can reach out to **Stacy Gilbert, Dean of Student Services & Academic Support, at**[**stacyc@latech.edu**](mailto:stacyc@latech.edu) for help with accommodations and additional information.
   * Failure to comply with the Safety Protocols listed in the Back to Campus Fall 2020  booklet, [latech.edu/documents/2020/07/covid-return-book.pdf/](https://www.latech.edu/documents/2020/07/covid-return-book.pdf/), specifically on pages 5-7 about masks and social distancing, could result in students being in violation of the Classroom Behavior Policy listed on page 125 of the Student Handbook [latech.edu/documents/2018/09/student-handbook.pdf/.](https://www.latech.edu/documents/2018/09/student-handbook.pdf/)
   * Information and contact numbers and sites for Louisiana Tech Counseling Services are located at: <https://www.latech.edu/current-students/student-advancement-affairs/counseling-services/>
2. **Examinations, Quizzes, and Class Activities**
   * All exams and quizzes will be conducted online. Supporting tools such as GradeScope and/or Respondus.
   * You will be provided a study guide before every exam.
   * All presentations will be recorded using the zoom cloud. Each of you have your zoom accounts.

**Course Objectives:**

* 1. Knowledge of various database modeling techniques
  2. Understand the difference between logical and physical modeling
  3. Compare models and be aware of database usage standards
  4. Understand terminology, relationships, and implement a basic database
  5. Understand and the use of relational algebra
  6. Understand and implement both Data Definition and Data Management queries
  7. Understand Entity Relationship Models, Design, and Functional Dependencies
  8. Apply the Boyce-Codd Normalization and Multivalued dependencies
  9. Differentiate between database constrains and database triggers
  10. Understand indexes and its applications
  11. Understand views in relational databases, view modification, and material views
  12. Understand transaction processing in databases, properties, and isolation levels
  13. Understanding the concepts of semi-structured databases, and NOSQL

**Student Outcomes:**

1. An ability to apply knowledge of computing and mathematics appropriate to the programs student outcomes and to the discipline
2. An ability to analyze a problem, and identity and define the computing requirements appropriate to its solution
3. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs
4. Ability to function as a team to accomplish a common goal.
5. An ability to use current techniques, skills, and tools necessary for computing practice
6. An ability to apply design and development principles in the construction of software systems of varying complexity

**The matrix identifies a map between student outcomes and course outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Student Outcomes Course Outcomes** | **(a)** | **(b)** | **(c)** | **(d)** | **(e)** | **(f)** | **(g)** | **(h)** | **(i)** | **(j)** | **(k)** |
| **1** |  |  |  |  |  |  |  |  |  |  |  |
| **2** |  |  |  |  |  |  |  |  |  |  |  |
| **3** |  |  |  |  |  |  |  |  |  |  |  |
| **4** |  |  |  |  |  |  |  |  |  |  |  |
| **5** |  |  |  |  |  |  |  |  |  |  |  |
| **6** |  |  |  |  |  |  |  |  |  |  |  |
| **7** |  |  |  |  |  |  |  |  |  |  |  |
| **8** |  |  |  |  |  |  |  |  |  |  |  |
| **9** |  |  |  |  |  |  |  |  |  |  |  |
| **10** |  |  |  |  |  |  |  |  |  |  |  |
| **11** |  |  |  |  |  |  |  |  |  |  |  |
| **12** |  |  |  |  |  |  |  |  |  |  |  |
| **13** |  |  |  |  |  |  |  |  |  |  |  |

**Direct Measures**

**Questions that map to student outcome: a, b, c. Here the student will be tested on**

1. Understand the difference between logical and physical modeling
2. Understand terminology, relationships, and implement a basic database
3. Understand and the use of relational algebra

**Sample Question:** Assume the schema consists of two relations R(A, B, C) and S(D, E). Consider the following expressions:

Are algebraic expressions (a) and (b) equivalent? Use no more than two sentences to explain your answer.

**Sample Question:** What does the following expression state (write in English)

**Sample Question:** What are the ACID properties? Define each property.

**Sample Question:** What are the properties of a good data model?

**Sample Question:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ describes how data is to be structured and stored in a database.

**Questions that map to student outcome: b, c, k. Here the student will be tested on**

* 1. Apply the Boyce-Codd Normalization and Multivalued dependencies
  2. Differentiate between database constrains and database triggers
  3. Understand indexes and its applications

**Sample Question:** An E/R diagram when converted to relations gives rise to the following relations:

R(A,B,C)

S(A,D)

T(A,D,F,G)

You may assume that the same symbols refer to the same attribute and different symbols refer to different attributes (e.g., the attributes a in the relations R, S, and T are the same). Your task is to reverse-engineer the E/R diagram from these relations, in other words, what E/R diagram could have produced these relations? For full credit, give two different E/R diagrams that could have produced these relations.

**Sample Question:** Draw an E/R diagram to model project groups in CSC430. Keep in mind that each enrolled student (identified by a PID) can work at most one project. Each project, identified uniquely by its name, can have at most two groups working on it. Be sure to identify all the appropriate multiplicity and referential integrity constraints in the diagram. Indicate key attributes in each entity set.

**Questions that map to student outcome: a, b, c, k. Here the student will be tested on**

1. Understand and implement both Data Definition and Data Management queries
2. Understand Entity Relationship Models, Design, and Functional Dependencies
3. Compare models and be aware of database usage standards
4. Understand terminology, relationships, and implement a basic database
5. Understand and the use of relational algebra

**Sample Question:** Consider the schema:

Suppliers (sid: integer, sname: string, address: string)

Parts (pid: integer, pname: string, color: string)

Catalog (sid: integer, pid: integer, cost: real)

The key fields are underlined, and the domain of each field is listed after the field name. The *Catalog* relation lists the prices charged for parts by *Suppliers.* Write the following queries in SQL.

(5 Marks) a. Find the *sids* of suppliers who supply some red part or are at 221 Parker Ave.

(5 Marks) b. Find pairs of *sids* such that the supplier with the first *sid* charges more for some part than the supplier with the second *sid.*

(6 Marks) c. Find the *pids* of parts that are supplied by at least two different suppliers.

(7 Marks) d. Find the *pids* of the most expensive parts supplied by at least two different suppliers.

(2 Marks) e. Write the equivalent SQL expression for the following:

**Sample Question:** Consider the relational database whose schema is shown below:

Lives (person-name, street, city)

Works (person-name, company-name, salary)

Located-in (company-name, city)

Manages (person-name, manager-name)

The primary key for each relation is denoted by the underlined attribute.

Write the following queries in Relational Algebra:

1. Find the name of all employees who work for the ‘Ruston Bank’ (a specific company name in the database.
2. Find the name and city of all employees who work for the ‘Ruston Bank’
3. Find the name, street, and city of all employees who work for the ‘Ruston Bank’ and earn more than $10,500.
4. Find all employees who live in the same city and on the same street as their manager.
5. Find all persons who do not work for the ‘Ruston Bank’.
6. Find all employees who live in the same city as the company they work for.