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| D:\UAAR\UIIT\courseOutlineCommittee\CourseContents_Final_V02\New folder\logo4.png | **PMAS Arid Agriculture University Rawalpindi**  **University Institute of Information Technology** | | | | C:\Users\Shahid\Downloads\IMG-20210824-WA0001.jpg |
| CS-400 Database Systems | | | | | | |
| **Credit Hours:** | | **4(3-3)** | **Prerequisites:** | **None** | | |
| **Teacher:** | |  |  |  | | |

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| **Course Description:** |
| Basic database concepts, Database approach vs file based system, database architecture, three level schema architecture, data independence, relational data model, attributes, schemas, tuples, domains, relation instances, keys of relations, integrity constraints, relational algebra, selection, projection, Cartesian product, types of joins, normalization, functional dependencies, normal forms, entity relationship model, entity sets, attributes, relationship, entity-relationship diagrams, Structured Query Language (SQL), Joins and sub-queries in SQL, Grouping and aggregation in SQL, concurrency control, database backup and recovery, indexes, NoSQL systems. |
| **Course Objective:** |
| The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.  Upon successful completion of this course, students should be able to:   * Describe the fundamental elements of relational database management systems * Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL. * Design ER-models to represent simple database application scenarios * Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data. * Improve the database design by normalization. * Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing. |
| **Teaching Methodology:** |
| Lectures, Written Assignments, Practical labs, Semester Project, Presentations |
| **Courses Assessment:** |
| Mid Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam |
| **Reference Materials:** |
| * Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition by Thomas Connolly and Carolyn Begg * Database Systems: The Complete Book, 4thEdition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom * Database System Concepts, 7thEdition by AviSilberschatz, Henry F. Korth and S. Sudarshan, released in March 2019. * Database Management Systems, 4thEdition by Raghu Ramakrishnan, Johannes Gehrke |

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| **Course Learning Outcomes (CLOs):** | | |
| At the end of the course the students will be able to: | **Domain** | **BT Level\*** |
| 1. **Explain** fundamental database concepts. | C | 2 |
| 1. **Design** conceptual, logical and physical database schemas using different data models | C | 5 |
| 1. **Identify** functional dependencies and resolve database anomalies by normalizing database tables | C | 2 |
| 1. **Use** Structured Query Language (SQL) for database definition and manipulation in any DBMS | C | 4 |
| \* BT= Bloom’s Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective doma | | |

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| **Week/Lecture #** | | **Theory** | | **Practical** | |
| **1** | Lect-I | File Based System, Database Approach,  Roll in Data Base Environment. | | **The Relational Model**  SQL  Displaying Table Structure  Selecting Specific Columns  Arithmetic Expressions  Operator Precedence  Defining a Column Alias | |
| Lect-II | History of data base Management System, Advantages and Disadvantages Of DBMSs | |
| **2** | Lect-I | How to build and manage database?  Database Systems, File based system, DBMS approach  What is File based approach? Limitations of File based approach | | **The Relational Model**  SQL Statements  Defining a Column Alias  Concatenation Operator  Eliminating Duplicate Rows | |
| Lect-II | DBMS approach, Advantages of DBMS, Cost and Risks Factors. | |
| **3** | Lect-I | Three Level ANSI-SPARC Architecture  External level, Conceptual Level. | | Restricting and Sorting Data  Limiting Rows Selected  Comparison Operators  Other operators (BETWEEN, IN, LIKE, IS NULL) | |
| Lect-II | Internal Level  Disadvantages of Three Level Architecture | |
| **4** | Lect-I | Entity Relationship modeling   * + Entity   + Attributes and its types   + Identifier   + Primary Key   + Candidate Key | | Logical Operators and Rules of Precedence | |
| Lect-II | * + Relationship   + Degree of Relationship     - Unary     - Binary     - Ternary     - Quaternary | |
| **5** | Lect-I | Cardinality of Relationship   * + One-to-one relationship   + One-to-many relationship   + Many-to-many relationship * Minimum/Maximum Cardinality   + Optional one   + Optional Many   + Mandatory one   + Mandatory Many | | Single-Row Functions  Character functions  Number functions  Date functions  Conversion function | |
| Lect-II | CASE STUDY (One in class and two as assignment) | |
| **6** | Lect-I | * Enhanced ERD   + Super Type   + Sub Type   + Generalization   + Specialization   + Attribute Inheritance   + Relationship Inheritance | | Group Functions   * + AVG   + COUNT   + MAX   + MIN   + STDDEV   + SUM   + VARIANCE | |
| Lect-II | * Constraints   + Completeness Constraint     - Total Specialization     - Partial Specialization   + Disjoint Constraint     - Disjoint Rule     - Overlap Rule | |
| **7** | Lect-I | * + Enhanced ERD CASE STUDY | | Sub queries | |
| Lect-II | Transformation of (E)ER Model into Relational Model  Attributes   * Simple * Composite * Multivalued | |
| **8** | Lect-I | Entities   * Regular * Weak * Associative   Relationship   * Unary   + One-to-one   + One-to-Many   + Many-to-Many * Binary   + One-to-one   + Minimum/Maximum same on both   + Optional-Mandatory   + One-to-Many   + Many-to-Many * Ternary * Quaternary | | * Producing readable output with iSQLplus * Substitution Variables * Using &Substitution Variables * Character and Date values with Substitution Variables * Specifying Columns Names, Expression and Text * Define and Undefined Commands | |
| Lect-II | Super Type  Subtype   * CASE STUDY of Transformation | |
| **Mid Term Exam** | | | | | |
| **9** | Lect-I | * Data Normalization   + Characteristics of Suitable Relation   + Advantages of Suitable Relations | Displaying Data from multiple Tables  Equi-Join  Non-Equi join  Outer- join  Self-join | |
| Lect-II | * + Goal of Normalization   + Data Anomalies     - Insertion Anomaly     - Deletion Anomaly     - Updating Anomaly |
| **10** | Lect-I | * + Definitions of Some Terms     - Functional Dependency     - Partial Dependency     - Transitive Dependency | Manipulating Data DML  Insert  Update  Delete  Rollback  Commit  Inserting values using substitution variables | |
| Lect-II | * + First Normal Form   + Second Normal Form   + Third Normal Form   + CASE STUDY |
| **11** | Lect-I | * + Advanced Normalization: Inference Rules for Functional Dependencies | Creating and Managing Tables  Create table  Create table using subquery  Alter table  Drop table  Truncate | |
| Lect-II | * + Minimal Sets of FD’s, Boyce-Codd Normal Form, Fourth Normal Form |
| **12** | Lect-I | * Physical Design   + Purpose   + Goal   + Inputs   + Decisions   + Designing Field   + Objectives during selection of data type | Including Constraints  Not Null  Unique  Primary Key  Foreign Key  Check  Adding constraint  Dropping constraints  Enabling and disabling constraints | |
| Lect-II | * + Controlling Data Integrity     - Data type     - Default value |
| **13** | Lect-I | * + Controlling Data Integrity     - Range control     - Null value control     - Referential integrity | * + Describe a view   + Create a view   + Retrieve data through a view   + Alter the definition of a view   + Insert, update, and delete data through a view   + Drop a view   + Create complex view   + Using with check option clause   + Denying DML operations | |
| Lect-II | * + File Organization   + Sequential File Organization   + Indexed File Organization   + Hashed File Organization |
| **14** | Lect-I |  | Create   * Sequence * Index * Synonym | |
| Lect-II |  |
| **15** | Lect-I |  | Controlling User Access   * + System privileges   + Granting privileges   + Revoking privileges | |
| **16** | Lect-I | Presentation |  | |
|  | Lect-II | Presentation |  | |