Course Title: Database Management System
Course No. : ICT. Ed. 446 Nature of course: Theoretical + Practical
Level: B.Ed. Credit Hour: 3 hours (2T+1P)
Semester: Fourth Teaching Hour: 80hours (32+48)

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1. Course Description

The purpose of this course is to introduce the fundamental concepts of database management, including aspects of data models, database languages, and database design. At the end of this course, a student will be able to understand the fundamental concepts required for the use and design of database management systems.

2. General Objectives

Through this course, students shall

- become proficient at modeling databases at conceptual and logical levels of design,
- be able to develop database schemas with design principles that enforce data integrity,
- become knowledgeable in the creation, altering, and manipulation of tables, indexes, and views using relational algebra and SQL,
- become proficient at casting queries in SQL, and
- be able to understand concepts of transaction management, concurrency control, and crash recovery.

3. Course Outlines:

Specific Objectives	Contents
• Identify data management approaches and their values. • Define terms related to database management systems. • Understand benefits of database management systems. • Describe different data models and their usefulness. • Understand the concept of data abstraction and data independence.	**Unit 1: Database System Introduction(6)** 1.1. Basic Terminologies: Data vs Information, Data Hierarchy, Database, Database Management System, Database System, Relational Database Management Systems. 1.2. Data Management Approaches: File Management Systems, Database Management Systems, Limitations, Advantages, and Applications. 1.3. Database Schema and Instance, Data Abstraction (views of Data), Data Independence, Database Languages, Database Users and Administrator. 1.4. Data Models: Hierarchical, Network, Entity Relationship, Relational, and object oriented data model 1.5. Database Application Architecture, Classification of DBMSs **Practical Work** • Demonstrate Creation and manipulation of Tables by using MS Access
• Explain use and importance of ER model. • Describe components of ER diagrams. • Use ER diagrams to design	**Unit 2: Entity Relationship Data Modeling (8)** 2.1. ER Model and ER Diagrams, Components of ER Model, Types of Attributes. 2.2. Degree of Relationship, Constraints on ER Model

databases. • Learn concepts used in EER modeling • Explain concept behind Relational model. • Learn conversion of ER diagrams into Relational model.	(Mapping Cardinalities and Participation Constraints), Keys and Types of Keys, Weak Entity Sets. 2.3. Extended ER Modelling: Subclass/Superclass Relationship, Specialization and Generalization, Constraints on Specialization/Generalization Aggregation. 2.4. Relational Model: Introduction, Structure of Relational Databases, Schema Diagram, Mapping ER Model to Relational Database. **Practical Works:** • Draw ER diagrams by using CASE Tools • Practice Conversion of ER model to Relational model
• Use basic operations of relational algebra. • Discuss and use additional relational algebra operations and extended relational algebra operations. • Understand and use database modification through relational algebra. • Apply the concept behind NULL values and three-valued logic.	**Unit 3: Relational Algebra (10)** 3.1. Introduction of Relational Algebra (RA), Fundamental Operations of RA: Select, Project, Set Union, Set Difference, Cartesian product and Rename Operations. 3.2. Additional Relational Algebra Operations: Set Intersection, Natural Join, Division and Assignment Operation. 3.3. Extended Relational Algebra Operations: Generalized Projection, Outer Join and Aggregate Functions 3.4. Database Modification: Insert, Delete and Update Operation 3.5. Null Values, Advantages and Limitations of Relational Algebra
• Explain structure of SQL queries. • Use SELECT, FROM and WHERE clauses efficiently. • Understand concept behind join operations. • Discuss and Use aggregate functions and subqueries. • Apply database modification statements. • Explain and use DDL statements. • Understand concept behind views and use them.	**Unit IV: Structured Query Language (20)** 4.1. Introduction: Basic Structure of SQL Query, SELECT, FROM and WHERE clause, Using Multiple Relations 4.2. String/Pattern Matching, Ordering the Display of Tuples, Join Operations: Join Types and Join Conditions. 4.3. Nested Queries: Set membership Test, Set Comparison and Test for Empty Relations. 4.4. Aggregate Functions, Group by Clause and Having Clause 4.5. Database Modifications: Insert, Delete and Update Operations 4.6. Data Definition Language: Domain Types in SQL, Create, Alter and Drop statements 4.7. View and Modification of Views, Embedded and Dynamic SQL **Practical Works:** • Create relational database by using create statements

	• Populate tables with data by using INSERT statement • Practice basic SQL queries by using Select..from.. where • Use Cartesian products, natural join and set operations to solve queries • Use sub queries, aggregate functions and outer joins to solve queries • Practice DML statements DELETE and UPDATE • Practice DDL statements ALTER, and DROP
• Understand importance of integrity constraints. • List and discuss different types of integrity constraints. • Use Integrity constraints for maintaining for achieving correctness of data. • Compare and contrast between assertions and triggers	**Unit 5: Integrity Constraints (8)** 5.1. Concept and Importance of Integrity Constraints, Data Integrity. 5.2. Domain Constraints: Not Null Constraints, Unique Constraints, Primary key Constraints, Check Constraints. 5.3. Referential Integrity: Using Referential Integrity, Cascading Actions 5.4. Assertions and Triggers: Creating and Deleting Assertions, Creating and Deleting Triggers, Assertions vs Triggers. **Practical Works:** • Demonstrate use of Domain constrains and referential integrity • Create assertions and triggers
• Exemplify database modification anomalies. • Understand and exemplify functional dependencies. • Discuss and exemplify conversion of de-normalized relations into normalized forms.	**Unit 6: Relational Database Design (8)** 6.1. Introduction, Database Modification Anomalies, Functional Dependencies (FDs), Types of FD's, FD Inference Rules. 6.2. Normalization: Purpose and Concept of Normalization, Forms of Normalization: 1-NF, 2-NF, 3-NF, BCN 6.3. Lossless Decomposition **Practical Works:** • Demonstrate Database modification anomalies
• Differentiate between authentication and authorization. • Apply the concept in database management systems. • Understand the concept behind indexing. • Demonstrate different types of indices. • Compare and contrast between	**Unit 7: Database Security and Indexing (8)** 7.1. Authentication vs, Authorization, Classification of DB Security, Levels of DB Security. 7.2. Types of Authorization, Creating Users, Granting and Revoking Authorizations in SQL, Concept of Roles, Authorization using Roles. 7.3. Concept of Indexing, Index File vs Data File, Index key Structure, Types of Indices 7.4. Primary Indices: Dense and Sparse Indices with their Strengths and Drawbacks, Indexing Evaluation. **Practical Works:**

dense and sparse indices.	• Demonstrate GRANT and REVOKE statements • CREATE and DROP indices
• Understand the concepts of transaction and schedules • Understand the problems behind concurrent execution of transactions • Describe and exemplify lock based concurrency control technique. • Discuss need of recovery in database management systems.	**Unit 8: Introduction to Transaction and Recovery (8)** 8.1. Transaction Processing: Transaction concepts, Transaction Operations, Desirable Properties of Transactions, Transaction States, Schedule, Serial, Non-serial and Serializable Schedule. 8.2. Concurrency Control: Introduction, Need of Concurrency Control, Lock-Based Protocols 8.3. Database Recovery: Need of Recovery, Concept of Recovery, Log Based Recovery, Write Ahead Logging, Checkpointing
• Understand the concept of emerging database trends and application	**Unit 9: Emerging Database Technology and Application (4)** 9.1 Concept of Big data 9.2 Concept of NoSQL 9.3 Concept of Mobile and Multimedia data 9.4 Concept of GIS database 9.5 Concept of Data Warehouse and Data Mining

10 Instructional Techniques

The instructional techniques for this course are divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to particular units.

4.1 General Techniques

Reading materials will be provided to students in each unit. Lecture, Discussion, use of multi-media projector, brain storming are used in all units.

4.2 Specific Instructional Techniques

Demonstration is an essential instructional technique for all units in this course during teaching learning process. Specifically, demonstration with practical works will be specific instructional technique in this course. The details of suggested instructional techniques are presented below:

Unit 1: Self reading, and making study reports
Unit 2: Assignment on Creating ER diagrams and converting ER model to Relational model
Unit 3: Homework and Assignment on solving queries by using RA
Unit 4: Homework and Assignment on Laboratory works in SQL
Unit 5: Group Discussion on Anomalies and Integrity
Unit 6: Mini Case Study on Normalization
Unit 7: Self reading and making study reports
Unit 8: Self reading, creating and presenting study reports

5. Evaluation :

Internal Assessment	External Practical Exam/Viva	Semester Examination	Total Marks
40 Points	20 Points	40 Points	100 Points

***Note**: Students must pass separately in internal assessment, external practical exam and semester examination.*

5.1 Internal Evaluation (40 Points):

Internal evaluation will be conducted by subject teacher based on following criteria:

1) Class Attendance 5 points
2) Learning activities and class performance 5 points
3) First assignment (written assignment) 10 points
4) Second assignment (Case Study/project work with presentation) 10 points
5) Terminal Examination 10 Points

Total 40 points

5.2 Semester Examination (40 Points)

Examination Division, Dean office will conduct final examination at the end of semester.

1) Objective question (Multiple choice 10 questions x 1mark) 10 Points
2) Subjective answer questions (6 questions x 5 marks) 30 Points

Total 40 points

5.3 External Practical Exam/Viva (20 Points):

Examination Division, Dean Office will conduct final practical examination at the end of semester.

11 Recommended books and References materials (including relevant published articles in national and international journals)

Recommended books:

- Silberschatz, H.F. Korth, and S. Sudarshan, Database System Concepts, 6th Edition, McGraw Hill, 2010

References materials:

- Raghu Ramakrishnan, and Johannes Gehrke, Database Management Systems, 3rd Edition ,McGraw-Hill, 2007
- Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 6th Edition, Pearson Addison Wesley; 2010.

- Saud S. Arjun, Saud S. Bupendra, Introduction to Database Systems, 2nd Edition, Kriti Publication, 2073