

**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**

**WORK INTEGRATED LEARNING PROGRAMMES**

**COURSE HANDOUT**

**Part A: Content Design**

|  |  |
| --- | --- |
| **Course Title** | Database Design and Applications |
| **Course No(s)** | CSI ZG518 / SS ZG518/SE ZG518 |
| **Credit Units** | 5 (1 unit for lecture, 2 for self-study, 2 for lab / assignment / work integrated activities) |
| **Course Author** | R Gururaj |
| **Version No** |  |
| **Date** |  |

**Course Objectives**

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| --- | --- |
| **No** | **Course Objective** |
| **CO1** | Enrich the skill and competency of students in Design and Development of Database Systems through experiential learning. |
| **CO2** | Provide knowledge about the internals of Database Management Systems. |
| **CO3** | Prepare students to tackle the challenges in operationalizing Database Systems, like- maintaining consistency and integrity, performance etc . |

**Text Book(s)**

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| --- | --- |
| T1 | Ramez Elmasri & Shamkant B. Navathe, Database Systems; Models, Languages, Design and Application Programming, Pearson Education, 7th Edition, 2017. |

**Reference Book(s) & other resources**

|  |  |
| --- | --- |
| R1 | Abraham Silberschatz, Henry F Korth and S Sudarshan, Database System Concepts, McGraw Hill, 6th Ed., 2013 |
| R2 | Date C.J., An Introduction to Database Systems, Addison Wesley, 8th Ed., 2006. |

**Content Structure**

1. Introduction to Database Management Systems (DBMS) Concepts and Architecture
   1. Database Management Systems Introduction
      1. Basics and advantages of storing data using DBMS
      2. Database systems environment
   2. Database Management System Architecture
      1. Abstraction and Three-schema architecture
      2. Basic modules of DBMS
      3. DBMS Users
2. Data Modeling
   1. Database Design and ER Modeling
      1. Steps in database Design Process
      2. Concepts and notations
      3. Relationships and constraints
      4. Examples
   2. Relational Data Model concepts
      1. Relational data model fundamentals
      2. Constraints in Relational data model
      3. Representation of schemas
   3. ER to Relational Mapping
      1. Mapping rules/guidelines for mapping ER constructs
      2. Mapping rules/guidelines for mapping heirarchies
      3. Examples
3. Relational Query Languages
   1. Relational Algebra
      1. Basic Relational operations
      2. Other operations and Joins
   2. SQL
      1. Introduction to SQL
      2. SQL features
      3. SQL join operations
      4. SQL Grouping operations
      5. SQL views
4. Schema Refinement
   1. Functional Dependencies
      1. Functional dependencies
      2. Inference rules
   2. Normalization and Decomposition
      1. First and Second Normal forms
      2. Third and BCNF normal forms
      3. Decomposition and desirable properties
      4. Lossless join decomposition
      5. Dependency preserving decomposition
5. Data storage, Hashing and Indexing
   1. Disk storage
      1. Disk features
      2. Storage capacity
      3. File and Record organization
      4. Types of File organizations
      5. Types of record organizations
   2. Hashing Techniques
      1. Static external Hashing
      2. Dynamic hashing schemes
   3. Indexing Techniques
      1. Introduction to indexing
      2. Primary and secondary indexing
      3. Multilevel indexing
      4. B+ tree indexing
6. Transaction processing, concurrency control and recovery
   1. Transaction model
      1. Transaction significance
      2. States of a transaction
      3. Schedules- serial and concurrent
   2. Concurrency Control
      1. Need for Concurrency control
      2. Lock based concurrency control and Deadlocks
      3. Time-stamp based concurrency control
   3. Database Recovery
      1. Log based recovery techniques
      2. Checkpointing
      3. Shadow paging
7. Database Security and Database Programming
   1. Database security
      1. Introduction to Database Security
      2. Access Control Mechanisms
      3. Statistical Database Security
      4. Flow Control
      5. Other Security Challenges
8. Additional Topics
   1. Query optimization and Tuning
      1. Query execution steps
      2. Query trees
      3. Heuristics
      4. Database tuning concepts
   2. Database Design methodology and UML
      1. Role of information systems
      2. Design process
      3. UML and tools in Database
   3. XML data model
      1. Basics of XML
      2. DTD and schemas
      3. XML storage
      4. XML query languages- XPath and XQuery
   4. Database programming
      1. Accessing databases from programming languages
      2. Triggers
      3. Stored procedures
   5. Distributed Databases and Client Server Architecture
      1. Purpose of Distributed databases
      2. Managing distributed databases
      3. Overview of 3-tier client server architecture
   6. Recent trends in databases
      1. NoSQL Databases
      2. Hadoop

NoSQL Database

<https://www.thoughtworks.com/insights/blog/nosql-databases-overview>

Hadoop

<https://www.mssqltips.com/sqlserverauthor/77/dattatrey-sindol/>

**Note:** Due to time constraints, all topics listed under module 8 may not be covered. Instructor may decide on some topics from module 8 to be covered as a part of the course.

**Learning Outcomes:**

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| --- | --- |
| No | Learning Outcomes |
| LO1 | More effective and efficient Database Systems leading to more elegant Information System. |
| LO2 | Students are equipped with knowledge on database concepts like- Modelling, Querying, Transactions, Indexing, Recovery etc. |
| LO3 | Students are equipped with the knowledge to tune the Database Systems and Applications for improved performance, response-time etc. |

**Part B: Contact Session Plan**

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| --- | --- |
| **Academic Term** | Second Semester 2023-2024 |
| **Course Title** | Database Design and Applications |
| **Course No** | CSI ZG518 / SS ZG518/SE ZG518 |
| **Lead Instructor** | AMIT DUA |

**Glossary of Terms:**

1. Contact Hour (CH) stands for a hour long live session with students conducted either in a physical classroom or enabled through technology. In this model of instruction, instructor led sessions will be for 22 CH.
   1. Pre CH = Self Learning done prior to a given contact hour
   2. During CH = Content to be discussed during the contact hour by the course instructor
   3. Post CH = Self Learning done post the contact hour
2. Contact Hour (CS) stands for a two-hour long live session with students conducted either in a physical classroom or enabled through technology. In this model of instruction, instructor led sessions will be for 11 CS.
   1. Pre CS = Self Learning done prior to a given contact session
   2. During CS = Content to be discussed during the contact session by the course instructor
   3. Post CS = Self Learning done post the contact session
3. RL stands for Recorded Lecture or Recorded Lesson. It is presented to the student through an online portal. A given RL unfolds as a sequences of video segments interleaved with exercises
4. SS stands for Self-Study to be done as a study of relevant sections from textbooks and reference books. It could also include study of external resources.
5. LE stands for Lab Exercises
6. HW stands for Home Work.
7. M stands for module. Module is a standalone quantum of designed content. A typical course is delivered using a string of modules. M2 means module 2.

## Teaching Methodology (Flipped Learning Model)

The pedagogy for this course is centered around flipped learning model in which the traditional class-room instruction is replaced with recorded lectures to be watched at home as per the student’s convenience and the erstwhile home-working or tutorials become the focus of classroom contact sessions. Students are expected to finish the home works on time.

## Contact Session Plan

* Each Module (M#) covers an independent topic and module may encompass more than one Recorded Lecture (RL).
* Contact Sessions **(2hrs each week)** are scheduled alternate weeks after the student watches all Recorded Lectures (RLs) of the specified Modules (listed below) during the previous week
* In the flipped learning model, Contact Sessions are meant for in-classroom discussions on cases, tutorials/exercises or responding to student’s questions/clarification--- may encompass more than one Module/RLs/CS topic.
* Contact Session topics listed in course structure (numbered CSx.y) may cover several RLs; and as per the pace of instructor/students’ learning, the instructor may take up more than one CS topic during each of the below sessions.

## Detailed Structure

**Introductory Video/Document:** *<< Introducing the faculty, overview of the course, structure and organization of topics, guidance for navigating the content, and expectations from students>>*

* Each of the sub-modules of **Recorded Lectures** (RLx.y ) shall delivered via **30 – 60mins videos** followed by:
* **Contact session** (CSx.y) of 2Hr each for illustrating the concepts discussed in the videos with exercises, tutorials and discussion on case-problems (wherever appropriate); contact sessions (CS) may cover more than one recorded-lecture (RL) videos.

## Course Contents

**Contact Hour 1**

|  |  |  |  |
| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL1.1 | Database Systems  DBMS  Database System Environment  Traditional File Systems  Advantages of DBMS over File Systems  Disadvantages of DBMS | Ch.1 (T1) 1.1 to 1.6 |
| RL1.2 | DBMS\_RL\_1.2:  Describing and Storing data in DBMS  Three Schema Architecture  Data Independence  Queries  Transactions  Structure of DBMS  Users of DBMS | Ch.2 (T1) 2.1 to 2.4 |
| During CH | CH1 | We discuss important concepts like advantages of using DBMS over traditional file systems; Three schema architecture; Data independence; DBMS architecture. | Ch.1 (T1) 1.1 to 1.6  and Ch.2 (T1) 2.1 to 2.4 |
| Post CH | SS1 | To be announced at the end of the contact hour (CH1). |  |
| Lab Reference |  |  |  |

Notes: T1 stands for Textbook 1, R1 stand for Reference book 1

**Contact Hour 2**

|  |  |  |  |
| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 2.1 | DBMS\_RL\_2.1:  Steps in database Design Process  ER Concepts and Notations  Class Hierarchies | Ch.3 (T1) 3.1 to 3.7  Ch.4 (T1) 4.1 to 4.3 |
| During CH | CH2 | We discuss ER concepts, notations with appropriate examples. We learn how to model databases using ER techniques. | Ch.3 (T1) 3.1 to 3.7  Ch.4 (T1) 4.1 to 4.3 |
| Post CH | HW2 | To be announced at the end of the contact hour (CH2). |  |
| Lab Reference |  |  |  |

**Contact Hour 3**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 2.2 | DBMS\_RL\_2.2:  Relational data model fundamentals  Constraints in Relational data model  Representation of schemas | Ch.5 (T1) |
| During CH | CH3 | We discuss to have a better understanding of characteristics and Constraints of Relational model with proper examples. | Ch.5 (T1) |
| Post CH | SS3 | Updates and dealing with constraint violations in Relational model | Ch.5 (T1) 5.3  Ch.2 (R1) 2.6 |
| QZ3 | To be announced at the end of the contact hour (CH3). |  |
| Lab Reference |  |  |  |

**Contact Hour 4**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 2.3 | DBMS\_RL\_2.3:  Mapping rules/guidelines for mapping ER constructs  Mapping rules/guidelines for mapping hierarchies  Examples | Ch.9 (T1) 9.1, 9.2 |
| During CH | CH4 | We understand Mapping rules/ guidelines for mapping various ER constructs to Relational model with appropriate examples | Ch.9 (T1) 9.1, 9.2 |
| Post CH | HW4 | To be announced at the end of the contact hour (CH4). |  |
| Lab Reference |  |  |  |

**Contact Hour 5**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 3.1 | DBMS\_RL\_3.1:  Relational Query Languages  Formal Query Languages  Introduction to relational algebra  Relational operators  Set Operators  Join operator  Aggregate functions  Grouping  Relational Calculus concepts | Ch.8 (T1) 8.1, 8.6 |
| During CH | CH5 | We practice writing Relational algebra queries for data retrieval with sample relational schemas. This consolidates our understanding of relational algebra operations. | Ch.8 (T1) 8.1, 8.6 |
| Post CH | SS5 | More on Tuple relational calculus (TRC) | Ch.8 (T1) 8.6 |
| HW5 | To be announced at the end of the contact hour (CH5). |  |
| QZ5 | To be announced at the end of the contact hour (CH5). |  |
| Lab Reference |  |  |  |

**Contact Hour 6**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 3.2 | DBMS\_RL\_3.2:  Introduction to Structured Query Language (SQL)  Features of SQL  DDL Statements | Ch.6 (T1) 6.1 to 6.3  Ch.7 (T1) 7.4 |
| During CH | CH6 | We practice writing SQL queries for data retrieval with sample relational schemas. This consolidates our understanding of SQL operations. | Ch.6 (T1) 6.1 to 6.3  Ch.7 (T1) 7.4 |
| Post CH | HW6 | To be announced at the end of the contact hour (CH6). |  |
| Lab Reference |  |  |  |

**Contact Hour 7**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL7 | DBMS\_RL\_3.3  Nested queries and correlated nested queries  Use of EXISTS and NOT EXISTS  Explicit join operations  Aggregate functions  Group by and Having clauses  Insert / Update / Delete operations  Views | Ch. 6(T1) 6.4  Ch.7 (T1) 7.1 to 7.4 |
| During CH | CH7 | We practice writing SQL queries for data retrieval with sample relational schemas. This consolidates our understanding of SQL operations. | Ch.6(T1) 6.1 to 6.4  Ch.7 (T1) 7.1 to 7.4 |
| Post CH | SS7 | Advanced SQL Concepts:  Triggers, Functions, Procedures, and Sequences. | Ch.5 (R1) 5.1 to 5.3 |
| HW7 | To be announced at the end of the contact hour (CH7). |  |
| QZ7 | To be announced at the end of the contact hour (CH7). |  |
| Lab Reference |  |  |  |

**Contact Hour 8**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 4.1 | DBMS\_RL\_4.1:  Introduction to Schema Refinement  Functional Dependencies  Inference Rules  Normalization  Normal Forms (1NF and 2NF) | Ch.14 (T1) 14.1 to 14.3 |
| During CH | CH8 | Understand Functional dependencies, 1 NF and 2 NF with examples | Ch.14 (T1) 14.1 to 14.3  Ch.15(T1) 15.1 |
| Post CH | HW8 | To be announced at the end of the contact hour (CH8). |  |
| Lab Reference |  |  |  |

**Contact Hour 9**

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| Time | Type | Description | Content Reference |
| Pre CH | RL9 | DBMS\_RL\_4.2:  3NF and BCNF  Decomposition requirements  Lossless join decomposition  Dependency preserving decomposition  Examples | Ch.14 (T1) 14.4 and 14.5  Ch.15 (T1) 15.2 and 15.3 |
| During CH | CH9 | Look at 3 NF, BCNF and Decomposition with examples | Ch.14 (T1) 14.4 and 14.5  Ch.15 (T1) 15.2 and 15.3 |
| Post CH | HW9 | To be announced at the end of the contact hour (CH9). |  |
| QZ9 | To be announced at the end of the contact hour (CH9). |  |
| Lab Reference |  |  |  |

**Contact Hour 10**

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| Time | Type | Description | Content Reference |
| Pre CH | RL10 | DBMS\_RL\_5.1  Disk pack features  Records and Files  File operations  Ordered and Unordered files | Ch.16 (T1) 16.1 to 16.7 |
| During CH | CH10 | To understand Secondary disk storage device; Files, records, blocks on disks | Ch.16 (T1) 16.1 to 16.7 |
| Post CH | SS10 | More on Storage devices | Ch.10 (R1) 10.1-10.4 |
| Lab Reference |  |  |  |

Mid semester exams

**Contact Hour 11**

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| Time | Type | Description | Content Reference |
| Pre CH | RL 5.2 | DBMS\_RL\_5.2:  Introduction to Hashing  Internal hashing  Collision  External hashing  Static hashing  Dynamic hashing | Ch.16 (T1) 16.8 |
| During CH | CH11 | To understand the concept of Hashing with examples. | Ch.16 (T1) 16.8 |
| Post CH | SS11 | More on Hashing | Ch.11 (R1) 11.6 to 11.7 |
| HW11 | To be announced at the end of the contact hour (CH11). |  |
| QZ11 | To be announced at the end of the contact hour (CH11). |  |
| Lab Reference |  |  |  |

**Contact Hour 12**

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| Time | Type | Description | Content Reference |
| Pre CH | RL 5.3 | DBMS\_RL\_5.3:  Introduction to Indexing  Primary and Secondary indexes  Dense and Sparse indexing  Multilevel indexing  Designing Primary and Multilevel indexes | Ch.17 (T1) 17.1 and 17.2 |
| During CH | CH12 | Understanding Primary and Multilevel Indexing with Examples | Ch.17 (T1) 17.1 and 17.2 |
| Post CH | SS12 | Other Indexing schemes; Indexing using SQL | Ch.11 (R1) 11.8 to 11.10 |
| Post CH | HW12 | To be announced at the end of the contact hour (CH12). |  |
| Lab Reference |  |  |  |

**Contact Hour 13**

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| Time | Type | Description | Content Reference |
| Pre CH | RL 5.4 | DBMS\_RL\_5.4  Introduction to Tree indexing  B+ Tree  Inserting and Deleting keys into B+ trees  Constructing a B+ tree  Designing a B+ tree node structure | Ch.17 (T1) 17.3 |
| During CH | CH13 | Understanding B+ Indexing with Examples | Ch.17 (T1) 17.3 |
| Post CH | SS13 | B Tree indexing , Indexing on multiple keys and Other types of Indexing | Ch.17 (T1) 17.3 to 17.5 |
| HW13 | To be announced at the end of the contact hour (CH13). |  |
| Lab Reference |  |  |  |

**Contact Hour 14**

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| Time | Type | Description | Content Reference |
| Pre CH | RL 6.1 | DBMS\_RL\_6.1:  Introduction to Transaction Model  Significance of Transaction Model  States of a transaction  ACID properties | Ch.20 (T1) 20.1 to 20.3 |
| During CH | CH14 | Discuss on significance of Transaction model and ACID properties in detail with examples | Ch.20 (T1) 20.1 to 20.3 |
| Post CH |  |  |  |
| Lab Reference |  |  |  |

**Contact Hour 15**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 6.2 | DBMS\_RL\_6.2  Concurrent Transactions  Transaction Schedule  Serial and Concurrent Schedules  Need for Concurrency Control  Conflicting Operations  Conflict Equivalent Schedule  Test for Conflict Serializability  View Equivalent Schedule  View Serializability | Ch.20 (T1) 20.4 and 20.5 |
| During CH | CH15 | We understand serializability of concurrent schedules with examples | Ch.20(T1) 20.4 and 20.5 |
| Post CH | SS15 | View equivalence and view serializability | Ch.20 (T1)  Ch.14 (R1) 14.4 to 14.7 |
| Lab Reference |  |  |  |

**Contact Hour 16**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 6.3 | DBMS\_RL\_6.3  Introduction to Concurrency Control  Implementing Serializability  Lock-based protocols  Deadlock condition  Two-phase locking protocol  Time-stamp based protocols | Ch.21 (T1) 21.1 and 21.2 |
| During CH | CH16 | We work with appropriate examples to understand lock-based concurrency control, time-stamp based concurrency control and Deadlock detection technique. | Ch.21 (T1) 21.1 and 21.2 |
| Post CH | SS16 | Multiversion Concurrency Control  Validation | Ch.21 (T1) 21.3 and 21.4 |
| HW16 | To be announced at the end of the contact hour (CH16). |  |
|  | QZ16 | To be announced at the end of the contact hour (CH16). |  |
| Lab Reference |  |  |  |

**Contact Hour 17**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 6.4 | DBMS\_RL\_6.4  Introduction to Recovery  Recovery strategies  Log-based recovery  Check-pointing  Shadow paging | Ch.22 (T1) 22.1 to 22.4 |
| During CH | CH17 | Consolidate our understanding of Recovery concepts with examples. | Ch.22 (T1) 22.1 to 22.4 |
| Post CH | SS17 | ARIES; Recovery in multidatabase Systems; Database backup | Ch.22 (T1) |
| HW17 | To be announced at the end of the contact hour (CH17). |  |
| Lab Reference |  |  |  |

**Contact Hour 18**

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| --- | --- | --- | --- |
| Time | Type | Description | Content Reference |
| Pre CH | RL 7.1 | DBMS\_RL\_7.1:  Introduction to database security;  Access control;  Statistical database security;  Flow control ;  Other challenges; | Ch.30 (T1) |
| During CH | CH18 | Look at access control options in Oracle and understand statistical databases. |  |
| Post CH |  |  |  |
| Lab Reference |  |  |  |

**Contact Hour 19, 20 and 21**

Some topics from module 8 to be covered as decided by the instructor.

**Contact Hour 22**

Revision Lecture

**Detailed Plan for Lab work**

Install SQLite & SQLiteBrowser on your laptop for carrying out the lab exercises

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| --- | --- | --- |
| **Lab No** | **Topic** | **Lab Objective** |
| 1 | Basics of SQL | Understand installation of DBMS such as SQLite and SQLiteBrowser and explore its features |
| 2 | Data Definition Language (DDL) | Understand how to CREATE tables |
| 4 | Data Manipulation Language(DML) | Basics of SQL: SELECT & JOIN |
| 5 | DML | Understand usage of Aggregate functions |
| 6 | DML | Understand how to use UPDATE and DELETE operations |
| 7. | PLSQL | Writing Triggers, Functions, Stored Procedures |

Please refer to the attached lab sheet to perform the SQL exercises

**Assignment**

1. Think of a web-based software application (with a central database), that you think will be useful to many people (1 week)
2. Write a brief description of the application (1 week)
   * Who will be the users?
   * What are the benefits of this application?
   * List of functions & features of the application
   * How many users will use it simultaneously?
3. Draw ER diagram for the application(2 weeks)
4. Convert ER model to relational model (2 weeks)
5. Write SQL queries to fulfil the end user needs (2 weeks)
6. Design indices to enhance the performance of queries and justify your choice of indices

**Work Integrated activities** (8 weeks)

|  |  |  |
| --- | --- | --- |
| **Activity No** | **Topic** | **Description** |
| 1 | Conceptual model | Draw ER diagram of the database used by your application |
| 2 | Logical database model | Study the tables of your application & determine if it satisfies 3rd Normal Form. Recommend improvements if any, to the table design |
| 3 | Physical design | Study the indexes of your application & suggest improvements if any. |
| 4 | Database administration | Talk to your DBA and find out what their challenges are. Think of ways to address these challenges and discuss your suggestions with them. What is the outcome of these discussions? |
| 5 | Security | What security features of DBMS are implemented in your application (set of applications). Give examples of situations where these features are used. |

**Evaluation Scheme**:

Legend: EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No | Name | Type | Duration | Weight | Day, Date, Session, Time |
| EC-1 | Quiz-I | Online | - | 5% | February 19-28, 2024 |
| Quiz-II | Online | - | 5% | March 19-28, 2024 |
| Quiz – III | Online | - | 5% | April 19-28, 2024 |
| Lab / Assignment | Online |  | 15% | To be announced |
| EC-2 | Mid-Semester Test | Closed Book | 2 hours | 30% | Sunday, 17/03/2024 (AN) |
| EC-3 | Comprehensive Exam | Open Book | 2½ hours | 40% | Sunday, 19/05/2024 (AN) |

***Note*** *- Evaluation components can be tailored depending on the proposed model.*

## Important Information:

Syllabus for Mid-Semester Test (Closed Book): Topics in CS 1-5.

Syllabus for Comprehensive Exam (Open Book): All topics given in plan of study

Evaluation Guidelines:

1. For Closed Book tests: No books or reference material of any kind will be permitted. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
2. For Open Book exams: Use of prescribed and reference text books, in original (not photocopies) is permitted. Class notes/slides as reference material in filed or bound form is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
3. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam. The genuineness of the reason for absence in the Regular Exam shall be assessed prior to giving permission to appear for the Make-up Exam. Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self-study schedule as given in the course handout, attend the lectures, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.

**Appendix**

**Lab Exercise in SQL**

1. Install SQLite & SQLiteBrowser on your laptop (free database)
2. Explore the features of SQLiteBrowser
3. Create a database with the schema given at the end of this document
4. Populate these tables of this schema with sample data
5. Write & execute SQL statements to obtain the following information from the database

Section 1

1. Get details of employees whose salary is greater than or equal to Rs. 30 lakhs
2. Get details of employees working in ‘Research’ department.
3. For all employees, get their SSN, their name and name of the project they are working on
4. For all employees, get their SSN, their name and the name of their manager (supervisor)

Section 2

1. Find total number of employees
2. Find total number of employees in ‘Research’ department
3. Find the number of projects controlled by each department (get department #, department name & # of projects controlled)

Section 3

1. Find departments which control more than 5 projects
2. Get Name & SSN of Employees with more than 2 dependents

Section 4

1. Increase salary of employees working in ‘HR’ department by 10%
2. Delete project whose project number = 12345

Database schema

