INDEX

UNIT I

Syllabus : Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables..

Chapter 1 : Introduction to Database Management System 1-1 to 1-21

1.1 Introduction to DBMS 1-1
1.1.1 Process of Database Management 1-2
1.1.2 History of Database System 1-2
1.2 Purpose of Database 1-2
1.2.1 Characteristics of DBMS 1-3
1.2.2 File System Vs Database System 1-4
1.3 View of Data 1-5
1.3.1 Three Level Architecture for Database 1-5
1.3.1.1 Introduction 1-5
1.3.1.2 Database architecture 1-5
1.3.1.3 Data Abstraction 1-6
1.3.1.4 Data Independence 1-7
1.3.1.5 Difference Between Logical and Physical data Independence 1-8
1.4 Database System Detailed Architecture 1-8
1.4.1 Query Processor Components 1-9
1.4.2 Storage Manager / Storage Management 1-10
1.4.3 Transaction Management 1-10
1.5 People / Database Users 1-10
1.5.1 Database Administrator (DBA) 1-11
1.6 Database Model 1-12
1.6.1 Benefits of Data Modeling 1-12
1.6.2 Basic Building Block of Data Model 1-13
1.7 Data Models 1-14
1.7.1 Hierarchical Model 1-14
1.7.2 Network Database Model 1-15
1.7.3 Relational Model 1-16
1.7.4 Entity Relationship Model 1-18
1.7.5 Object Model 1-19
1.8 Comparison of All Data Models 1-19
1.9 Database Languages 1-20
1.9.1 Data Definition Language (DDL) 1-20
1.9.2 Data Manipulation Language (DML) 1-20
1.9.3 Data Control Language (DCL) 1-20
1.10 Database System Application 1-20

Chapter 2 : Database Design and ER Modeling 2-1 to 2-25

2.1 ER Model 2-1
2.1.1 ER Diagrams 2-1
2.1.2 Entities 2-2
2.1.3 Attributes 2-2
2.2 Relationships 2-4
2.2.1 Constraints on Relationship 2-4
2.3 Design Process 2-6
2.4 ER Design Issues 2-7
2.5 Enhanced Entity Relationship (EER) 2-8
2.6 Sub Class - Super Class and Inheritance 2-8

2.7 Specialization 2-8

2.8 Generalization 2-9

2.9 Aggregation 2-10

2.10 Union and Category Relation 2-10

2.11 Converting ER & EER Diagram into Tables 2-11

2.11.1 Entity to Tables 2-11

2.11.2 Attributes to Columns of Table 2-11

2.11.3 Relationships to Tables 2-12

2.11.4 Inheritance (Specialisation and Generalisation) to Tables 2-14

2.11.5 Union or Category to Tables 2-14

2.12 Solved Examples for EER and ER Model 2-15

UNIT II

Syllabus : SQL : Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updating using Views, Indexes, SQL DML Queries: SELECT Query and clauses, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update and Delete Queries.

PL/SQL: Concept of Stored Procedures & Functions, Cursors, Triggers, Assertions, roles and privileges, Embedded SQL, Dynamic SQL.

Chapter 3 : SQL 3-1 to 3-10

3.1 Overview of SQL 3-1

3.1.1 Role of SQL 3-1

3.1.2 Characteristics and Advantages of SQL 3-2

3.2 MySQL Data Types 3-2

3.2.1 Built-in Data Types 3-2

3.2.2 Literals 3-4

3.3 Data Definition Language (DDL) 3-4

3.4 Data Manipulation Language (DML) 3-4

3.5 Data Control Language (DCL) 3-6

3.6 Transaction Control Language (TCL) 3-6

3.7 Tables 3-6

3.7.1 Handling Tables using Data Definition Language (DDL) 3-6

3.7.2 Creating Tables using CREATE Command 3-6

3.7.3 Modifying Table using ALTER Command 3-7

3.7.4 Removing Table using DROP Command 3-7

3.7.5 Renaming Table 3-7

3.7.6 Truncate Table 3-7

3.3.7 Data Integrity Constraints in Tables 3-7

3.7.7.1 Domain Relational Constraint – Business Rule Constraint 3-8

3.7.7.2 Entity Relational Constraints 3-9

3.7.7.3 Referential Integrity – Foreign Key 3-9

Chapter 4 : Views 4-1 to 4-6

4.1 Introduction of Views 4-1

4.2 Creating a Views 4-2

4.3 Dropping Views 4-3

4.4 Modifying a Views 4-3

4.5 Renaming Views 4-3

4.5.1 Advantages of Views 4-4

4.5.2 Disadvantages of Views 4-4

4.6 SQL Indexes 4-4

Chapter 5 : SQL DML Queries 5-1 to 5-27

5.1 SELECT Statement 5-1

5.1.1 SELECT Clause to Select all Columns 5-1

5.1.2 SELECT Clause – To Select Specific Columns 5-1

5.1.3 SELECT Clause – To Select Unique Records 5-2

5.2 Ordering of Types.....5-2

5.2.1 Ordering Query Results - ORDER BY Clause.....5-2

5.3 SQL Operations.....5-3

5.3.1 Filtering Query Results - WHERE Operator 5-3

5.3.1.1 Row Selection – WHERE Clause.....5-3

5.3.2 Arithmetic Operators.....5-4

5.3.3 Comparison Operators 5-4

5.3.4 Logical Operators (AND, OR, NOT).....5-5

5.3.5 Range Searching Operators (BETWEEN) 5-5

5.3.6 Pattern Matching Operation – LIKE Operator.....5-5

5.4 SET Operations.....5-7

5.4.1 Union.....5-7

5.4.2 INTERSECT.....5-7

5.4.3 EXCEPT.....5-8

5.4.4 Nesting SET Operations.....5-8

5.5 Aggregate Functions 5-8

5.5.1 Types of Aggregate Functions.....5-8

5.5.1.1 COUNT ().....5-8

5.5.1.2 SUM ().....5-9

5.5.1.3 AVG ().....5-9

5.5.1.4 MIN().....5-9

5.5.1.5 MAX().....5-10

5.5.1.6 Summary of Aggregate Functions.....5-10

5.6 GROUP BY Clause - Grouping Query Results.....5-10

5.7 HAVING Clause – Filtering grouped Query Results ...5-11

5.7.1 Apply Conditions with GROUP BY.....5-11

5.8 GROUP BY and Aggregate Function.....5-12

5.9 SQL Joins and Predicates (Join Conditions).....5-12

5.9.1 Cartesian Product / Cross Join 5-12

5.9.2 Inner Join 5-13

5.9.3 Outer Join.....5-15

5.9.3.1 Left Outer Join.....5-15

5.9.3.2 Right Outer Join 5-16

5.9.3.3 Full Outer Join.....5-16

5.10 Nested Sub Queries 5-17

5.10.1 Independent Subquery 5-17

5.10.2 Multiple Row Subquery.....5-18

5.11 Set Membership 5-18

5.11.1 IN 5-18

5.11.2 ANY.....5-19

5.11.3 ALL.....5-20

5.11.4 EXISTS Clause 5-20

5.11.5 NOT EXISTS Clause 5-20

5.12 Aliasing in SQL / Tuple Variable 5-21

5.13 Correlated Sub Queries.....5-22

5.14 Solved Examples.....5-23

Chapter 6 : PL / SQL 6-1 to 6-16

6.1 Stored Procedure 6-1

6.1.1 Creating Stored Procedure.....6-1

6.1.2 Executing Stored Procedure.....6-2

6.1.3 Parameter Types in stored Procedure 6-2

6.1.4 Parameter Modes in stored Procedure 6-2

6.1.5 Altering Stored Procedure 6-3

6.1.6 Dropping Stored Procedure 6-4

6.2 Stored Function 6-4

6.2.1 Create Function.....6-4

6.2.2 Calling Function.....6-4

6.2.3 Deleting a Function.....6-5

6.2.4 Advantages of Stored Functions.....6-5

6.3 Concept of Cursor 6-5

6.3.1 Implicit Cursor 6-6

6.3.2 Explicit Cursor 6-7

6.4 Trigger....6-9

6.4.1 Components of Trigger (E-C-A model) – How to Apply Trigger ?....6-9

6.4.2 Trigger Syntax....6-9

6.4.3 Trigger Types 6-10

6.4.4 Trigger Example 6-10

6.4.5 Trigger Operations....6-11

6.4.6 Trigger Advantages \ Uses of Trigger 6-12

6.4.7 Trigger Disadvantages....6-12

6.4.8 Solution for Mutating Table Error 6-12

6.5 Assertions 6-12

Chapter 7 : Programmatic SQL 7-1 to 7-6

7.1 Role....7-1

7.1.1 Creating a User and Role 7-1

7.1.2 Dropping a User and Role 7-1

7.2 Privileges....7-1

7.2.1 Granting Privileges 7-2

7.2.2 Revoking of Privileges 7-3

7.2.3 Viewing Privileges 7-4

7.3 Embedded (Static) SQL....7-4

7.4 Interactive (Dynamic) SQL....7-5

7.4.1 Working with various languages 7-5

7.4.2 Advantages 4-6

7.4.3 Disadvantages....4-6

7.4.4 Applications....7-6

7.5 Comparison between Static and Dynamic SQL 7-6

UNIT III

Syllabus : Relational Model : Basic concepts, Attributes and Domains, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF, Modeling Temporal Data.

Chapter 8 : Relational Model 8-1 to 8-9

8.1 Relational Data Model 8-1

8.1.1 Relation / Relational Table....8-1

8.1.1.1 Attributes / Fields....8-2

8.1.1.2 Tuple / Records 8-2

8.1.1.3 Domain....8-2

8.2 E. F. Codd's Rule for RDBMS....8-2

8.2.1 Overview of Codd's Rule 8-2

8.2.2 Codd's Rule in Details 8-3

8.3 Key Concept....8-5

8.3.1 Types of Keys....8-5

8.4 Relational Integrity....8-7

8.4.1 Types of Relational Integrity 8-7

8.5 Enterprise Constraints 8-8

8.5.1 Unique Constraint....8-8

8.5.2 Primary Key Constraint....8-8

Chapter 9 : Database Design 9-1 to 9-22

9.1 Functional Dependencies 9-1

9.1.1 Solved Examples on Functional Dependencies 9-2

9.1.2 Types of Functional Dependencies....9-3

9.2 FD Properties (Armstrong's Axioms / Closures of FD) .9-5

9.3 Decomposition using FD....9-6

9.3.1 Goals....9-6

9.3.2 Algorithm of Decomposition....9-7

9.3.2.1 Lossless-join decomposition....9-7

9.3.2.2 Dependency preservation....9-8

9.3.2.3 Repetition of information....9-8

9.4 Normalization....9-9

9.4.1 Features of Good Database Design....9-9

9.4.1.1 Purpose of Normalisation to remove pitfalls in database design....9-10

9.5 Keys and Attributes in keys....9-12

9.6 First Normal Form (1NF)....9-13

9.7 Second Normal Form (2NF)....9-14

9.8 Third Normal Form (3NF)....9-16

9.9 Boyce Codd Normal Form (BCNF)....9-17

9.10 Modeling Temporal Data....9-20

UNIT IV

Syllabus : Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlocks, Time-stamping Methods, Recovery methods : Shadow-Paging and Log-Based Recovery, Checkpoints, Query Processing, Query Optimization, Performance Tuning.

Chapter 10 : Database Transaction 10-1 to 10-14

10.1 Transaction....10-1

10.1.1 Concept of Transaction....10-1

10.1.2 Transaction Management Architecture....10-3

10.1.3 Working of Transaction Processing - Transaction State Diagram....10-4

10.1.3.1 Transaction states....10-4

10.1.4 Fundamental Properties of Transaction/ ACID Properties....10-4

10.1.5 Transactions Schedules (Concept of Schedules)....10-6

10.2 Serial Schedule....10-7

10.2.1 Concurrent Schedule....10-7

10.3 Serializability/Serializable Schedule....10-9

10.3.1 Conflict Serializability....10-10

10.3.2 View Serializability....10-10

10.4 Precedence Graph....10-11

10.5 Recoverability / Recoverable and No Recoverable Schedules....13

10.5.1 Recoverable schedules....10-13

10.5.2 Cascade less schedules /cascaded aborts / cascaded rollbacks....10-13

Chapter 11 : Concurrency Control 11-1 to 11-14

11.1 Need of Concurrency Control....11-1

11.1.1 Concurrency Control Schemes....11-2

11.2 Lock Based Protocols\Locking Methods....11-3

11.2.1 Types of Locks....11-3

11.2.2 Locking Levels....11-4

11.2.3 Working of Locking Protocol / Locking Scheduler / Locking Manager....11-4

11.2.4 Granting Locks....11-5

11.2.5 Rejecting Locks....11-6

11.3 Two-Phase Locking (2PL) Protocol....11-6

11.3.1 Modified Versions of Two-phase Locking Protocol....11-7

11.4 Concept of Deadlock....11-7

11.4.1 Approaches for Deadlock Prevention....11-8

11.4.2 Deadlock Detection and Recovery....11-9

11.5 Timestamp Based Protocols\Time Stamping Methods 11-10

11.5.1 Concept of Timestamp 11-11

11.5.2 Timestamp - ordering Protocol 11-11

11.5.3 Advantages 11-12

11.5.4 Disadvantages 11-12

11.6 Thomas' Write Rule 11-12

11.7 Optimistic Methods – Validation Based Protocol 11-13

Chapter 12 : Recovery Methods 12-1 to 12-14

12.1 Database Recovery Concepts 12-1

12.2 Log-Based Recovery 12-2

12.2.1 Types of Transaction Log 12-2

12.2.2 Working of Log Based Protocol 12-2

12.2.3 Deferred-Modification Technique (REDO Algorithm) .. 12-3

12.2.4 Immediate-Modification Technique (UNDO Algorithm) 12-5

12.3 Recovery Related Structures – Checkpoint 12-7

12.3.1 Problems in This Approach 12-7

12.3.2 Need of Checkpoints 12-8

12.3.3 Working 12-8

12.3.4 Advantages 12-8

12.3.5 Disadvantages 12-8

12.4 Shadow Paging 12-9

12.4.1 Overview 12-9

12.4.2 Method 12-9

12.4.3 Process of Recovery 12-9

12.4.4 Advantages 12-9

12.4.5 Disadvantages 12-10

12.5 Query Processing in SQL Database 12-10

12.5.1 Introduction to Query Processing 12-10

12.5.2 Typical Query Processing in DBMS 12-10

12.6 Query Optimization in SQL 12-12

12.6.1 Goals of Query Optimization 12-12

12.6.2 Query Optimization Approaches / Performance Tuning 12-13

12.6.3 Query Optimizers 12-13

UNIT V

Syllabus : Introduction to Distributed Database System, Advantages, Disadvantages, CAP Theorem.

Types of Data : Structured, Unstructured Data and Semi-Structured Data. **NoSQL Database :** Introduction, Need, Features. Types of NoSQL Databases: Key-value store, document store, graph, wide column stores, BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL.

MongoDB (with syntax and usage) : CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding

Chapter 13 : NoSQL Database 13-1 to 13-13

13.1 Introduction to Distributed Databases 13-1

13.1.1 Distributed Databases System Concepts 13-1

13.1.2 Advantages of Distributed Database System 13-3

13.1.3 Drawback of Distributed Databases 13-4

13.2 Types of Data 13-4

13.2.1 Structured Data 13-4

13.2.2 Unstructured Data 13-5

13.2.3 Semi Structure Data 13-5

13.3 Introduction to NoSQL Database 13-5

13.4 Types of NoSQL Database 13-6

13.4.1 Key-Value Store Databases 13-6

13.4.2 Wide Column Store Database 13-7

13.4.3 Document Store Database 13-7

13.4.4 Graph Database (Distributed Document Store) 13-8

13.4.5 Performance NoSQL Data Models 13-8

13.4.6 Benefits of NoSQL....13-8
13.5 CAP Theorem (Brewer's Theorem)....13-8
13.6 BASE Properties for NoSQL....13-9
13.7 Database Consistency Models : ACID vs Base Notion....13-9
13.7.1 ACID Consistency Model....13-10
13.8 BASE Consistency Model....13-11
13.9 Comparative Study of RDBMS and NoSQL (SQL vs NoSQL)....13-11
13.9.1 Advantages of NoSQL....13-12
13.10 Case Study - Unstructured data from social media....13-13

Chapter 14 : Mongo DB 14-1 to 14-11

14.1 MongoDB....14-1
14.1.1 Comparison MongoDB and RDBMS....14-2
14.2 MongoDB Syntax and usage of Basic CRUD Operations....14-2
14.3 MongoDB Aggregation....14-3
14.4 Mongo DB Indexing....14-6
14.5 Database Replication and Sharding....14-10

UNIT VI

Syllabus : Emerging Databases : Active and Deductive Databases, Main Memory Databases, Semantic Databases.

Complex Data Types : Semi-Structured Data, Features of Semi-Structured Data Models. **Nested Data Types :** JSON, XML. **Object Orientation :** Object-Relational Database System, Table Inheritance, Object-Relational Mapping. **Spatial Data :** Geographic Data, Geometric Data.

Chapter 15 : Emerging Database 15-1 to 15-7

15.1 Active Databases....15-1
15.1.1 Trigger for Creating Active Databases....15-1
15.1.2 Assertions for Creating Active Databases....15-1
15.2 Deductive Database....15-1
15.2.1 Semantics in Database : Fact and Predicates....15-2
15.2.2 Deductive Database Semantics....15-4
15.2.3 Query Evaluation in Deductive Databases....15-4
15.2.4 Deductive Databases Prototype....15-4
15.2.5 Deductive Databases Vs RDBMS....15-5
15.3 Main Memory Database....15-5
15.3.1 Oracle 12c "in-Memory Database"....15-7

Chapter 16 : Complex Data Types 16-1 to 16-11

16.1 Introduction to XML Documents....16-1
16.2 Types of XML Documents....16-1
16.2.1 Well Formness....16-1
16.2.2 Valid XML Documents....16-1
16.3 Semi Structured Data....16-2
16.4 XML Hierarchical Data Model – Tree Data Model....16-3
16.4.1 Introduction....16-3
16.4.2 Structuring concepts used to construct an XML document....16-3
16.4.3 A major difference between XML and HTML....16-3
16.4.4 Tree Representation....16-3
16.5 XML Document Type Definition (DTD)....16-4
16.5.1 Introduction....16-4
16.5.2 Types of DTD as per location of DTD....16-4
16.5.3 Types of DTD Declarations....16-4
16.5.3(A) Element Type Declarations....16-4
16.5.3(B) Attribute List Declaration....16-5

16.5.3(C) Entity Declaration and Notation Declaration.....16-5

16.5.4 Advantages of DTD 16-5

16.5.5 Disadvantages of DTD.....16-5

16.6 XML Schema.....16-5

16.6.1 Introduction.....16-5

16.6.2 Types of XML documents 16-5

16.6.3 An XML Schema Defines.....16-5

16.6.4 XML Schemas as the replacement to DTDs 16-6

16.7 Introduction to JSON (Java Script Object Notion) 16-6

16.7.1 Comparison JSON and XML (XML vs JSON) 16-7

16.7.2 JSON Data Types.....16-7

16.8 JSON Schema.....16-8

16.9 Stringify JSON for sending and receiving.....16-9

16.10 JSON Object Retrieval using key value pair and JQuery.....16-10

Chapter 17 : Object Oriented Database 17-1 to 17-9

17.1 Need of Object Relational Database systems.....17-1

17.1.1 Features of OODB (Object Oriented Databases) 17-1

17.2 Object Relational Database Systems.....17-2

17.2.1 Differences Between ODBMS, RDBMS and ORDBMS.....17-2

17.2.2 Table Inheritance using SQL3 17-3

17.2.3 Type Constructors 17-4

17.2.4 Object Identifiers using References 17-4

17.2.5 Table Inheritance.....17-5

17.2.6 Object Definition Language (ODL) – Object Relational Mapping 17-5

17.3 Object Oriented Queries - OQL 17-7

17.4 Spatial Databases 17-7

- **Appendix : Solved University Question Papers of Oct. 2019 and Dec. 2019** ..... A-1 to A-7

❑❑❑