Syllabus

BCA – 203
INTRODUCTION TO DATABASE SYSTEM

External Marks: 80
Internal Marks: 20

Time: 3 hours

Note: *Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (short-answer type questions) covering the entire syllabus and will carry 16 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 16 marks. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one question from each Unit.*

UNIT – I

Basic Concepts – Data, Information, Records and files. Traditional file –based Systems-File Based Approach-Limitations of File Based Approach, Database Approach-Characteristics of Database Approach, advantages and disadvantages of database system, components of database system, Database Management System (DBMS), Components of DBMS Environment, DBMS Functions and Components, DBMS users, Advantages and Disadvantages of DBMS, DBMS languages. Roles in the Database Environment - Data and Database Administrator, Database Designers, Applications Developers and Users .

UNIT – II

Database System Architecture – Three Levels of Architecture, External, Conceptual and Internal Levels, Schemas, Mappings and Instances. Data Independence – Logical and Physical Data Independence.
Classification of Database Management System, Centralized and Client Server architecture to DBMS. Data Models: Records- based Data Models, Object-based Data Models, Physical Data Models and Conceptual Modeling.

UNIT – III

Entity-Relationship Model – Entity Types, Entity Sets, Attributes Relationship Types, Relationship Instances and ER Diagrams, abstraction and integration. Basic Concepts of Hierarchical and Network Data Model, Relational Data Model:-Brief History, Relational Model Terminology-Relational Data Structure, Database Relations, Properties of Relations, Keys, Domains, Integrity Constraints over Relations.

UNIT – IV

Relational algebra, Relational calculus, Relational database design: Functional dependencies, Modification anomalies, Ist to 3rd NFs, BCNF, 4th and 5th NFs, computing closures of set FDs, SQL: Data types, Basic Queries in SQL, Insert, Delete and Update Statements, Views, Query processing: General strategies of query processing, query optimization, query processor, concept of security, concurrency and recovery.

Note:- This is an outline of the syllabus. For complete and correct syllabus, see the University Syllabus.

Q.1 SHORT – ANSWER TYPE QUESTIONS

Q1.1 What do you mean by Data? MDU BCA 2021

Q1.2 Define Information.

Q1.3 What is the difference between data and information? MDU BCA 2022, 2016, 2015

OR

How is data different from information, explain by example. MDU BCA 2021

Q1.4 Explain the term Character.

Q1.5 Explain the term Field.

Q1.6 Explain the term Record.

Q1.7 Explain the term File.

Q1.8 Differentiate between record and file.

Q1.9 Define the term database. MDU BCA 2021

OR

What is a database? MDU BCA 2015

Q1.10 Explain the term DBMS.

Q1.11 Name different type of database user. MDU BCA 2022

Q1.12 Differentiate file system and DBMS. MDU BCA 2017

Q1.13 What are the components of database system? MDU BCA 2016

Q1.14 What is the difference between Database and DBMS? IGU BCA 2018

Q1.15 Name the five components of DBMS environment and how they relate to each other? MDU BCA 2017

Q1.16 What are the application areas of database system?

Q1.17 Define redundancy. Gurugram University BCA 2021

OR

What do you mean by data redundancy? MDU BCA 2018

Q1.18 What are the advantages of DBMS? IGU BCA 2018

Q1.19 What are disadvantages of DBMS? MDU BCA 2021

Q1.20 What is the role of Application developer?

Q1.21 What do database designers do?

Q1.22 Write the major characteristics of database approach.

Q1.23 Define the term catalog and metadata in DBMS. MDU BCA 2018

Q1.24 How data redundancy problem is handled with a DBMS?

Q1.25 Enumerate the major responsibilities of Data Administrator?

Q1.26 What is the need of DBA?

Q1.27 Differentiate between Data Administrator and Database Administrator.

Q1.28 Define Schema. MDU BCA 2022, 2016

OR

What do you mean by database schema? MDU BCA 2018

Q1.29 Define Sub-schema. MDU BCA 2022

Q1.30 What is an instance? MDU BCA 2022, 2018, 2016

Q1.31 What is the difference between a database schema and a database state?

Q1.32 What do you mean by data independence?
MDU BCA 2021

Q1.33 What are the reasons to use Data Independence?

Q1.34 Discuss two advantages of Physical Data Independence. MDU BCA 2014

Q1.35 Discuss advantages of Logical Data Independence.

Q1.36 Explain the three levels of data abstraction.

Q1.37 Write the advantages of three level architecture.

Q1.38 What is client server architecture of database system?

Q1.39 What are the advantages of Client Server architecture? Gurugram University BCA 2021
MDU BCA 2021

Q1.40 List the disadvantages of Client-Server architecture.
Gurugram University BCA 2021

Q1.41 What is mapping?
IGU BCA 2018, MDU BCA 2017, 2015

Q1.42 What is mapping? Why it is necessary in DBMS architecture? MDU BCA 2017

Q1.43 Define data model. MDU BCA 2014

Q1.44 List two major advantages of conceptual modeling.
MDU BCA 2014

Q1.45 Explain the term Entity. MDU BCA 2021

Q1.46 What is entity set? MDU BCA 2021, 2015

Q1.47 Write the uses of entity sets. MDU BCA 2014

Q1.48 What is relationship type? MDU BCA 2016

Q1.49 What is relationship instance?

Q1.50 Explain various components of E-R diagram. MDU BCA 2022

Q1.51 Write the advantages of ER diagram.

Q1.52 Write the uses of E-R model. MDU BCA 2015

Q1.53 What is abstraction? MDU BCA 2014

Q1.54 Explain uses of abstraction. MDU BCA 2014

Q1.55 Explain data integration.

Q1.56 List two major advantages of Network Data Model.

Q1.57 List disadvantages of Network Data Model.

Q1.58 Define the term Relation.

Q1.59 Define the term Tuple.

Q1.60 Why is a key essential? What are the different types of keys?

Q1.61 Define/explain Primary key. MDU BCA 2021

Q1.62 Define/explain Candidate key. MDU BCA 2021

Q1.63 Define/explain Alternate key. MDU BCA 2021

Q1.64 Define/explain Foreign key. MDU BCA 2022, 2021

Q1.65 Explain uses of foreign key.

Q1.66 Define data integrity. MDU BCA 2018

Q1.67 What is difference between primary key and candidate key? IGU BCA 2018

Q1.68 Write the operations that DBMS can perform.

Q1.69 What is domain? MDU BCA 2022, 2021, 2016

Q1.70 Differentiate record-based and object-based data models. MDU BCA 2017

Q1.71 What are the benefits of database approach?

Q1.72 What is relational algebra?

Q1.73 What is relational calculus?

Q1.74 Differentiate between relational algebra and relational calculus. MDU BCA 2016

Q1.75 Define the two principal integrity rules for the relational model.

Q1.76 What is the need of database security? MDU BCA 2018

Q1.77 Define entity integrity constraint. MDU BCA 2021

Q1.78 Define Referential integrity constraint. Explain with an example. Gurugram University BCA 2021

Q1.79 Define Normalization. Gurugram University BCA 2021

Q1.80 Why do we need to normalize databases? Gurugram University BCA 2021

OR

What is purpose of normalization?

Q1.81 What do you mean by modification anomalies? IGU BCA 2018

Q1.82 What is Boyce-Codd Normal Form? Gurugram University BCA 2021

OR

Explain BCNF with an example. MDU BCA 2014

Q1.83 Describe 4NF with an example.

Q1.84 Differentiate between BCNF and 3NF.

Q1.85 What is functional dependency? MDU BCA 2022, 2016

Q1.86 Discuss the properties of a relation. MDU BCA 2017

Q1.87 What is the degree of relationship? Give example also. MDU BCA 2017

Q1.88 List the advantages of Normalization.

Q1.89 Explain why 4NF is more desirable than BCNF?

Q1.90 Show that if a relational database is in BCNF, then it is also in 3NF. MDU BCA 2017

Q1.91 What is SQL? MDU BCA 2021

Q1.92 What are the components of SQL and what function do they serve?

Q1.93 Explain the function of each of the clauses in the SELECT statement.

Q1.94 Explain the purpose of DDL and DML commands used in SQL. Also give two examples of each.

Q1.95 What is view? MDU BCA 2021, 2016, 2015

Q1.96 Define Data Manipulation Language.

Q1.97 Discuss relation, attribute, domain, tuple, relational database in the context of the relational data model in one line.

Q1.98 Explain how the GROUP BY clause works. What is the difference between the WHERE and HAVING clauses?

Q1.99 Define query language.

Q1.100 What is query processing? What are the typical phases of query processing? MDU BCA 2017

Q1.101 Define query optimization. MDU BCA 2014

Q1.102 Differentiate between DDL and DML.

Q1.103 What are the components of query processor?

Q1.104 Explain concurrency in database system. MDU BCA 2018

OR

What is concurrency? MDU BCA 2015

UNIT - I

Q2.(a) Discuss the main characteristics of the database approach. MDU BCA 2018

Q2.(b) What is database? What are the objectives of database? Also discuss the advantages and disadvantages of database. MDU BCA 2016

Q2.(c) What is data base system? Discuss the main objectives of any data base system also.

Q3.(a) How database approach differs from traditional file system? MDU BCA 2018

OR

Explain the difference between database approach and traditional file based system. IGU BCA 2018

OR

Differentiate between file system and database system.

Q3.(b) What is File Processing System? What are its disadvantages? MDU BCA 2021

OR

What is file-processing system? What are the disadvantages of a file-processing system over database system? MDU BCA 2015

OR

What do you mean by traditional file based system? What are the limitations of the File Processing System / File-Based Approach?

Q4.(a) What is DBMS? What are the main/common facilities that every DBMS should provide? Explain. MDU BCA 2021

OR

Discuss the capabilities that should be provided by a DBMS. MDU BCA 2017

Q4.(b) What do you mean by DBMS? Also discuss the advantages and disadvantages of DBMS.
MDU BCA 2018

Q4.(c) What is DBMS? Explain DBMS functions with suitable examples. MDU BCA 2014

Q5.(a) Explain the role of DBA.
MDU BCA 2022, 2016, 2015

OR

What are the responsibilities of a DBA?
Gurugram University BCA 2021

OR

Who is DBA? What are its various jobs and responsibilities? MDU BCA 2021

Q5.(b) Discuss different languages used in DBMS for storage, manipulation and querying of data.
MDU BCA 2017

OR

What do you mean by database language? Explain.
MDU BCA 2015

Q5.(c) What do you mean by Query Language? Distinguish between DDL, DML and DCL. Explain any two DDL & DML commands using suitable examples. Gurugram University BCA 2021
MDU BCA 2016

Q6.(a) Explain the various roles in database environment.
IGU BCA 2018

Q6.(b) Explain Components of Database.

Q6.(c) Explain the various functional components of DBMS with the help of suitable diagram.
MDU BCA 2018

OR

Components of DBMS MDU BCA 2015

Q6.(d) Explain Components of DBMS environment.

UNIT - II

Q7.(a) Explain the three-level architecture of DBMS.
MDU BCA 2022, 2016, 2015

OR

Explain three level architecture of database system with suitable diagram. IGU BCA 2018

OR

Discuss architecture of DBMS with an example.
MDU BCA 2014

OR

What do you mean by Database System Architecture? Explain in detail.

OR

Describe the architecture of a database system. Why a database is described to be an integrated one?

Q7.(b) What do you mean by Schema and Instance? Explain difference between external, conceptual and internal schemas.

Q8.(a) What is data independence? MDU BCA 2022

OR

What do you mean by data independence? Why it is important to maintain data independence in a database? MDU BCA 2018

OR

What is data independence and why is it important? MDU BCA 2016

OR

What do you mean by Data Independence? Also explain Logical and Physical data independence.

Q8.(b) Differentiate between physical and logical data independence. MDU BCA 2022, 2016, 2015
Gurugram University BCA 2021

Q8.(c) What is mapping? Also explain Conceptual / Internal mapping and External / Conceptual mapping.

OR

What types of mapping are used in database systems?

Q9.(a) What are the different ways of classifying a DBMS? Explain in detail. MDU BCA 2021, 2017

OR

How DBMS can be classified into different categories on the basis of different criteria? Explain.

Q9.(b) Explain client server architecture of DBMS.
Gurugram University BCA 2021
MDU BCA 2016

OR

Explain client server architecture.
MDU BCA 2015

Q9.(c) What is centralized DBMS? How is it useful and used? Explain its disadvantages with examples.

Q10.(a) What is data model? Explain different types of data models. Gurugram University BCA 2021
MDU BCA 2018

Q10.(b) What is object-oriented database model? Also write the advantages and disadvantages of object-oriented database model.

Q11.(a) Explain object based data models by giving suitable examples. IGU BCA 2018

OR

Describe object-based data model with examples.
MDU BCA 2016, 2015

Q11.(b) What is a hierarchical model? Also explain the various problems faces by this model in representing relationships.

UNIT - III

Q12.(a) What is mapping cardinalities? Explain various types of mapping cardinalities. MDU BCA 2018

Q12.(b) What do you mean by attributes? Describe the types of attributes that occur in the E-R model by giving suitable examples.

Q12.(c) What do you mean by the term relationship? Explain the categories of relationships.

Q13.(a) Design an E-R diagram for library management system? Make your own assumptions about the system. MDU BCA 2021

OR

What is ER diagram? Draw the ER diagram of library management system. MDU BCA 2016

Q13.(b) What is ER diagram? Draw the ER diagram of school management system. MDU BCA 2015

Q13.(c) Define the term E-R diagram. Explain the various types of relationships in an E-R diagram. Draw an E-R diagram for taking your own example.

Q13.(d) Write note on Data Abstraction and Data Integrity/Integration.

Q14.(a) Define Data Model. Explain Hierarchical model and Network model in detail.

Gurugram University BCA 2021
MDU BCA 2016

Q14.(b) Explain Relational model in detail.

Q14.(c) Differentiate between Network model and Hierarchical model. MDU BCA 2022, 2015

OR

What are the main differences between Hierarchical and Network models?

Gurugram University BCA 2021

Q14.(d) Differentiate between hierarchical model and relational model. IGU BCA 2018

Q15.(a) Discuss database relations and their properties with examples. MDU BCA 2014

OR

What is a relation? Enumerate the properties of a relation.

Q15.(b) What do you mean by key? Explain different types of key with suitable example.

Gurugram University BCA 2021
MDU BCA 2016, 2015

Q16.(a) Explain integrity rule/constraints. Describe their importance. MDU BCA 2022, 2015

OR

Discuss entity integrity and referential integrity constraints. Why each is considered important?

MDU BCA 2017

Q16.(b) Out of three models: Hierarchical, Network and Relational data model, which data model do you select?

UNIT - IV

Q17.(a) What are the various set operational in relational algebra? Explain with example. MDU BCA 2022

OR

What are the various operators in relational algebra? Explain with examples. MDU BCA 2015

Q17.(b) Explain the operators of relational calculus with the help of examples.

Q18.(a) Explain by giving examples, the conditions that are necessary for a relation to be in 1NF, 2NF, 3NF, BCNF, 4NF. MDU BCA 2022, 2015

OR

What is the need of normalization? Define and discuss 1NF, 2NF, 3NF and BCNF by giving suitable example for each. MDU BCA 2018

OR

Define normalization. How is it useful and used? Explain by giving examples, the conditions that are necessary for a relation to be in 1NF, 2NF, 3NF, BCNF. MDU BCA 2016

OR

What is normalization? Explain the different types of normalization with suitable example.

Q18.(b) Write short note on various types of functional dependencies with examples.

OR

Explain functional dependency, full functional dependencies, partial dependencies, transitive dependencies and multi valued dependencies with the help of suitable examples.

Q18.(c) "No loss decomposition is an aid to relational data base design". Is it true? If yes then justify it through an appropriate example.

Q19.(a) What is SQL? Explain its use, purpose and importance through appropriate examples.

Q19.(b) What is SQL? What are the major components of SQL? MDU BCA 2018

Q19.(c) Write SQL command syntax for create, alter, drop, insert, select using suitable examples.

Q19.(d) Using example illustrate 'in', 'between' and 'is null' used with WHERE clause.

Q20.(a) What is query processing? How is it used and useful? Discuss its strategies with examples.
MDU BCA 2014

Q20.(b) What is query optimization? Explain.
MDU BCA 2022

OR

What is query optimization? Discuss the significance and different steps followed during query optimization. MDU BCA 2017

Q20.(c) What is database security? What are the various techniques to secure the database? Explain in detail. IGU BCA 2018

OR

What is database security? Why is it important? Also discuss the various security issues.
MDU BCA 2015

Q20.(d) What are different threats of the database? How can you protect the database against misuse? Also discuss the different access control policies.

Q21.(a) What is concurrency control? How is it implemented? Explain. MDU BCA 2016

Q21.(b) Explain database recovery briefly with examples.

Q.1 SHORT – ANSWER TYPE QUESTIONS

Q1.1 What do you mean by Data? MDU BCA 2021

Ans. *Data is defined as a collection of raw facts. It is raw facts and figures from which useful information is derived.*

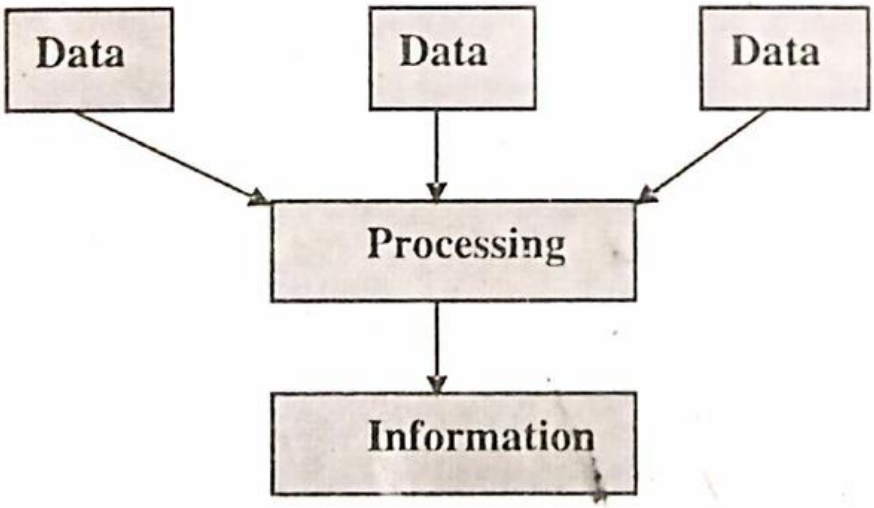
Data are streams of raw facts representing events occurring in organisations or the physical environment before they have been organized and arranged into a form that people can understand and use.

Data are any collection of facts i.e. the facts known to us. For example, length, breadth, height of the room.

Data are facts obtained by reading, observation, counting, measuring, and weighing etc. which are then recorded. They are called raw or basic data and are often records of the day to day transactions of the organisation.

Q1.2 Define Information.

Ans. *Information is processed form of data i.e. data that have been processed and shaped into a form that is meaningful to its users is known as information.*



Information is derived from data. For example, volume of the room is the information which can be derived from the data by using the formula

Volume = Length × Breadth × Height

It is the main activity of the computer to process data to produce useful information. On the basis of information a number of decisions may be taken i.e. information is a vital input in any decision making process in an organisation.

Q1.3 What is the difference between data and information? MDU BCA 2022, 2016, 2015

OR

How is data different from information, explain by example. MDU BCA 2021

Ans. Following are the differences between data and information:

Data	Information
1. Data is collection of raw facts. For example, length, breadth, height of the room.	1. Information is processed form of data. For example, volume of the room is the information which can be derived from the data by using the formula: Volume = Length × Breadth × Height
2. Data can not be made use of by the users.	2. Information is understood and used by the users.

Data	Information
3. Data can be taken as input form.	3. Information can be taken as output form.
4. Data is generally in disorganized and disintegrated form.	4. Information is properly arranged, classified and organized.
5. Data does not depend upon information.	5. Information is based upon and derived from data.
6. Interpretation of data can not be possible.	6. Information can be interpreted efficiently and effectively.
7. Data are facts, events, transactions and so on which have been recorded. They are input raw materials from which information is produced.	7. Information is data that have been processed in such a way as to be useful to the user.

Q1.4 Explain the term Character.

Ans. *A character is a smallest element in a file.*

e.g.

Rollno	Registration Number	Name	Marks		
			Sub1	Sub2	Sub3
1001	MDU2017	RAVI	98	76	67

Characters

The character can be alphabetic (A-Z or a-z), numeric (0-9) or special character like #, * etc. The student record, shown in the example, consists of characters alphabetic (A – Z) and numeric (0 – 9).

Q1.5 Explain the term Field.

Ans. ***A group of characters form a field. It is the smallest piece of independent information.***

For example, Rollno, Registration Number, Name and Marks are fields. The Rollno 1001 is an independent piece of information and is made of numeric 0 and 1. Similarly the Name RAVI is made of alphabetic characters R, A, V, I.

Sometimes a field may be divided into subgroups or subfields. For example, the Marks field is divided into subfields such as Sub1, Sub2, Sub3.

Q1.6 Explain the term Record.

Ans. ***A record is a collection of related fields. A record gives the complete information about a particular entity.***

For example, a student record, an employee record etc. Records are of two types:

- Fixed length record
- Variable length record

Fixed length record

Records, which have identical fields with corresponding fields in the records with the same field lengths, are called fixed length records.

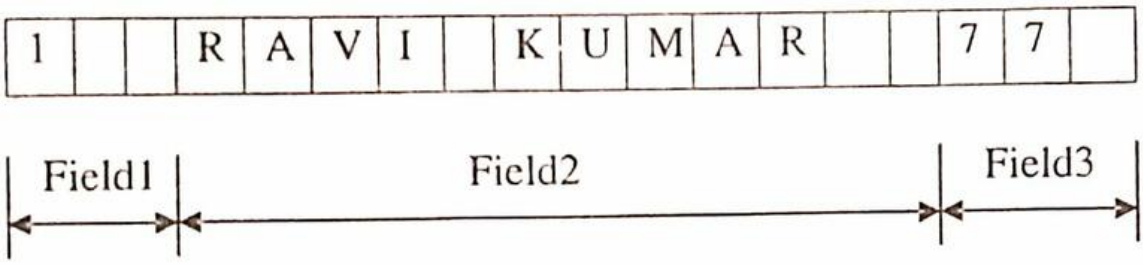
For each of the corresponding fields of the records, a fixed storage space is allocated.

A field may or may not fill the allocated storage space. Thus in fixed length records, each record is allocated the same fixed storage space.

Consider the student record divided into three fields as given below:

Data Field	Field Length
Rollno	3
Name	12
Marks	3

The storage of this record as a fixed length record is shown below:



A lot of storage space is wasted while storing this 18 bytes long record as a fixed length record. Though storage of records as fixed length record results in wastage of storage space but these are more convenient to store and process.

Variable length record

Records which do not have the same lengths are called variable length records.

To overcome the problem of wastage of the storage space variable length records are used. In variable length records, the various data fields are allowed only that storage space which they need. Here, the position of the end of each field and record is not known. So some special symbols are used to indicate these positions.

The method of storage of a variable length record is shown in the following figure:

1	,	R	A	V	I		K	U	M	A	R	,	7	7	*	

The character (,) indicates the end of a field in the record and the character (*) signals the end of the record. Such symbols are called delimiters.

Q1.7 Explain the term File.

Ans. *A collection of related records created as a unit is known as file.*

For example, the table given below shows a file with 4 records.

Rollno	Registration Number	Name	Marks		
			Sub1	Sub2	Sub3
1001	MDU2017A	RAVI	98	76	67
1002	MDU2017B	HARI	45	87	98
1003	MDU2017C	MONA	56	65	76
1004	MDU2017D	MANI	76	78	89

Thus, in general a file has records in the same format.

Q1.8 Differentiate between record and file.

Ans. Following are the differences between record and file:

Record	File
1. Record is a collection of related data items.	**1. File is a collection of related records.**
2. Record is small in size.	**2. File is large in size.**

Record	File
3. Record is physical representation of an entity set made by aggregating the attributes.	3. File is collection of identical record type occurrences pertaining to an entity set.
4. Record is basic unit of file.	4. File is made up of many records.

Q1.9 Define the term database. MDU BCA 2021

OR

What is a database? MDU BCA 2015

Ans. A database is a collection of many files. All the files are linked in such a way that any information can be fetched as per requirement.

Database is a collection of related information that acts as a single centralized data bank for various data processing applications.

In other words, when the related information is placed in an organized form it makes a database. This organization is necessary, as unorganized information has no meaning. For example, telephone directory is organized information where the names are arranged in an alphabetic order.

In a manual system a database is stored on paper whereas in a computer based system it is stored on secondary storage devices. The information stored in a database is a part of the real world called miniworld or the Universe of Discourse.

A database is designed and built to serve a specific purpose as needed by a group of users. Database can be

of any size and varying complexity. Once designed database can be implemented in many forms. Database represents a part or real world and any changes in this are reflected in the database.

A database may be generated and maintained manually or it may be computerized. For example, library card catalogue is a good example of this, which can be automated as well.

Q1.10 Explain the term DBMS.

Ans. *Database management system (DBMS) is a software that enables users to interact with the database. It enables users to store, modify and extract information from a database as per the requirements.*

It is an intermediate layer between user programs and the data. User programs access the DBMS which then accesses the data. It controls the creation, maintenance and utilization of the databases of an organization.

Thus a DBMS is a collection of

- *Database which acts as a single centralized databank for various data processing applications.*
- *Programs for the management of database.*

Q1.11 Name different type of database user.

MDU BCA 2022

Ans. A human that interacts with a database is known as its user. Database users store new information into the database and retrieve information from the database. There are three different types of database users depending on the way that they expect to interact with the system. They are:

- ***Database administrators***

- *System analyst/Application programmers*
- *End-users*

Q1.12 Differentiate file system and DBMS.

MDU BCA 2017

Ans. Following are the differences between file system and DBMS:

File System	DBMS
1. It is the software that manages the data files in a computer system.	1. It is the software to create and manage databases.
2. It helps to store a collection of raw data files into the hard disk.	2. It helps to easily store, retrieve and manipulate data in a database.
3. Operations such as storing, retrieving and searching are done manually, so it is difficult to manage data.	3. Operations such as storing, retrieving, searching, updating selecting data are easier since it allows using SQL querying.
4. It has data inconsistency.	4. It provides higher data consistency using normalization.
5. There is more redundant data.	5. There is low data redundancy.

Q1.13 What are the components of database system?

MDU BCA 2016

Ans. *A database system refers to an organisation of components that define and regulate the collection,*

storage, management and use of data within a database environment.

Database system has four main components. These are:

- **Data:** The most important component of database system is the data. The totality of data in the system is all stored in a single database. These data in a database are both integrated and shared in a system.

- **Hardware:** Hardware is the physical device on which the database system resides, i.e., the hardware is the actual computer system used for keeping and accessing the database. This can range from a single PC to a single mainframe or to a network of computers.

- **Software:** In a database system, software lies between the stored data and the users of data. The software used for databases is known as DBMS. All requests made to database by users are handled by this software.

- **Users:** Users are the people who interact with the database system. The users of a database system are divided into three categories based on the way they interact with the system. These are: application programmers, end users and data administrators.

Q1.14 What is the difference between Database and DBMS? **IGU BCA 2018**

Ans. A database is a collection of organized data and the system that manages a collection of databases is called a Database Management System. The database holds the records, fields and cells of data. The DBMS is the tool used to manipulate the data inside the database.

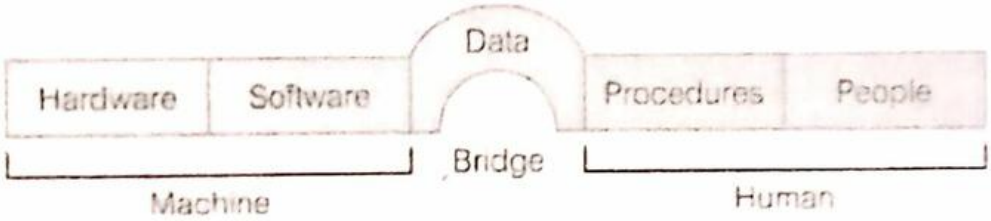
Thus

- *Database is an organized collection of data or information so that it can be easily accessed, updated or manipulated.*
- *Database Management System (DBMS) is a software that manages database on a computer. Example: Microsoft Access, MySQL, Oracle etc.*

Q1.15 Name the five components of DBMS environment and how they relate to each other?
MDU BCA 2017

Ans. DBMS environment has the following five major components:

1. Hardware
2. Software
3. Data
4. Database Users
5. Procedures



The hardware is the actual computer system used for keeping and accessing the database. All requests made to database by users are handled by this software. The data acts as a bridge between the hardware and software components and the user components. It is the most important component of DBMS environment from the end user point of view. Database users store new information into the database and retrieve information from the database.

Q1.16 What are the application areas of database system?

Ans. Database systems are being used in different areas. Some of them are:

1. Educational Institutions

For course registration, result & other information databases are used in educational institutions.

2. E-commerce

Databases are used for storing information such as sales, purchases of stocks and bonds of data useful for online trading, online shopping etc.

3. Employee's record

Organizations use databases for storing information about their employees – their salaries, benefits, taxes and for generating salary slips.

4. Credit card transactions

Keeping track of purchases on credit cards in order to generate monthly statements is possible by using databases.

5. Banking

Banks use databases for customer inquiry, accounts, loans and other transactions. The database system supports storage as well as retrieval of information.

6. Bookings and reservations

Airlines and railways use online databases for reservation and for displaying the schedule information.

Q1.17 Define redundancy.

Gurugram University BCA 2021

OR

What do you mean by data redundancy?

MDU BCA 2018

Ans. ***Data redundancy is the duplication of same data at more than one storage place.***

Thus, data redundancy exists when the same data are stored unnecessarily at different places. In an application, a file may have fields that are common to more than one file. The data for these common fields is thus replicated in all the files having these fields. This results in data redundancy, as more than one file has the same data values stored in them. For example, *student_name* and *student_course* may be stored in two file – "Student_profile" and "Student_fees". This unnecessary duplication of data may result in excess memory consumption.

Q1.18 What are the advantages of DBMS?

IGU BCA 2018

Ans. The advantages of using a DBMS are:

1. Redundancy Control
2. Access Control
3. Provides multiple User Interfaces
4. Easy and Fast access of data
5. Simplicity
6. Sharing of data
7. Reducing application development time
8. Persistent storage of data
9. Backup and Recovery

Q1.19 What are disadvantages of DBMS?

MDU BCA 2021

Ans. Disadvantages of DBMS are:

1. Expensive
2. Complex
3. Higher Programming Cost
4. Integration: A failure in any component of the integrated system can stop the complete system.
5. Recovery difficult
6. High Conversion Cost
7. Slow processing in some applications

Q1.20 What is the role of Application developer?

Ans. Applications developers translate software requirements into workable programming code and maintain and develop programs for use in business.

Their job titles and specific duties may vary in different organizations but the role mainly involves writing specifications and designing, building, testing and implementing applications using programming languages and development tools. In simple words, the main function of an application developer is to make computers perform specific tasks based on the client's specifications.

Q1.21 What do database designers do?

Ans. Database designers are the database architects.

- ***They develop strategies for design, modeling and implementation stages of the database lifecycle.***
- ***They often join with software architects and system analysts to understand and best address the particular needs of certain businesses or industries.***

- *They draw the blueprints of a database which technicians and other specialists then use to put the technology together.*
- *They also develop data models, metadata tables and related database structures for applications.*

Q1.22 Write the major characteristics of database approach.

Ans. Following are the major characteristics of database approach:

- *Self-describing nature of a database system.*
- *Minimal redundancy.*
- *Insulation between programs, data and data abstraction.*
- *Sharing of data*
- *Multi-user transaction processing.*
- *Support of multiple views of data.*

Q1.23 Define the term catalog and metadata in DBMS.
MDU BCA 2018

Ans. DBMS catalog is that which contains information like Data Types, Relationships among the data and Data Constraints of the underlying database. In addition, it also contains the information about Authorized Users of the database like their Access Rights. Since, this information defines the nature of the data stored in the database, it is called metadata (data about data). This information makes the DBMS software independent of its underlying database. When a need arises to change the structure of data, no changes need to be made to the DBMS software; only the catalog is updated to reflect the changes.

Q1.24 How data redundancy problem is handled with a DBMS?

Ans. In non-database systems, each application or department has its own private files resulting in considerable amount of redundancy of the stored data. Thus storage space is wasted. By having a centralized database most of this can be avoided.

Q1.25 Enumerate the major responsibilities of Data Administrator?

Ans. *The data administrator or DA refers to a person or a group of persons who understand and manage the data items.*

The Data Administrator is responsible for defining data elements, data names and their relationship with the database.

His basic responsibilities include:

- *To install and configure the RDBMS applications*
- *To know the requirements of the software application in terms of functions and assure the data integrity.*
- *To validate the data and files.*
- *To decide what data to be stored in database.*
- *To establish policies for data maintenance.*

Data Administrator is also known as data analyst.

Q1.26 What is the need of DBA?

Ans. DBA is needed:

- *To control the design and the use of database.*

- It provides the necessary technical support for the managerial policy decisions of databases.
- It defines all relations like database, DBMS and DBA as well.
- It keeps control of both the data and the programs that access those data.

Relationship between Data Administrator and Database Administrator

Following are the differences between Data Administrator and Database Administrator.

Data Administrator	Database Administrator
1. The Data Administrator (DA) is responsible for managing and controlling the activities associated with the corporate data.	1. The Database Administrator (DBA) is responsible for managing and controlling the activities associated with the corporate database.
2. The DA is more concerned with the data design. Thus understanding of database design is important.	2. The DBA is more concerned with the data design. Thus understanding of database design is important.
3. Data Administrator is the technical specialist responsible for implementing low-level technical details.	3. Database Administrator is the technical specialist responsible for implementing low-level technical details.

Data Administrator	Database Administrator
4. DA does not implement technical control to enforce policies.	4. DBA implements technical control required to enforce policies.
5. DA develops logical database design.	5. DBA develops physical database design.
6. Data Administrator is also known as Data Analyst.	6. Database Administrator is also known as Database Coordinator/ Database Programmer.
7. DA determines long term goals.	7. DBA executes plans to achieve goals.
8. DA coordinates database development.	8. DBA monitors and controls database use.

Q1.28 Define Schema. **MDU BCA 2022, 2016**

OR

What do you mean by database schema?

MDU BCA 2018

Ans. ***The overall design of the database is called as database schema, which is specified during database design and changes very rarely.***

Database system has several schemas corresponding to each level of abstraction. At the physical level one physical schema, at logical level one logical schema and at the view level, several sub-schemas. In general, database system supports:

- **One physical / internal schema:** It describes the database design at the physical level.
- **One logical / conceptual schema:** It describes the database design at the logical level.
- **Several subschema / external schema:** It describes the database design at the view level.

Q1.29 Define Sub-schema. **MDU BCA 2022**

Ans. It is a subset of schema having the same properties that a schema has. The subschema allows the user to view only that part of database that is of interest to him. The subschema defines the portion of database as seen by the application programs and application program can have different view of data stored in database.

The Subschema Definition Language (SDL) used to specify a subschema in DBMS.

There are several different reasons for using subschemas. One reason for a subschema is let a user or programmer to see different views without having to see all the data contained in the database. Another reason would be to improve the security so that someone who is not authorized can change or add to data.

Schema describes the entire database whereas subschema describes the partial view of the database. They are called subschema because different user have different view to see data.

Q1.30 What is an instance?

MDU BCA 2022, 2018, 2016

Ans. ***The collection of information stored in the database at a particular moment is called an instance of the database.***

Q1.31 What is the difference between a datab schema and a database state?

Ans. The collection of information stored in database particular moment in time is called database state wh the overall design of database is called database schem

Q1.32 What do you mean by data independence?

MDU BCA 202

Ans. *Data Independence is the capacity to change th schema at one level of a database system withou having to change the schema at the next higher level abstraction.*

A major objective for three-level architecture is provide data independence which means that uppe levels are unaffected by changes in lower levels.

Q1.33 What are the reasons to use Dat Independence?

Ans. Data independence is needed to:

- *Allow DBA to make changes in database withou affecting application programmers.*
- *Allow the supplier of data processing equipment an software to introduce new technologies withou affecting customer's applications.*
- *Simplify the development of application program.*
- *Allow data sharing without creating separate dat for different applications.*

Q1.34 Discuss two advantages of Physical Data Independence. **MDU BCA 2014**

Ans. The advantages of physical data independence are:

1. *It has the capability to change the physical schema without having to change to logical schema.*
2. *It is not so complex.*
3. *It allows changing the structure of the database without making any changes in the application programs that use the database.*

Q1.35 Discuss advantages of Logical Data Independence.

Ans. The advantages of logical data independence are:

1. *It has the capability to change the logical schema without causing application program to be rewritten.*
2. *It provides immunity of external schemas or application programs.*
3. *The users are shielded from changes in the logical structure of the data or changes in the choice of relations to be stored.*

Q1.36 Explain the three levels of data abstraction.

Ans. The three levels of data abstraction are:

1. **Physical Level:** It is the lowest level of abstraction. It describes how the data are actually stored.
2. **Logical Level:** It is the middle level of abstraction. It describes what data are stored in the database and what relationships exist among those data.
3. **View Level:** It is the highest level of abstraction. It describes only that part of the entire database which is actually needed by the user.

Q1.37 Write the advantages of three level architecture.

Ans. Following are the advantages of three level architecture:

- *Each user is able to access the same data even though they have different view of data as per their requirement.*
- *Users need not to know anything about physical data storage. If changes are made to physical storage organisation then it would not affect the structure of database or user interaction with database.*
- *Any change made to one user view does not have any effect on other users.*
- *The DBA is able to change the conceptual or internal structure without affecting any user.*

Q1.38 What is client server architecture of database system?

Ans. Client server architecture consists of a server and a set of clients. DBMS resides on server and performs all functions related to database management like data definition, manipulation, integrity, security etc. A client is a personal computer or a workstation that runs various DBMS applications. These servers and client computers are connected to a network. Client requests for a service by running an application program. The server response to the request by returning results to the clients.

Q1.39 What are the advantages of Client Server architecture? Gurugram University BCA 2021 MDU BCA 2021

Ans. Following are the advantages of client-server architecture:

- ***All data is stored on servers, which generally have far more better security than clients.***
- ***It increases overall performance of DBMS.***

- *It is used to develop highly complex applications.*
- *Clients with different operating systems can be connected with each other.*
- *It functions with multiple different clients of different capabilities.*
- *It provides better user interface.*
- *Since data is centralized, updates to that data are easy.*
- *It reduces cost.*
- *Load can be distributed among clients.*

Q1.40 List the disadvantages of Client-Server architecture. **Gurugram University BCA 2021**

Ans: Following are the disadvantages of client-server architecture:

- *If server fails whole network fails.*
- *If server crashes, there can be loss of data.*
- *Recovery is typical.*
- *Network may be error prone.*
- *As number of simultaneous client requests to a given server increases, the server can become overloaded.*

Q1.41 What is mapping?
IGU BCA 2018, MDU BCA 2017, 2015

Ans. ***Mapping is the process of transforming requests and results between any of the two levels of logical architecture of a DBMS.***

Programs refer to an external schema and are mapped by the DBMS to the internal schema for execution. Data

extracted from the internal DBMS level is reformatted
match the user's external view.

Q1.42 What is mapping? Why it is necessary
DBMS architecture? **MDU BCA 201**

Ans. *Mapping is the process of transforming requests an results between any of the two levels of logic architecture of a DBMS.*

Mapping is necessary to transform requests between an of the two levels of logical architecture of a DBM These mappings may be time-consuming, so som DBMSs especially those that are meant to support sma databases, do not support external views. Even in suc systems, however, a certain amount of mapping necessary to transform requests between the conceptu and internal levels.

Q1.43 Define data model. **MDU BCA 2014**

Ans. *Underlying the structure of the database is the dat model. It is a collection of conceptual tools fo describing data, data relationships, data semantics an consistency constraints.*

A data model provides mechanism to structure the dat for the entities being modeled, allows a set o manipulative operators to be defined on them, an enforce set of constraints to ensure the accuracy of data.

Q1.44 List two major advantages of conceptua modeling. **MDU BCA 201**

Ans. Following are the advantages of conceptual modeling:

1. ***It provides an easily understandable macro-leve view of the data environment.***

2. *It is independent of both software and hardware. Therefore, changes in software or hardware do not have any effect on the database design at conceptual level.*

3. *It integrates all external views (entities, relationships, constraints and processes) into a single global view of entire data in the enterprise.*

Q1.45 Explain the term Entity. MDU BCA 2021

Ans. ***An entity is a 'thing' in the real world with an independent existence. In other words, anything which exists and is distinguishable from one another is known as an entity.***

For example, a student 'Ravi' with roll number 236 is an entity.

An entity may be physical and tangible like an employee or a non-tangible thing with conceptual existence like a bank account.

Entities are classified as independent/strong entities and dependent/weak entities. An independent entity is one that does not rely on another for identification. A dependent entity is one that relies on another for identification.

Q1.46 What is entity set? MDU BCA 2021, 2015

Ans. ***An entity set is a set of entities of the same type. The set of all employees of an organization can be defined as the entity set employees. Similarly the entity set projects represents the set of all the projects undertaken by the organization.***

An entity set is represented by a set of attributes. Possible attributes of the employees entity set are

emp_no, emp_name and address. Possible attributes of the projects entity set are project_no and project_name.

Q1.47 Write the uses of entity sets. **MDU BCA 2014**

Ans. Entity set serves as a collection of all instances of a particular entity type in the database at any point of time. Thus, this set shares the same type of properties. For example: set of all persons, companies, trees etc.

Q1.48 What is relationship type? **MDU BCA 2016**

Ans. In an ER-model similar relationships are grouped into relations sets called as the relationship type.

Thus, a relationship type is a set of meaningful associations between one or more participating entity types. Each relationship type is given a name that describes its function.

For example, EMPLOYEE Ram Singh WORKS_FOR Computer DEPARTMENT. WORKS_FOR is relationship type in which EMPLOYEE and DEPARTMENT participate.

Q1.49 What is relationship instance?

Ans. ***A particular occurrence of a relationship is called as a relationship instance relational occurrence.***

It is a uniquely identifiable association which includes one occurrence from each participating entity type. It indicates the particular entity occurrences that are related.

Q1.50 Explain various components of E-R diagram. **MDU BCA 2022**

Ans. Following are the various components of E-R diagram:

1. *Rectangles represent entity sets.*
2. *Ellipses represent attributes.*
3. *Diamonds represent relationship sets.*
4. *Lines link attributes to entity sets and entity sets to relationship sets.*
5. *Double ellipses represent multivalued attributes.*
6. *Dashed ellipses denote derived attributes.*
7. *Double lines indicate total participation of an entity in a relationship set.*
8. *Double rectangles represent weak entity set.*

Q1.51 Write the advantages of ER diagram.

Ans. Following are the advantages of ER diagram:

1. ***It provides a visual presentation of the layout of proposed database.***
2. ***It is easy to use.***
3. ***It can be easily mapped to relational model.***
4. ***It allows database designer to focus on complete and accurate modeling of enterprise without thinking of implementation details.***

Q1.52 Write the uses of E-R model.

Ans. The ER model is currently widely used in databases, information systems and software engineering.

ER model is also used:

- ***To facilitate the process of communication among analysts, managers and users of data.***

- *To design a common data model that will accommodate the different needs of individuals and organizations within the enterprise.*
- *To establish a logical model that can be implemented in a database management system (DBMS).*

Q1.53 What is abstraction? **MDU BCA 2015**

Ans. *Abstraction is hiding of implementation details from the users.*

Since non-computer professionals also use database, thus database complexity must be hidden from them. Moreover users are of different capabilities and data needed by them is also of different levels. Thus for smooth running of database systems, hide the complexity of database system from the end users.

Thus abstraction principle is applied to the DBMS and DBMS hides the complex details of how the data is stored in DBMS. It allows different users to concentrate only on their respective subparts.

Q1.54 Explain uses of abstraction. **MDU BCA 2014**

Ans. Following are the uses of abstraction:

1. ***It provides an abstract view of the data to its users without giving the physical storage and implementation details.***
2. ***It hides the implementation details from the users i.e. database complexity is hidden from the users.***

Q1.55 Explain data integration. **MDU BCA 2014**

Ans. ***Data Integration means data in database is always accurate. It also implies that incorrect information cannot be stored in the database.***

In a database system, better data integrity is obtained by imposing consistency constraints on the database.

Examples:

1. A student database has the information regarding marks obtained in an examination. A student cannot obtain marks more than100 – the maximum marks in one subject. Integrity constraints can be specified so that database will accept marks only in the range of 0 to 100 per subject.

2. The database of a college till graduation will have the data for BA, BSc, BCA, Bcom classes only. If a user enters the data for MSc/MCA class then this incorrect/invalid data entry must not be stored in the database. To enforce this integrity constraints are imposed easily on the database instead of file system where these constraints are imposed on all the applications separately.

Q1.56 List two major advantages of Network Data Model.

Ans. Advantages of network data model are:

- *Many-to-many relationship can be implemented.*
- *It is efficient and flexible.*
- *It provides data independence, data integrity and capability to handle more relationship types.*
- *Easier access as compared to hierarchical data model.*
- *Simple and easy to design.*
- *Data access is easy in network data model.*

Q1.57 List disadvantages of Network Data Model.

Ans. Disadvantages of network data model are:

- *Complexity increases as the number of lin increases.*
- *Extra storage memory is required for pointers.*
- *General purpose Query facility is not available.*
- *Maintenance of this model is expensive.*
- *New queries cannot be implemented.*
- *High level language is required to program the database.*
- *Insertion, deletion and updation operations of any record require large number of pointers adjustment.*

Q1.58 Define the term Relation.

Ans. *In relational data model, the data is organized into tables i.e. rows and columns. These tables are called relations. A row in a table represents relationship among a set of values.*

A relation has the following properties:-

- ***In a relation rows can be in any order.***
- ***Columns can be present in any order.***
- ***All the rows should be different.***
- ***The value of each column should come from some common domain.***
- ***Number of columns of a relation is called its degree.***
- ***Number of rows of a relation is called its cardinality.***

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR

In the above example, the relation Account has degree 4 and cardinality 3.

Q1.59 Define the term Tuple.

Ans. *A tuple is a collection of values that compose one row of a relation. A tuple is equivalent to a record instance.*

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA

Tuple

Q1.60 Why is a key essential? What are the different types of keys?

Ans. A key is essential because:

- ***It allows one to identify a set of attributes that suffice to distinguish entities from each other.***

- *It also helps to uniquely identify relationships and thus distinguish relationships from each other.*

Different types of keys are: Primary key, Foreign key, Candidate key and Super key.

Q1.61 Define/explain Primary key. MDU BCA 2021

Ans. *An attribute which recognize a tuple uniquely is called a primary key.*

Consider a relation STUDENT. Let its attributes as Rollno, Regdno, Name, Class, Address.

Rollno is a primary key in STUDENT relation.

STUDENT

Rollno	Regdno	Name	Class	Address
101	05NRG01	HARI	BCA II	ROHTAK
102	05NRG02	RAVI	BCA II	ROHTAK
103	05NRG03	ANIL	BCA II	KARNAL
104	05NNG01	AJAY	BCA III	KARNAL
105	06NRG01	HARISH	BCA I	PANIPAT
106	06NRG02	MOHAN	BCA I	ROHTAK
107	06NRG03	VIJAY	BCA I	ROHTAK

The value of primary key in any tuple cannot be null.

Q1.62 Define/explain Candidate key. MDU BCA 2021

Ans. *There may be more than one attributes in a relation that recognize a tuple uniquely. These attributes are called candidate keys.*

For example, in the relation STUDENT, Rollno and Regdno are candidate keys.

Q1.63 Define/explain Alternate key. MDU BCA 2021

Ans. *Out of candidate keys, one is chosen as a primary key. Candidate key which is not primary key is called alternate key.*

For example, in the relation STUDENT, if Rollno is taken as primary key then Regdno is the alternate key.

Q1.64 Define/explain Foreign key.

MDU BCA 2022, 2021

Ans. *If a non key attribute in one relation appears as the primary key in another relation, it is called foreign key.*

For example, consider relation Account and Branch of a banking organization database.

Account

Accountno	Name	Balance	Distr
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
105	HARPREET	9712	PANIPAT
106	JAGDEEP	625	ROHTAK

Branch

Distr	State
ROHTAK	HARYANA
SIRSA	HARYANA
PANIPAT	HARYANA
HISSAR	HARYANA
KARNAL	HARYANA
AMBALA	HARYANA
JHAJJAR	HARYANA

Distt of relation Account is foreign key since it primary key of relation Branch.

Q1.65 Explain uses of foreign key.

Ans. Foreign key is used:

- ***To represent relationship between two or mo tables.***
- ***To ensure that all values present in a foreign k column are listed in the corresponding primary k of the other table.***
- ***To preserve the defined relationship between t tables when the data is deleted, modified or inserte***
- ***To maintain referential integrity. Referent integrity specifies that if a column is defined as foreign key, the validation of this column happe automatically against the table to which it h reference.***

Q1.66 Define data integrity. MDU BCA 20

Ans. ***Integrity means that the data contained in the databa is both accurate and consistent.***

An example of poor data integrity would be where poet's name is stored differently in two different places

Database provides data integrity by checking to ensu that the data employed by many different users a associations between data items may not be destroyed.

Thus, Data integrity describes the accuracy, validi and consistency of data.

Q1.67 What is difference between primary key and candidate key? IGU BCA 2018

Ans. A candidate key is a column or a group of columns that is capable of becoming the primary key. A table can have multiple candidate keys but it can have only one primary key.

For example, a table STUDENT contains columns like AdmNo, RollNo, Name, Address and PhoneNo. In this table AdmNo and RollNo (both are unique for every row in the table) are candidate keys. Out of these any one can be chosen as the primary key of the table.

Q1.68 Write the operations that DBMS can perform.

Ans. Following are the operations that DBMS can perform:

- *Adding new, empty files to the database.*
- *Inserting new data into existing files.*
- *Retrieving data from existing files.*
- *Updating data in existing files.*
- *Deleting data from existing files.*
- *Removing existing files, empty or otherwise, from the database.*

Q1.69 What is domain? MDU BCA 2022, 2021, 2016

Ans. *A domain describes the set of possible values for a given attribute.*

Mathematically, attaching a domain to an attribute means that "all values for this attribute must be an element of the specified set". The character data value 'XYZ' for instance, is not in the integer domain. The integer value 123, satisfies the domain constraint.

A domain specification defines the possible values of a attribute. It includes:

- *The domain name*
- *The data type and the length*
- *Whether NULL values are acceptable*
- *The default values*
- *Constraints on the allowable values*

Q1.70 Differentiate record-based and object-based data models. **MDU BCA 2017**

Ans. Following are the differences between record-based and object-based data models:

Record-based data models	Object-based data models
1. These models are used to specify the overall logical structure of the database.	1. These models are used to describe data at view level and logical level.
2. They provide a higher level description of the implementation.	2. They provide flexible structuring capabilities.
3. Hierarchical model, network model and relational model are the types of record based data model.	3. Entity relationship model, object oriented model, semantic data model and functional data model are the types of object-based data model.

Q1.71 What are the benefits of database approach?

Ans. Following are the benefits of database approach:

- ***Redundancy can be reduced.***
- ***Inconsistency can be avoided.***
- ***Data can be shared.***
- ***Standards can be enforced.***
- ***Integrity can be maintained.***
- ***Data independence can be provided.***

Q1.72 What is relational algebra?

Ans. ***Relational algebra is a set of operations that can be used to manipulate relations.***

It is a procedural query language. It takes one or more than one relations as input and produces a new relation as output. Thus the result of a query in relational algebra is always a relation. Relational algebra serves as the basis of SQL and query optimization.

Q1.73 What is relational calculus?

Ans. ***Relational calculus is a query system wherein queries are expressed as formulas consisting of a number of variables and an expression involving these variables. Such formulas describe the properties of the required result relation without specifying the method of evaluating it.***

Thus, in a relational calculus, there is no description of how to evaluate a query; a relational calculus query specifies what is to be retrieved rather than how to retrieve it. Everything depends upon the DBMS to

Q1.71 What are the benefits of database approach?

Ans. Following are the benefits of database approach:

- *Redundancy can be reduced.*
- *Inconsistency can be avoided.*
- *Data can be shared.*
- *Standards can be enforced.*
- *Integrity can be maintained.*
- *Data independence can be provided.*

Q1.72 What is relational algebra?

Ans. *Relational algebra is a set of operations that can be used to manipulate relations.*

It is a procedural query language. It takes one or more than one relations as input and produces a new relation as output. Thus the result of a query in relational algebra is always a relation. Relational algebra serves as the basis of SQL and query optimization.

Q1.73 What is relational calculus?

Ans. *Relational calculus is a query system wherein queries are expressed as formulas consisting of a number of variables and an expression involving these variables. Such formulas describe the properties of the required result relation without specifying the method of evaluating it.*

Thus, in a relational calculus, there is no description of how to evaluate a query; a relational calculus query specifies what is to be retrieved rather than how to retrieve it. Everything depends upon the DBMS to

transfer these non procedural queries into equivalent procedural queries.

Relational calculus is the collective term used for tuple calculus and domain calculus. In relational tuple calculus, the variables represent the tuples from specified relations. In domain calculus the variables represent the values drawn from specified domains.

Q1.74 Differentiate between relational algebra and relational calculus. **MDU BCA 2016**

Ans. Following are the differences between relational algebra and relational calculus:

Relational Algebra	Relational Calculus
1. Relational algebra is a procedural method of solving the queries.	1. Relational calculus is a non-procedural method of solving the queries.
2. It takes one or more than one relations as input and produces a new relation as output.	2. In it, the query is expressed as a formula consisting of a number of variables and an expression involving these variables. How this formula is evaluated, there is no specified rule. Everything depends upon the DBMS to transfer these non procedural queries into equivalent procedural

Relational Algebra	Relational Calculus
3. It describes about 'how' to evaluate a query, i.e., it specifies how the information should be retrieved.	3. It describes about 'what' is to be retrieved, i.e., it just specifies what information is required, not how to retrieve that information.

Q1.75 Define the two principal integrity rules for the relational model.

Ans. The two principal integrity rules for the relational model are:

1. **Entity integrity:** In a base table, no column of a primary key can be null.
2. **Referential integrity:** If a foreign key exists in a table, either the foreign key value must match a candidate key value of some record in its home table or the foreign key value must be wholly null.

Q1.76 What is the need of database security?
MDU BCA 2018

Ans. Database security is needed for the protection of the data in the database against:

- *Unauthorized access.*
- *Intentional destruction or alteration.*
- *Accidental introduction of inconsistency or accidental disclosure.*

Q1.77 Define entity integrity constraint.

MDU BCA 2021

Ans. No attribute of a primary key can have a null value. This is because primary key values are used to identify the individual tuples. This constraint is known as Entity Integrity Constraint.

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
107	HARPREET	9712	PANIPAT
	T	625	ROHTAK
	JAGDEEP	7250	SONIPAT

Not allowed

Entity Integrity ensure that there is no duplicate records in the table and each field that recognizes each record in the table must have unique value and not having null values.

Entity Integrity specifies that every instance of entity have the unique values, i.e., primary key must be kept and must have the values other than null values.

Q1.78 Define Referential integrity constraint. Explain with an example.

Gurugram University BCA 2021

Ans. It states that "If a foreign key in relation R_1 refers to the primary key of relation R_2, then every value of the

foreign key in relation R_1 must be available in relation R_2".

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
105	HARPREET	9712	PANIPAT
106	JAGDEEP	625	ROHTAK
107	HANI	7250	SONIPAT

Branch

Distt	State
ROHTAK	HARYANA
SIRSA	HARYANA
PANIPAT	HARYANA
HISSAR	HARYANA
KARNAL	HARYANA
AMBALA	HARYANA
JHAJJAR	HARYANA

Distt of relation Account is foreign key. Thus Distt Sonipat is not allowed in Account relation because it is not available in Branch relation.

Referential Integrity is a property of data which when satisfied, requires every value of one attribute of a relation to exist as a value of another attribute in a different relation.

For referential integrity to hold in a relational database, any field in a table that is declared a foreign key can contain only values from a parent table's primary key.

For instance, deleting a record that contains a value referred to by a foreign key in another table would break referential integrity.

Referential Integrity is used to maintain the consistency among tuples of the two relations.

Q1.79 Define Normalization.

Gurugram University BCA 2021

Ans. ***Normalization is a process of decomposing a relation into various smaller relations that contains minimum or no redundancy.***

Normalization is an essential part of database design. A good understanding of the semantics of data helps the designer to build efficient design in using the concept of normalization.

Q1.80 Why do we need to normalize databases?

Gurugram University BCA 2021

OR

What is purpose of normalization?

Ans. The need/purpose of normalization is:

- ***To minimize redundancy by storing each fact within the database only once.***
- ***To remove, insert, delete and update anomalies during database activities.***
- ***To reduce the need to reorganize data when it is modified or enhanced.***
- ***To maintain data consistency in the database.***
- ***To avoid unnecessary coding. Extra programming can be required to handle the non-normalized data and this in turn can impair performance significantly.***

Q1.81 What do you mean by modification anomalies?

IGU BCA 2018

Ans. Modification anomalies are so named because they are generated by the addition of, change to, or deletion of data from a database table.

Thus modification anomalies include:

- **Insertion Anomaly:** Data cannot be inserted when it is desirable to do so; one has to wait on some future data, due to organization of the data structure.
- **Deletion Anomaly:** Deletion of some undesirable aspect(s) of data necessarily means deletion of some other desirable aspect(s) of data.
- **Update Anomaly:** Update of some aspect(s) of data necessarily means update of other aspect(s) of data.

Modification anomaly leads to a situation in which repeated data change at one place results in inconsistency unless the same data is also changed at other places. For example, change in the name of a publisher, say, EPEX Publications to EPEX Publishers Pvt. Ltd. needs modification in multiple tuples. If the name of a publisher is not modified at all places, it will show different values for publisher name in different tuples. Normalized relations eliminate or reduce modification anomalies.

Q1.82 What is Boyce-Codd Normal Form?

Gurugram University BCA 2021

OR

Explain BCNF with an example.

MDU BCA 2014

Ans. ***A normalized relation is in Boyce-Codd Normal form if every determinant is a candidate key.***

A determinant is an attribute in a relation on which some other attribute of the relation is fully functionally dependent. Every BCNF is in 3 NF.

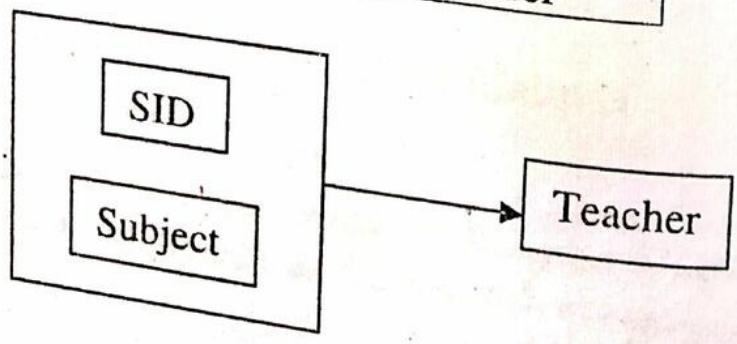
Example:

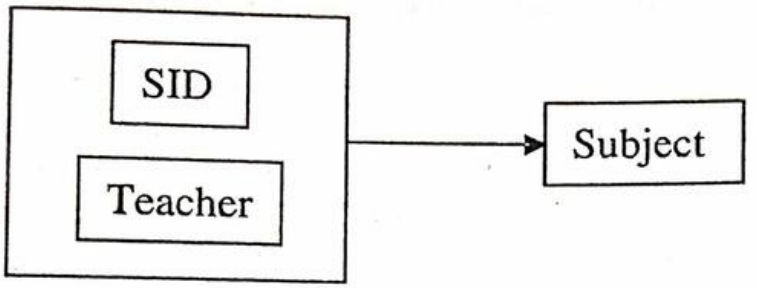
Consider the relation Guide(SID, Subject, Teacher)

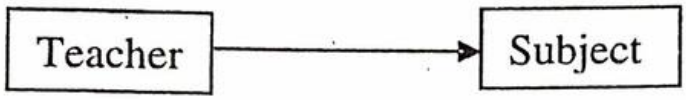
- It is assumed that
  - A student can select one or more subjects.
  - A teacher teaches only one subject.
  - A subject can be taught by many teachers.
- Since students can select several subjects, SID does not determine subject. Also students can be taught by several teachers, SID does not determine Teacher. Thus SID cannot be a primary key.
- The two possible composite keys are (SID, Subject) and (SID, Teacher).
- Since a teacher teaches only one subject. Thus teacher determine subject i.e. teacher is a determinant.

Guide

SID	Subject	Teacher
101	English	Ravi
101	Maths	Hari
102	English	Ravi
102	Hindi	Ramesh
103	Maths	Ravinder







In the relation Guide, there are three determinant (SID, SUBJECT), (SID, Teacher) and Teacher. Out of these (SID, Subject), (SID, Teacher) can be candidate key. Hence relation Guide is not BCNF.

Moreover if one deletes student 103's tuple, there is loss of information that Ravinder teaches Maths. This is deletion anomaly. Similarly one can not store the information that Harnaam teaches Computer if there is no student in computer subject. This is insertion anomaly.

Thus Guide relation can be decomposed into two relations Std_guide (SID, Teacher) and Teacher_sub (Teacher, Subject)

Std_guide

SID	Teacher
101	English
101	Maths
102	English
102	Hindi
103	Maths

Key: (SID, teacher)

Teacher_sub

Teacher	Subject
Ravi	English
Hari	Maths
Ramesh	Hindi
Ravinder	Maths

Key : Teacher

Thus relations Std_guide and Teacher_sub are in BCNF.

Q1.83 Describe 4NF with an example.

Ans. *A relation is said to be in fourth normal form (4 NF)*

- *It is in BCNF.*
- *It has no multi valued dependencies.*

Given a relation R with attributes A, B and C Multivalued dependency represents a dependence between these attributes such that

- A leads to multiple values of C and B
- B and C are independent of each other.

MVD between attributes A, B and C in a relation R can be indicated as:

$$A \twoheadrightarrow B \quad (\text{A multidetermines B})$$

$$A \twoheadrightarrow C \quad (\text{A multidetermines C})$$

Multivalued dependency in a relation is due to first normal form, which disallows an attribute in a row from having a set of values.

Example:

Consider the relation Student(SID, Subject, Activity)

Student

SID	Subject	Activity
101	English	Skating
101	Maths	Skating
101	English	Cricket
101	Maths	Cricket
102	Computer	Swimming

Here SID leads to multiple values of Subject and multiple values of Activity. Subject and Activity are independent of one another.

These multivalued dependencies can be indicated as:

$$SID \twoheadrightarrow Subject$$
$$SID \twoheadrightarrow Activity$$

To remove this problem decompose the relation as:

SID	Subject
101	English
101	Maths
102	Computer

SID	Subject
101	Skating
101	Cricket
102	Swimming

Q1.84 Differentiate between BCNF and 3NF.

Ans. Following are the differences between BCNF and 3NF:

3NF	BCNF
1. A relation is in 3NF if it is in 2NF and every non key attribute is non transitively dependent on primary key.	1. A relation is in BCNF if every determinant is a candidate key.
2. It is not a stronger form of BCNF. Every relation in 3NF is not necessary also in BCNF.	2. It is stronger form of 3NF. Every relation in BCNF is also in 3NF.
3. 3NF design is always dependency preserving and lossless.	3. Dependency preserving is difficult to achieve in BCNF sometimes.

Q1.85 What is functional dependency?

MDU BCA 2022, 201

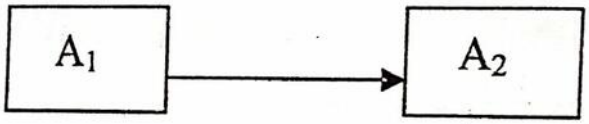
Ans. Functional dependency is the relationship between the attributes or fields of a relation.

An attribute A_2 of relation R is said to be functionally dependent on another attribute A_1 of the same relation if there is only one value of A_2 corresponding to A_1.

In other words whenever two tuples of R, agree on their A_1 value then they also agree on their A_2 value. Mathematically for any two tuples t_1 and t_2 of R

$$t_1[A_1] = t_2[A_1] \Rightarrow t_1[A_2] = t_2[A_2]$$

Diagrammatically this can be shown as:



Saying that A_2 is functionally dependent on A_1 is same to say that A_1 determines A_2.

For example, consider a relation Item (Item_code, Item_name, Price, Qty).

Item

Item_code	Item_name	Price	Qty
101	Pen	10	50
102	Pencil	2	100
103	Eraser	1	50
104	Sharpener	3	75

Here, each of the attributes Item_name, Price, Qty is functionally dependent on the attribute Item_code.

Thus Item_code → Item_name
Item_code → Price
Item_code → Qty

Functional dependencies play a key role in differentiating good database designs from bad database designs. A functional dependency is a type of constraint that is a generalization of the notion of key.

Q1.86 Discuss the properties of a relation.

MDU BCA 2017

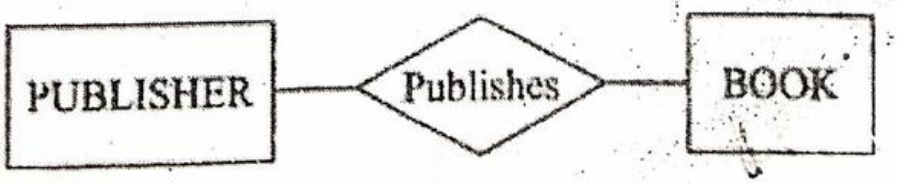
Ans. A relation has the following properties:

- ***In a relation rows can be in any order.***
- ***Columns can be present in any order.***
- ***All the rows should be different.***
- ***The value of each column should come from some common domain.***
- ***Number of columns of a relation is called its degree.***
- ***Number of rows of a relation is called its cardinality.***

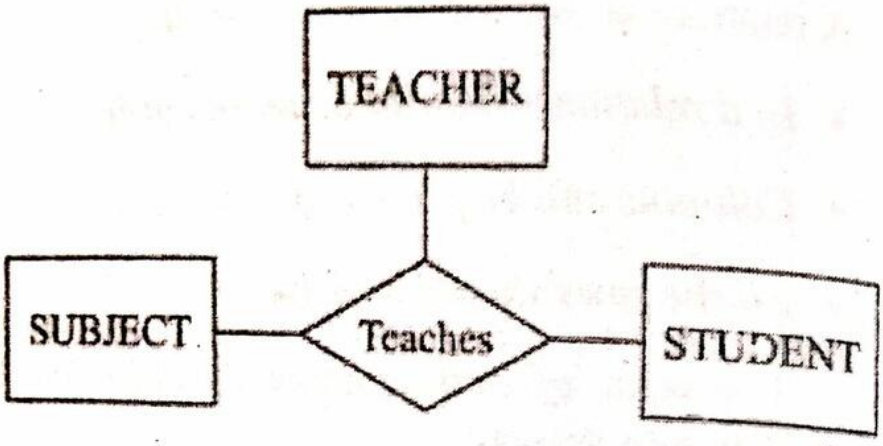
Q1.87 What is the degree of relationship? Give example also. **MDU BCA 2017**

Ans. ***The number of participating entities in a relationship defines the degree of the relationship.***

If numbers of participating entity type are two, then degree of relationship is 2, which may be represented as 2-ary or binary relationship. For example, the BOOK-PUBLISHER relationship shown below is a binary relationship.



If numbers of participating entity type are three, then degree of relationship is 3, which may be represented as 3-ary or ternary relationship. For example, the BOOK-PUBLISHER relationship shown below is a binary relationship. For example, the entities TEACHER, SUBJECT and STUDENT are related using a ternary relationship called 'teaches' as shown below:



Q1.88 List the advantages of Normalization.

Ans. Advantages of normalization are:

- ***By eliminating duplicate data, the overall size of the database will be reduced.***
- ***Normalization is very simple, easy, understandable technique.***
- ***Normalization helps to simplify the structure of tables.***
- ***Less redundant data, which determines:***
  - ***Better transactional performance.***
  - ***Less storage.***
  - ***Less time for maintenance operations such as backup and restore.***
  - ***More compact databases and fewer NULLs.***
- ***Normalization improves performance.***

Q1.89 Explain why 4NF is more desirable than BCNF?

Ans. 4NF is more desirable than BCNF because

- ***4NF is more restrictive than BCNF.***
- ***4NF reduces repetition of information than BCNF.***
- ***4NF removes the problems encountered in BCNF.***
- ***Every 4NF schema is in BCNF but there are BCNF schemas that are not in 4NF.***

Q1.90 Show that if a relational database is in BCNF, then it is also in 3NF. **MDU BCA 2017**

Ans. If a relation schema is in BCNF then all functional dependencies are of the form "super key determines a set of attributes" or the dependency is trival. Thus, a BCNF schema can not have any transitive dependencies. As a result, every BCNF schema is also in 3NF.

Q1.91 What is SQL? **MDU BCA 2021**

Ans. ***Structured Query Language (SQL) is an advanced relational database language to help users to extract information from a database easily.***

It was originally developed in 1970 at IBM's San Jose Research laboratory. It was originally called Structured English **QUE**ry **L**anguage or SEQUEL. The capability of an RDBMS is "Structured Query Language" as it caters to most of the routine queries placed by the user on the database.

The American National Standards Institute (ANSI) adopted SQL as the standard language for RDBMS in 1986. In 1987, SQL was adopted for use with RDBMSs, as an international standard by ISO (International Organization for Standardization).

Q1.92 What are the components of SQL and what function do they serve?

Ans. Following are the components of SQL:

1. **DDL (Data Definition Language):** These are SQL commands used to create, modify and delete database structure.

   Examples of DDL statements are: CREATE, ALTER, DROP, TRUNCATE, GRANT, REVOKE etc.

2. **DML (Data Manipulation Language):** These are the commands used to insert, delete and manipulate data in a database.

   Examples of DML statements are: INSERT, UPDATE, DELETE etc.

3. **DCL (Data Control Language):** These are the commands that control access to data in a database.

   Examples of DCL command are: COMMIT, ROLLBACK, SAVEPOINT etc.

4. **DQL (Data Query Language):** These components of SQL are used to retrieve data from database. SELECT command is used for this purpose.

Q1.93 Explain the function of each of the clauses in the SELECT statement.

Ans. The function of each of the clause in the SELECT statement is given below:

FROM: specifies the table or tables to be used.

WHERE: filters the rows subject to some condition.

GROUP BY: forms groups of rows with the same column value.

HAVING: filters the groups subject to some condition.

SELECT: specifies which columns are to appear in the output.

ORDER BY: specifies the order of the output.

Q1.94 Explain the purpose of DDL and DML commands used in SQL. Also give two examples of each.

Ans. DDL: Data Definition Language. DDL commands are used to create, destroy, and to restructure the database objects. For example, CREATE, ALTER.

DML: Data Manipulation Language. DML commands are used to insert, delete and change data in tables. For example, SELECT, DELETE.

Q1.95 What is view? **MDU BCA 2021, 2016, 2015**

OR

Explain views in SQL.

Ans. Views are the means by which information relevant to a person is only presented and rest of the information is hidden from him/her.

A view is a virtual table:

- ***Which looks like a table, but does not exist as such.***
- ***There is no copy of the data, its data are derived from tables.***

Thus views are tables whose contents are taken or derived from other tables. They themselves do not contain data. Thus, creating a VIEW is different than creating a table.

Example:

```
SQL > CREATE VIEW MANAGER AS
      SELECT Emp_no, Name, Design
        FROM employee
          WHERE Name LIKE '%K';
```

Above SQL command creates a view MANAGER with three columns: Emp_no, Name and Design. As a result of this command, definition of view is stored in the database. When creating a VIEW, any valid SELECT statement which does not contain an ORDER BY clause may be used. CREATE VIEW is a DDL command.

To display the VIEW Manager the command is:

```
SQL > SELECT *
        FROM MANAGER;
```

Above command will retrieve data from employee table which is base table for MANAGER.

Q1.96 Define Data Manipulation Language.

Ans. *A data manipulation language (DML) is a language that enables users to access or manipulate data as organized by the appropriate data model.*

Types of DML

1. **Procedural DML:** It requires a user to specify what data are needed and how to get those data.
2. **Declarative DML:** It requires a user to specify what data are needed without specifying how to get those data. It is also referred to as non-procedural DML.

Q1.97 Discuss relation, attribute, domain, tuple, relational database in the context of the relational data model in one line.

Ans. **Relation:** A table with columns and rows.

Attribute: A named column of a relation.

Domain: The set of allowable values for one or more attributes.

Tuple: A record of a relation.

Relational database: A collection of normalized tables.

Q1.98 Explain how the GROUP BY clause works. What is the difference between the WHERE and HAVING clauses?

Ans. SQL first applies the WHERE clause. Then it conceptually arranges the table based on the grouping column(s). Next, applies the HAVING clause and finally orders the result according to the ORDER BY clause.

WHERE filters rows subject to some condition; HAVING filters groups subject to some condition.

Q1.99 Define query language.

Ans. ***A query is a statement requesting the retrieval of information. The portion of a DML that involves information retrieval is called a query language.***

Q1.100 What is query processing? What are the typical phases of query processing?

MDU BCA 2017

Ans. A user may specify a query to the system, it is necessary to find the best method to respond the query using the existing database.

Query processing is the technique of selecting the best method to be used in responding to a database request.

Generally there are different methods for computing the query. Each method of expressing the query suggests a plan to find the answer.

Firstly a user's query is converted into an internal standard representation. Subsequently, it is modified to an equivalent query which can be computed more efficiently. Then an access plan for evaluating the query is determined and the query is executed.

When a query is presented to the system, it is the responsibility of the system to transform the query into an equivalent query which can be computed more efficiently.

Q1.101 Define query optimization. **MDU BCA 2014**

Ans. ***To improve the strategy for processing a query is called query optimization.***

In query optimization:

- First to find an expression that is equivalent to the given expression.
- Second to find the detailed strategy for processing the query which includes:
  - (i) How the query will be executed.
  - (ii) The order in which tuples are processed.
  - (iii) How many times the disk access required.

Q1.102 Differentiate between DDL and DML.

Ans. Following are the differences between DDL and DML:

DDL	DML
1. DDL stands for Data Definition Language.	1. DML stands for Data Manipulation Language.
2. DDL helps a user in defining the data structure in the database.	2. DML helps a user in manipulation of data in the database.
3. It defines the physical characteristics of each record.	3. It provides the way to process the data that is already existing in the database.
4. It provides commands for defining relations, deleting relations, creating indices and modifying relations.	4. It provides commands for accessing, inserting, deleting and updating the rows of tables of the database.
5. It establishes a link between conceptual and internal view	5. It establishes a link between user view and conceptual view.
6. It provides data security restriction.	6. It provides data retrieval, updation, deletion, insertion of data.
7. It describes data type and name of each element in the database.	7. It accesses the data by the name.

Q1.103 What are the components of query processor?

Ans. The components of query processor are:

1. **DDL interpreter:** It interprets DDL statements and records the definition in the data dictionary.
2. **DML compiler:** It translates the DML statements into an evaluation plan and performs query optimization.
3. **Query evaluation engine:** It executes low-level instructions generated by the DML compiler.

Q1.104 Explain concurrency in database system.

MDU BCA 2018

OR

What is concurrency? **MDU BCA 2015**

Ans. ***The term concurrency refers to the fact that DBMS typically allows many transactions to access the same data at the same time and therefore, such systems require a concurrency control mechanism to ensure that concurrent transactions do not interfere with each other's operation.***

When two or more than two transactions try to process the same data item simultaneously, such situation is called concurrent processing.

For this concurrent access to a database, it is necessary for the system must control the interaction among the concurrent transactions:

- ***To preserve the consistency of the database.***
- ***To ensure that the modifications made by the transactions are not lost.***

This control is achieved by various techniques called concurrency control techniques.

When many users use the database for read-only, there is no problem but if the transactions

concurrently to modify some data items, it may lead to inconsistencies or lead to incorrect values. Thus for handling the concurrent processing, various techniques are used. These techniques guarantee simultaneous processing during concurrent processing.

Locking Techniques for Concurrency Control

To avoid the concurrent update problem, the data which is accessed for update must not be shared among users. To stop this type of sharing, the DBMS must incorporate a resource-locking mechanism. That is, the data which are accessed by one user for updating must be "locked" or denied to other users until the update is completed.

Concurrency Control based on Timestamp ordering

Concurrency control problem can be handled by assigning ordered timestamp values to transactions. Timestamp values are assigned to transactions as per their starting time. This means that time stamps are based on the order in which transactions started. In this technique locking is not used.

Q2.(a) Discuss the main characteristics of the database approach. **MDU BCA 2011**

Ans. The database system has the following characteristics:

1. Self Describing
2. Multiple view support
3. Data sharing
4. Integrity
5. Multi-user Transaction Processing
6. Data Independence
7. Minimal redundancy

1. Self Describing

The database system is self describing in nature. It contains a complete description of the database structure in the system catalog.

The information stored in the catalog is about:

- ***Structure of each file.***
- ***Type and storage format of each data item &***
- ***Various constraints on the data.***

2. Multiple view support

Each user according to his need looks at different view of the same database. A view is a subset of the database that contains the virtual data derived from the database files. Thus each user gets the required data in his desired format without bothering how the data is stored in the database.

3. Data sharing

Data can be shared not only by existing applications but new application can also be developed to use the same

stored data. Thus, this means that data requirements of various new applications may also be satisfied without creating new files.

4. Integrity

Integrity means that the data contained in the database is both accurate and consistent. Database provides data integrity by checking to ensure that the data employed by many different users and associations between data items may not be destroyed.

5. Multi-user Transaction Processing

The database system has concurrency control mechanisms. These mechanisms ensure that the results of database access by multiple simultaneous users are always correct.

6. Data Independence

This characteristic allows any change in the layout of data without affecting all applications manipulating the database. It is possible because the structure of data files is stored in the DBMS catalog separately.

7. Minimal redundancy

Another characteristic of database system is the elimination of the unnecessary duplicate data.

Q2.(b) What is database? What are the objectives of database? Also discuss the advantages and disadvantages of database. **MDU BCA 2016**

Ans. Database

Database is a collection of related information that acts as a single centralized data bank for various data processing applications.

A database is a collection of interrelated data stored together with controlled redundancy to serve one or more applications in a best possible way. The data are stored in such a way that they are independent of the programs used by the people for accessing the data.

In other words, when the related information is placed in an organized form it makes a database. This organization is necessary, as unorganized information has no meaning. For example, telephone directory is organized information where the names are arranged in an alphabetic order.

A database may be generated and maintained manually or it may be computerized. For example, library card catalogue is a good example of this, which can be automated as well. In a manual system a database is stored on paper whereas in a computer based system it is stored on secondary storage devices.

Database has following features:

- ***Items of data occur only once, i.e., redundancy is eliminated.***
- ***The data is independent of any one program.***
- ***The data is usable by many users.***
- ***The data is related and well organized.***

- ***The data is accessible in different orders without great difficulty.***

Thus, a database is a well organized collection of data that are related in a meaningful way which can be accessed in different logical orders but are stored only once. The data in the database is therefore integrated, structured and shared.

Objectives of database

The database aims at handling organizational data as an integrated whole. A database is a general collection of interrelated data stored with minimum redundancy and used by a variety of users. The general objective of database is to make data access easy, quick, inexpensive and flexible for the users. Thus, following are the objectives of database:

1. Minimization of redundant data
2. Data independence
3. Consistency
4. Sharing of Data
5. Flexibility
6. To restrict unauthorized access
7. Accuracy
8. Recovery from failure
9. Privacy and Security
10. To enforce integrity

1. Minimization of redundant data

Data redundancy is the duplication of same data at more than one storage place. Redundant data often causes system to give conflicting information, as versions of the same data are in different phases of updating. This redundancy has to be eliminated by integrating the data

at one place. This will control redundancy and improve system performance.

2. Data independence

One of the prime objectives of database is to eliminate the need to rewrite application programs in case hardware or storage procedures are altered or new data is added. The database should adapt to the new setup without rewriting programs.

3. Consistency

Data duplication creates multiple levels of updation. At some occasions, updation of duplicated data entries may supply incorrect or conflicting information. At such times, the database is said to be inconsistent. In other words, inconsistency means when we query for the same data, that is placed on two different places and updation is done at only one place, then result will not same. Consistency of data has to be achieved through redundancy control.

4. Sharing of Data

This means various users can use the same data in the database. Moreover new applications can be developed according to the needs to operate against the same stored data. Hence the objective of database is to satisfy the data requirement of various new applications without the need of having separate data for each application.

5. Flexibility

Another objective of database should be flexible enough. This is needed to meet the future specifications. In future, requirements can be changed so database should be able to adapt them. Thus, it should make the application developments cheaper, faster and flexible.

6. To restrict unauthorized access

Data in database must be secured. Hence an important objective of database is to restrict unauthorized access. To assure this database system must provide:

- *Identification of users of the database before they can use the database.*
- *Monitoring user's actions so that if they do something wrong they are likely to be found.*
- *All contents should be proper and not easy to crack.*

7. Accuracy

The accuracy of a database ensures that the quality and content of data remains constant. Integrity procedure detects and controls data inaccuracies as they take place.

8. Recovery from failure

As many users have an access to a database, the system must recover quickly in case of failure and that too with no loss of transaction data. This objective also facilitates data accuracy and integrity.

9. Privacy and Security

Privacy means when, how and to what extent data should be given to users. Data bases are costly products and hence their security is very important. Security of data is needed from accidental as well as intentional disclosures. Thus to achieve privacy and security is also an objective of database.

10. To enforce integrity

Integrity is data accuracy. It also implies that incorrect information cannot be stored in the database. In order to achieve the objective of integrity, some integrity constraints are enforced on the database.

Advantages of database

A database is a collection of interrelated data of a organization or enterprise. It is a way to consolidate and control the operational data centrally. The advantages of having a centralized control of data are:

1. Redundancy can be reduced
2. Inconsistency can be avoided
3. Data can be shared
4. Security can be enforced
5. Integrity can be maintained
6. Standards can be enforced
7. Faster development of new application

1. Redundancy can be reduced

Data redundancy is the duplication of same data at more than one storage place. By having a centralized database most of this can be avoided.

2. Inconsistency can be avoided

Data duplication may leads to inconsistency. If a fact is stored at two locations, then it is possible that user may forget to update other location. Hence at an instance of time, system returns two values. So, if the redundancy is removed, chances of having inconsistent data are also removed.

3. Data can be shared

This means various users can use the same data in the database. Moreover new applications can be developed according to the needs to operate against the same stored data.

4. Security can be enforced

Security of data is needed from accidental as well as intentional disclosures. DBA can define the access paths for accessing the data stored in database and he can define authorization checks whenever access to sensitive data is attempted.

5. Integrity can be maintained

Integrity means that the data in the database is accurate. It also implies that incorrect information cannot be stored in the database. Centralized control of the data helps in permitting the administrator to define some integrity constraints to the data in the database.

6. Standards can be enforced

With central control of the database, the DBA can ensure that all applicable standards are observed in the representation of the data.

7. Faster development of new application

When a new application is proposed, it is likely that the data required for it is already stored in the database. Thus, development time is reduced for the new application.

Disadvantages of database

The disadvantages of having a centralized control of data are:

1. Problems associated with centralization
2. Complexity of backup and recovery
3. Privacy and security
4. Enterprise Vulnerability
5. Database damage
6. Complexity increases

1. Problems associated with centralization

Centralization of data in database increases the security problem and disruption of operations of the organization because of the down times and failures.

2. Complexity of backup and recovery

Due to centralization of data in database, there is no duplication of data. It means data must be adequately backed up so that in case of failure data can be recovered.

3. Privacy and security

As data in database is centralized and is made available to users from remote locations, the possibilities of misuse are often more than in a conventional data processing system.

4. Enterprise Vulnerability

Centralized all data of an enterprise in one database means that the database becomes an indispensable resource. The survival of the enterprise may depend on reliable information being available from its database. The enterprise therefore becomes vulnerable to the destruction or to unauthorized modification of database.

5. Database damage

All data is integrated in a single database. If database is damaged due to database corruption or electric failure, valuable data is lost forever.

6. Complexity increases

The data structure may become more complex because of the centralized database supporting many applications in an organization. This may lead to difficulties in its management.

Q2.(c) What is data base system? Discuss the main objectives of any data base system also.

Ans. Data base system

It is a computer based record keeping system. It is a system that records and maintains large amount of information.

For example, a college keeps all the information of the students through a database system.

Thus, the main purpose of database system is to store complete information and help in retrieving it whenever required. It uses an integrated approach that all data is stored at one place. It is shared by all. Any user can query the data as per his requirement.

Main objectives of any data base system

The main objectives of data base system are:

1. Minimization of redundancy
2. Consistency
3. Sharing of Data
4. Simplicity
5. Flexibility
6. Data migration
7. To restrict unauthorized access
8. Privacy and Security
9. Maintaining standards
10. To enforce integrity

1. Minimization of redundancy

Data redundancy is the duplication of same data at more than one storage place. The duplication of data leads to

wastage of storage space and time and affects cost also. This redundancy has to be eliminated by integrating the data at one place. Thus, the main objective of database system is to keep the redundancy as low as possible i.e. duplication of data must be avoided.

2. Consistency

Data duplication creates multiple levels of updation. At some occasions, updation of duplicated data entries may supply incorrect or conflicting information. At such times, the database is said to be inconsistent. In other words, inconsistency means when we query for the same data, that is placed on two different places and updation is done at only one place, then result will not same. Consistency of data has to be achieved through redundancy control.

3. Sharing of Data

This means various users can use the same data in the database. Moreover new applications can be developed according to the needs to operate against the same stored data. Hence the objective of data base system is to satisfy the data requirement of various new applications without the need of having separate data for each application.

4. Simplicity

Another objective of data base system is to make application development procedure simple and easier. For this purpose, pointers should be avoided because they create complexity.

5. Flexibility

Another objective of data base system should be flexible enough. This is needed to meet the future specifications.

In future, requirements can be changed so data base system should be able to adapt them. Thus, it should make the application developments cheaper, faster and flexible.

6. Data migration

Data migration is a process of transferring the data from one hardware or software to other.

All data are not referenced very frequently. Thus the rarely accessed data can be stored on slower access or on cheap devices. Whereas more frequently accessed data can be stored on fast access or direct access media devices. Thus data migration implies the adjustment of data on costly or cheap media devices. This objective is important to make the database economical.

7. To restrict unauthorized access

Data in database must be secured. Hence an important objective of database system is to restrict unauthorized access. To assure this data base system must provide:

- ***Identification of users of the database before they can use the database.***
- ***Monitoring user's actions so that if they do something wrong they are likely to be found.***
- ***All contents should be proper and not easy to crack.***

8. Privacy and Security

Privacy means when, how and to what extent data should be given to users. Data bases are costly products and hence their security is very important. Security of data is needed from accidental as well as intentional disclosures. Thus to achieve privacy and security is also an objective of data base system.

9. Maintaining standards

All applicable standards should be followed in representation of data such as format, conventions data names, documentation etc. The standardized dat very helpful during migration or interchanging of da This will result in uniformity of the entire database well as its usage.

10. To enforce integrity

Integrity is data accuracy. It also implies that incorr information cannot be stored in the database. In order achieve the objective of integrity, some integr constraints are enforced on the database. A data ba system should have the capabilities for defining a imposing consistency constraints.

Q3.(a) How database approach differs from traditional file system? **MDU BCA 2018**

OR

Explain the difference between database approach and traditional file based system. **IGU BCA 2018**

OR

Differentiate between file system and database system.

Ans. Following are the differences between file system and database system:

File System	Database System
1. Redundant data Redundant data is the duplication of same data at more than one storage place. Since all the files are designed and developed independently, same fields are stored in more than one file.	**1. Redundancy control** Being the central control over data, DBMS removes duplication of data. Thus DBMS controls redundancy by ensuring that the data are not repeated many times.
2. No security Security restrictions can not be applied on the data.	**2. Rigorous security** As data is stored in a common place, thus, DBMS assures a sound security system.
3. Simple structure It has simple structure.	**3. Complex structure** It has complex structure.

File System	Database System
4. Often single user It has often single user.	**4. Multiple users** It has multiple users.
5. Isolated data Data is separated and scattered at various locations. It may be in different formats. To make a decision, the programmer may need different files. Thus, to extract data from different files and their coordinating is a different process.	**5. Data can be shared** Various users can use the same data in the database. Data can be shared not only be existing applications but new applications can also be developed to use the same stored data. Thus, this means that data requirements of various new applications may also be satisfied without creating new files.
6. Relatively cheap File management systems are relatively cheap as compared to database systems.	**6. Relatively expensive** Database systems are expensive. The cost can be of two types: (i) Software cost which includes purchase of DBMS and development of DBMS. (ii) Hardware cost includes upgradation needed to allow the extra overheads put up by DBMS.

File System	Database System
7. Small systems File management systems are small systems.	**7. Large systems** Database management systems are large systems.
8. Distributed control It has distributed control	**8. Central Control** It has central control.
9. Simple backup & recovery There are simple procedures for backup and recovery process.	**9. Complex backup & recovery** Data recovery in case of hardware or software failure is difficult due to the complexity of the database system.
10. No search capability There is no search capability in file system to give response to user queries.	**10. Search capability** There is search capability in database system to give response to user queries.
11. Chances of inconsistent output In file processing system inconsistent output is often produced.	**11. Consistent output** In database system consistent output is produced.

Q3.(b) What is File Processing System? What are its disadvantages? **MDU BCA 2021**

OR

What is file-processing system? What are the disadvantages of a file-processing system over database system? **MDU BCA 2015**

OR

What do you mean by traditional file based system? What are the limitations of the File Processing System / File-Based Approach?

Ans. File-processing / Traditional file based system

File processing was an early attempt to computerize the manual system. A file system is a method for storing and organizing computer files and the data they contain to make it easy to find and access them.

A file processing system stores groups of records in separate files. These files are designed and developed to meet independent applications. Each user designs file systems and data structures according to one's own applications.

Thus file processing system consists of:

- *Permanent data files which store data.*
- *Application programs for retrieval of data*

In early processing systems, an organization's information was stored as groups of records in separate files.

Some important characteristics of file processing system are:

- *It is a group of files storing data of an organization.*
- *Each file is independent fro*

- *Files are designed by using programs written in programming languages such as COBOL, C etc.*
- *Each file contains and processes information for one specific function such as accounting or inventory.*

As systems became more complex, file processing systems offered little flexibility, presented many limitations and were difficult to maintain. So they are not suitable for complex systems.

Disadvantages/Limitations of file processing system

File processing system has great improvement over manual systems yet it has the following limitations over database system:

1. Data isolation
2. Wastage of storage space
3. Duplicated data
4. Problem of data integrity
5. Difficulty in accessing data
6. Inconsistent output
7. Program/Data dependency
8. Security problem

1. Data isolation

Data is scattered at various locations & may be in different formats. To make a decision, the programmer may need different files. To extract data from different files and their co-ordination is a difficult process. The programmer has to determine the data required from different files and then to write a program to access and process the data required.

2. Wastage of storage space

Duplication of data causes wastage of storage space.

3. Duplicated data

Since all the files are designed and develope independently, same fields are stored in more than on file.

Duplication of data is not good because it causes:

- *Wastage of time and money to enter the data more than once.*
- *Requirement for additional storage space to store the duplicate data.*
- *Inconsistency of results.*
- *Multiple level of updation.*

4. Problem of data integrity

Data integrity is data accuracy and completeness. Data has integrity if duplicated data items agree with one another.

In file processing system, same data is found in different forms in different files. When data validation is implemented, it results data in one file correct and same data in another file as wrong. Thus in a file processing system poor data integrity often develops.

5. Difficulty in accessing data

Since there is no indexing & no relations established in file processing system, accessing data based on a query is difficult.

6. Inconsistent output

In a file processing system inconsistent output is often produced. For example, if a data item is to be changed, it must be changed in all the files containing that data. Problem always lies in the risk that all the files are not updated and thus the results produced are not consistent.

7. Program/Data dependency

In a file processing system, the records in the files are kept in specific physical formats. These physical formats are coded into the application program. Change in the format of a certain record requires a change in the code in each file containing that format. If the data field is to be added to a master file, all programs that access this master file, required to be changed.

8. Security problem

As same data is available in different files, sometimes it becomes difficult to relate them and implement uniform policies in an organization. Thus, due to lack of central control over data, security standards cannot be enforced.

Q4.(a) What is DBMS? What are the main/common facilities that every DBMS should provide? Explain. **MDU BCA 2021**

OR

Discuss the capabilities that should be provided by a DBMS. **MDU BCA 2017**

Ans. DBMS

Database management system (DBMS) is a software that enables users to interact with the database. It enables users to store, modify and extract information from a database as per the requirements.

It is an intermediate layer between user programs and the data. User programs access the DBMS which then accesses the data. It controls the creation, maintenance and utilization of the databases of an organization.

Thus a DBMS is a collection of

- *Database which acts as a single centralized databank for various data processing applications.*
- *Programs for the management of database.*

Facilities provided by DBMS

DBMS should provide following capabilities/facilities:

1. Minimal Redundancy
2. Flexibility
3. Sharing of Data
4. Multiple User Interface
5. Consistency
6. Restrict Unauthorized Access
7. Privacy and Security

8. Simplicity
9. Enforce Integrity

1. Minimal Redundancy

Data redundancy is the duplication of same data at more than one storage place. This duplication of data leads to wastage of storage space & time and affects cost also. This redundancy has to be eliminated by integrating the data at one place and DBMS should facilitate this.

2. Flexibility

DBMS should allow changes to the structure of the database without affecting the stored data and the existing application. It should make the application developments cheaper, faster and flexible.

3. Sharing of Data

DBMS should allow the sharing of data. This means various users can use the same data in the database. Moreover new applications can be developed according to the needs to operate against the same stored data. Hence DBMS should satisfy the data requirement of various new applications without the need of having separate data for each application.

4. Multiple User Interface

In order to allow different users to access the database DBMS should provide:

- *Query languages for casual users such as SQL or QBE to access the database.*
- *Programming language interfaces for application programmers and*
- *Menu-driven interfaces for stand-alone users.*

5. Consistency

Data duplication creates multiple levels of updation. At some occasions, updation of duplicated data entries may supply incorrect or conflicting information. At such times, the database is said to be inconsistent. DBMS should provide consistency of data through redundancy control.

6. Restrict Unauthorized Access

Data in database must be secured. Hence database system should restrict unauthorized access. To assure this DBMS must provide:

- *Identification of users of the database before they can use the database.*
- *Monitoring user's actions so that if they do something wrong they are likely to be found.*
- *All contents should be proper and not easy to crack.*

7. Privacy and Security

Privacy means when, how and to what extent data should be given to users. Databases are costly products and hence their security is very important. Security of data is needed from accidental as well as intentional disclosures. DBMS should provide such privacy and security.

8. Simplicity

Another facility that DBMS should provide is to make application development procedure simple and easier. To achieve this DBMS should be accompanied with powerful query manipulation and report generation tools.

9. Enforce Integrity

Integrity is data accuracy. It also implies that incorrect information cannot be stored in the database. In order to achieve the objective of integrity, some integrity constraints are enforced on the database. DBMS should provide integrity by defining and imposing consistency constraints.

Q4.(b) What do you mean by DBMS? Also discuss the advantages and disadvantages of DBMS.

MDU BCA 2018

Ans. Database Management System

Database management system (DBMS) is a software that enables users to interact with the database. It enables users to store, modify and extract information from a database as per the requirements.

It is an intermediate layer between user programs and the data. User programs access the DBMS which then accesses the data. It controls the creation, maintenance and utilization of the databases of an organization.

Thus a DBMS is a collection of

- ***Database which acts as a single centralized databank for various data processing applications.***
- ***Programs for the management of database.***

Advantages of DBMS

The advantages of using a DBMS are:

1. Redundancy Control
2. Access Control
3. Provides multiple User Interfaces
4. Easy and Fast access of data
5. Simplicity
6. Sharing of data
7. Reducing application development time
8. Persistent storage of data
9. Backup and Recovery

10. Flexible
11. Reduced programming and Maintenance Cost
12. Integrity, Security and Privacy
13. Data Independence

1. Redundancy Control

Data redundancy is the duplication of same data at more than one storage place. Data redundancy has the following disadvantages:

- ***Wastage of storage space.***
- ***Wastage of time to enter the data more than once.***
- ***Cost of generating data when same data already exists.***
- ***Inconsistency of results.***
- ***Multiple level of updation.***

DBMS controls redundancy by ensuring that the data are not repeated many times. DBMS as a central control over data removes:

- ***Duplication of data.***
- ***Saving of storage space and***
- ***Inconsistency of the data***

2. Access Control

As multiple users share a database, it is likely that some users will not be authorized to access all information in the database. Only authorized user make changes in the existing database, whereas other user category is allowed only to retrieve the database. Database Administrator (DBA) uses security and authorization subsystem in order to specify access restrictions. It

provides a security and authorization system for each class of user. Users are given account numbers and passwords to gain access to the database.

Thus DBA has full control on users, which are using the database. This feature of DBMS guards the database from any misuse or destruction.

3. Provides multiple User Interfaces

DBMS offers a multiple level of interfaces to enable users to access the database. These include:

- ***Query languages for casual users such as SQL or QBE to access the database.***
- ***Programming language interfaces for application programmers and***
- ***Menu-driven interfaces for stand-alone users.***

Thus various Menu driven interfaces, graphical interfaces and natural language interfaces are provided with DBMS for end user access.

4. Easy and Fast access of data

DBMS provides methods, which are flexible enough to retrieve the data. But in a file processing system, any request to access the data cannot be done until the programmer has written its application program. Thus DBMS allows a more responsive data access system.

5. Simplicity

DBMS are accompanied by powerful query manipulation and report generation tools. The availability of many 4GLs hides the various data storage complexities. Thus DBMS provides access and manipulation operations that are simple and easy to use.

6. Sharing of data

This means various users can use the same data in the database. Moreover new applications can be developed according to the needs to operate against the same stored data i.e. data requirement of various new applications are satisfied without the need of having separate data for each application.

7. Reducing application development time

Designing and implementing a new database may take more time. Once the database is set up and running, then developing any new application using DBMS requires lesser time nearly $1/6^{th}$ time of the file processing system.

8. Persistent storage of data

The data stored in the database survives after the termination of program execution. Thus the data in the database remains even after it has been used by many users many times. Hence the users need not spend time to enter data every time they need to use the database.

9. Backup and Recovery

Hardware failures and various types of accidents occur occasionally. DBMS provides facilities for recovering from such failures. For example, suppose a computer system fails during a update program, the DBMS is responsible to make sure that the database is restored to a form as it was earlier when the program started executing.

Thus DBMS:

- ***Provides the facility of recovery by maintaining its regular backup.***

- *Ensures that program may be resumed from the point at which it was interrupted.*

10. Flexible

DBMS allows changes to the structure of the database without affecting the stored data and the existing application.

11. Reduced programming and Maintenance Cost

The development time in DBMS is reduced since it has powerful easy-to-use interfaces as compared to file processing system. Logical data independence and catalog features of DBMS keep the maintenance efforts very much under control. Moreover, a user need not write programs for activities such as: querying database, report generation, addition or deletion of data etc.

12. Integrity, Security and Privacy

Integrity is data accuracy. It also implies that incorrect information cannot be stored in the database. In a database system, better data integrity is obtained by imposing consistency constraints on the database. As data is stored in a common place, all data cannot be placed for public domain. Thus DBMS assures a sound security system. Data access is provided at file level, record level and field level. Access like read only, read and write only etc. are provided for authorized persons/users.

For example:

1. The database of a college till graduation will have the data for BA, BSc, BCA, Bcom classes only. If a user enters the data for MSc/MCA class then this incorrect/invalid data entry must not be stored in the

database. To enforce this integrity constraints are imposed easily on the database instead of file system where these constraints are imposed on all the applications separately.

2. A student database has the information regarding marks obtained in an examination. A student cannot obtain marks more than100 – the maximum marks in one subject. Integrity constraints can be specified so that database will accept marks only in the range of 0 to 100 per subject.

DBMS assures privacy and security for data by providing:

- ***Identification of users of the database before they can use the database.***
- ***Reconstruction facility for damaged data.***
- ***Monitoring user's actions so that if they do something wrong they are likely to be found.***
- ***Auditing subsystems.***
- ***Tamperproof and authorization subsystems.***

13. Data Independence

DBMS allows any change in the layout of data without affecting all applications manipulating the database. Some common approach is used to store, retrieve and manipulate data in database.

Disadvantages of DBMS

Disadvantages of database system are:

1. Expensive
2. Complex
3. Higher Programming Cost
4. Integration

5. Recovery difficult
6. High Conversion Cost
7. Slow processing in some applications

1. Expensive

Cost is the main disadvantage of DBMS. The cost can be of two types:

- ***Software cost which includes purchase of DBMS and development of DBMS.***
- ***Hardware cost includes upgradation needed to allow the extra overheads put up by DBMS.***

2. Complex

Database processing tends to be complex due to complex structure. To handle a large amount of data, sophisticated programming is needed.

3. Higher Programming Cost

Due to complex structure, it requires experienced programmers with complete knowledge. The cost of hiring of system analyst, database designers, database administrators, data processing personnels and cost of training will also be considered. Thus the programming cost is high.

4. Integration

The centralization of resources increases the vulnerability of the system. A failure in any component of the integrated system can stop the complete system. This situation is very critical.

5. Recovery difficult

Data recovery in case of hardware or software failure is difficult due to the complexity of the database system.

To determine the exact state at the time of failure is a great problem. Allowing users to update database concurrently further complicates the recovery process.

6. High Conversion Cost

To convert the files into database system, data is removed from files and loaded into the database.To take full advantages of the database system, the various persons like database designers, developers, database administrators and the users must understand the functionality of the system. Failure to understand the system can affect the progress of an organization.

Conversion cost also includes the cost of training staff to use the new system. Conversion process is expensive and time consuming. Thus, this cost also becomes a factor why some organizations cannot switch over to latest database technology.

7. Slow processing in some applications

Due to integrated database, many applications' processing may be slow. For example, a file based system for invoicing application shows better performance than a DBMS which is written for many applications rather than just one.

Q4.(c) What is DBMS? Explain DBMS functions with suitable examples. **MDU BCA 2014**

Ans. ***Database management system (DBMS) is a software that enables users to interact with the database. It enables users to store, modify and extract information from a database as per the requirements.***

It is an intermediate layer between user programs and the data. User programs access the DBMS which then accesses the data. It controls the creation, maintenance and utilization of the databases of an organization.

Thus a DBMS is a collection of

- ***Database which acts as a single centralized databank for various data processing applications.***
- ***Programs for the management of database.***

Example: A University Management System has records of employees. The DBMS adds newly appointed employees, deletes records when an employee has left the University or accesses each employee record once every month to compute the salary. Query such as "How many employees have salary greater than 15000", the DBMS processes the query and reports accordingly on the VDU or on a printer.

There are different types of DBMS available in the market. Popular used DBMS are dbase, foxpro and oracle.

To sum up, DBMS is a set of programs designed to:

- ***Set up storage structures.***
- ***Load the data.***

- *Accept data requests from programs or users in a form the program or user expects.*
- *Hide data from an unauthorized access.*
- *Allow concurrent use of data without requiring user's interference.*
- *Perform backup and recovery automatically.*

Functions of DBMS

The various functions performed by DBMS are:

1. Database Creation
2. Database Maintenance
3. Database processing
4. Redundancy Control
5. Access Control
6. Provides multiple User Interfaces
7. Backup and Recovery
8. Reducing application development time
9. Easy and Fast access of data
10. Integrity, Security and Privacy

1. Database Creation

The DBMS helps the users by providing methods and procedures to specify the data, their types and conditions for the data to be stored in the database. It organizes the data and creates the necessary database.

2. Database Maintenance

Various database maintenance tasks like addition, deletion and updation of data are performed by the

DBMS. It provides the required processes for storing the data itself on the storage media.

3. Database processing

DBMS provides rich set of processes and functions to retrieve the necessary information from the database.

4. Redundancy Control

Data redundancy is the duplication of same data at more than one storage place. Data redundancy has the following disadvantages:

- *Wastage of storage space.*
- *Wastage of time to enter the data more than once.*
- *Cost of generating data when same data already exists.*
- *Inconsistency of results.*
- *Multiple level of updation.*

DBMS controls redundancy by ensuring that the data are not repeated many times. DBMS as a central control over data removes:

- *Duplication of data.*
- *Saving of storage space and*
- *Inconsistency of the data*

5. Access Control

As multiple users share a database, it is likely that some users will not be authorized to access all information in the database. Only authorized user make changes in the existing database, whereas other user category is allowed only to retrieve the database. Database

Administrator (DBA) uses security and authorization subsystem in order to specify access restrictions. He provides a security and authorization system for each class of user. Users are given account numbers and passwords to gain access to the database. Thus DBA has full control on users, which are using the database. This feature of DBMS guards the database from any misuse or destruction.

6. Provides multiple User Interfaces

DBMS offers a multiple level of interfaces to enable users to access the database. These include:

- ***Query languages for casual users such as SQL or QBE to access the database.***
- ***Programming language interfaces for application programmers and***
- ***Menu-driven interfaces for stand-alone users.***

Thus various Menu driven interfaces, graphical interfaces and natural language interfaces are provided with DBMS for end user access.

7. Backup and Recovery

Hardware failures and various types of accidents occur occasionally. DBMS provides facilities for recovering from such failures. For example, suppose a computer system fails during a update program, the DBMS is responsible to make sure that the database is restored to a form as it was earlier when the program started executing. Thus DBMS:

- ***Provides the facility of recovery by maintaining its regular backup.***
- ***Ensures that program may be resumed from the point at which it was interrupted.***

8. Reducing application development time

Designing and implementing a new database may take more time. Once the database is set up and running, then developing any new application using DBMS requires lesser time nearly 1/6th time of the file processing system.

9. Easy and Fast access of data

DBMS provides methods, which are flexible enough to retrieve the data. But in a file processing system, any request to access the data cannot be done until the programmer has written its application program. Thus DBMS allows a more responsive data access system.

10. Integrity, Security and Privacy

Integrity is data accuracy. It also implies that incorrect information cannot be stored in the database. In a database system, better data integrity is obtained by imposing consistency constraints on the database. As data is stored in a common place, all data cannot be placed for public domain. Thus DBMS assures a sound security system. Data access is provided at file level, record level and field level. Access like read only, read and write only etc. are provided for authorized persons. For example, the database of a college till graduation will have the data for BA, BSc, BCA, Bcom classes only. If a user enters the data for MSc/MCA class then this incorrect/invalid data entry must not be stored in the database. To enforce this integrity constraints are imposed easily on the database instead of file system where these constraints are imposed on all the applications separately.

DBMS assures privacy and security for data by providing:

- *Identification of users of the database before they can use the database.*
- *Reconstruction facility for damaged data.*
- *Monitoring user's actions so that if they do something wrong they are likely to be found.*
- *Auditing subsystems.*
- *Tamperproof and authorization subsystems.*

Q5.(a) Explain the role of DBA.

MDU BCA 2022, 2016, 2015

OR

What are the responsibilities of a DBA?

Gurugram University BCA 2021

OR

Who is DBA? What are its various jobs and responsibilities? **MDU BCA 2021**

Ans. DBA

DBA is a person or group of persons who have central control over data and the programs comprising the database system.

DBA is one who has central control over DBMS. He has the central control on both data and programs to access those data.

DBA's job requires a high degree of technical expertise and the ability to understand management requirements. They are most familiar with the database and are responsible for:

- *Creating*
- *Manipulating and*
- *Authorizing access to the database.*

Main responsibilities of DBA are:

1. Schema definition
2. Deciding the information Contents of Database
3. Physically organize the data
4. Storage structure and access methods
5. Intermediator
6. Maintenance of database

7. Ensures the security of the system
8. Maintaining data dictionary
9. Ensuring safe modification of schema
10. Backup and recovery
11. Granting of authorization for data access
12. Ensuring Integrity
13. Works with database team
14. Provides support to users
15. Data implementation
16. Tuning the database

1. Schema Definition

The DBA specifies a database schema by writing a set of definitions.

2. Deciding the information Contents of Database

It is the duty of DBA to decide what type of information is held in the database. DBA has to identify:

- ***The entities of interest to the organization and***
- ***The information to be recorded about these entities.***

DBA writes the set of definitions using DDL (Data Definition Language) statements.

3. Physically organize the data

DBA decides how to physically organize the data. When any updations are done on data, DBA ensures that it is updated accurately.

4. Storage structure and access methods

The DBA creates appropriate storage structure and according to storage structure defines the access methods.

5. Intermediator

DBA acts as an intermediator between the end user and application programmer. Moreover, it is the responsibility of the DBA to provide support to the users, to ensure availability of the data required.

6. Maintenance of database

The main goal of DBA is to maintain the database. DBA maintains the data and programs. As requirements changes, DBA updates the database. He recognizes the database regularly.

7. Ensures the security of the system

DBA has to design and implement data security measure, to restrict unauthorized access. DBA must also ensure the integrity of the database.

8. Maintaining data dictionary

He maintains the data dictionary. The data dictionary is a database that contains "data about data".

9. Ensuring safe modification of schema

The DBA is responsible for any modification in schema. He ensures that the person working on one application is not allowed to change the data structure of others.

10. Backup and recovery

Incase of damage to any portion of the database it is necessary to repair it at the earliest. DBA must also decide a method for backup and also for its recovery if data has been lost.

11. Granting of authorization for data access

The DBA is also responsible for granting of different types of permission to the users of the database. DBA

decides which contents of database are available to users.

12. Ensuring Integrity

Ensuring that appropriate measures are taken to maintain the integrity of the database.

13. Works with database team

To make the best performance of database DBA works closely with developers and network administrator. They work as a team for designing, debugging and implementing the database.

14. Provide support to users

DBA is responsible to provide support to users. He provides the data that is required in easy, fast and efficient manner.

15. Data Implementation

DBA implements the database. He maintains the performance level of database, flexibility and reliability.

16. Tuning the database

The DBA is responsible for organizing the database to get the performance that is best for the organization. DBA rearranges database. This rearrangement gives better storage management.

Q5.(b) Discuss different languages used in DBMS for storage, manipulation and querying of data.

MDU BCA 2017

OR

What do you mean by database language? Explain.

MDU BCA 2015

Ans. DBMS languages

Database management system allows users to perform a number of operations on the database such as insert, delete and retrieve data without knowing about the physical representations of data. To help the users have these facilities, DBMS provides one or more specialized programming languages called Database or DBMS languages.

The DBMS provides the following database languages:

1. Data Definition Language

It is a language that allows the users to define data and their relationship to other types of data. It is mainly used to create files, databases, data dictionary and tables within databases.

Data Definition Language (DDL) is used by the DBA and database designers to specify the conceptual schema of a database. In many DBMS, the DDL is also used to define internal and external schemas (views). In some DBMS, separate Storage Definition Language (SDL) and View Definition Language (VDL) are used to define internal and external schemas.

Storage definition language (SDL):- SDL is used to specify the internal schema. The specified set of SDL statements specifies the storage structure and access methods used by the database system. The

implementation details of the database schemas which are generally hidden from the users are implemented by the specified SDL statements.

View Definition Language (VDL):- VDL is used to define the external schema. There are two views of data: the **logical view** as perceived by the programmer and **physical view** that is data stored on storage devices. VDL is used to specify user's views and their mappings to the conceptual schema.

2. Data Manipulation Language (DML)

It is a language that provides a set of operations to support the basic data manipulation operations on the data stored in the databases. It allows the users to insert, update, delete and retrieve data from the database.

The statement which is used to retrieve the information is called a query. The part of the DML used to retrieve the information is called a query language.

Types of DML

Procedural DML: It requires a user to specify what data are needed and how to get those data.

Declarative DML: It requires a user to specify what data are needed without specifying how to get those data. It is also referred to as non-procedural DML.

3. Data Control Language (DCL)

DCL is used to create user roles, grant permissions and control access to database by securing it. DCL statements control access to data and the database using statements like GRANT and REVOKE.

Q5.(c) What do you mean by Query Language? Distinguish between DDL, DML and DCL. Explain any two DDL & DML commands using suitable examples.

Gurugram University BCA 2021
MDU BCA 2016

Ans. Query Language

The DBMS provides data manipulation language (DML) that enables users to retrieve and manipulate the data. The statement that is used to retrieve the information is called a query. The part of the DML used to retrieve the information is called a query language.

Distinguish between DDL, DML and DCL

The database language which is used to define database objects; to drop database objects; to alter (change) database objects, such as tables, views, is known as Data Definition Language (DDL). Data Definition Language (DDL) is used by the DBA and database designers to specify the conceptual schema of a database.

The database language, which is used to insert data, manipulate data, delete data or retrieve data in tables or views, is known as Data Manipulation Language (DML). Thus, this is a language that provides a set of operations to support the basic data manipulation operations on the data stored in the databases.

The database language which is used to control data access is known as Data Control Language (DCL). DCL statements control access to data and the database using statements like GRANT and REVOKE.

DDL commands

DDL commands are: CREATE, ALTER, DROP, TRUNCATE, GRANT, REVOKE etc.

CREATE is the most commonly used DDL command. It may be used to create a database, a schema, a new table, a new index or a new view. To create an empty table student which stores student's data – Roll number, name and date of birth, the CREATE TABLE command is:

```
CREATE TABLE student
(roll_no number(5)
name char(20)
birth_date date);
```

ALTER command can be used to make the following changes to any table:

ADD - for adding new columns into the table.
MODIFY - for modifying the structure of columns
DROP - for removing a column in the table (8i)
RENAME - for renaming the column name (9i)

Syntax is:

ALTER TABLE <tablename> (ADD | MODIFY | DROP | RENAME] (column(s));

To add two new columns sex and fname to student table, the command is:

ALTER TABLE student ADD (sex VARCHAR(6), fname VARCHAR(20));

To change the datatype of column sex from varchar to char, the command is:

ALTER TABLE student MODIFY (sex CHAR(1));

DML commands

DML commands are: INSERT, UPDATE, DELETE, SELECT etc. To add data to tuples (or rows) of table student, the syntax used is:

INSERT INTO <table-name> (columns to insert) VALUES (values to insert)

Another most commonly used DML command is SELECT. It's syntax is:

```
SELECT <column_name>
FROM   <table_name>
```

or

```
SELECT <column_name>
FROM   <table_name>
WHERE  <condition>;
```

For example, consider the following table employee:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

(i) Selecting all columns

Query:- What data are in the employee table?

```
SQL > SELECT *
      FROM employee;
```

Once the above command is obeyed, the table will be:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

The asterisk (*) is used to select all columns in the table. This is very useful when the columns names are not known. Thus, a wild card (*) character indicates to view data from every column in the table.

(ii) Selecting a specific column

```
SQL > SELECT Name
      FROM employee;
```

Once the above command is obeyed, the table will be:

Name
RAJIV
MOHAN
RAVINDER
BALVINDER
RAJBIR
ASHU

(iii) Selecting multiple columns

```
SQL > SELECT Emp_no, Name, Design
      FROM employee;
```

Once the above command is obeyed, the table will be:

Emp_no	Name	Design
101	RAJIV	CLERK
102	MOHAN	SALESMAN
103	RAVINDER	MANAGER
105	BALVINDER	CLERK
106	RAJBIR	CLERK
108	ASHU	SALESMAN

(iv) Select from where

It is one of the most important clause available in SQL. By specifying a WHERE clause, specific rows can be chosen. When a WHERE clause is present, the database program goes through the entire table one row at a time and checks each row to determine if the condition is true with respect to that row.

```
SQL > SELECT  Name
        FROM  employee
          WHERE Basic = 6400 ;
```

Once the above command is obeyed, the table will be:

Name
MOHAN
ASHU

Q6.(a) Explain the various roles in database environment.

IGU BCA 2018

Ans. A database system refers to an organisation of components that define and regulate the collection, storage, management and use of data within a database environment.

A database is designed and built to serve a specific purpose as needed by a group of users. Roles are designed to ease the administration of the end user system. Each of the following has to perform specified set of roles or responsibilities:

1. Data Administrator

The data administrator or DA refers to a person or a group of persons who understand and manage the data items.

The Data Administrator is responsible for defining data elements, data names and their relationship with the database.

His basic role/responsibilities include:

- *To install and configure the RDBMS applications*
- *To know the requirements of the software application in terms of functions and assure the data integrity.*
- *To validate the data and files.*
- *To decide what data to be stored in database.*
- *To establish policies for data maintenance.*

Data Administrator is also known as data analyst.

2. Application developer or Application programmer

Applications developers translate software requirements into workable programming code and maintain and develop programs for use in business.

Their job titles and specific duties may vary in different organizations but the role mainly involves writing specifications and designing, building, testing and implementing applications using programming languages and development tools. In simple words, the main function of an application developer is to make computers perform specific tasks based on the client's specifications.

Application developer:

- ***Program new applications for regular running.***
- ***Test new applications and run into existing ones.***
- ***Restart the unsuccessful jobs.***

3. Database Designers

Database designers are the database architects.

- ***They develop strategies for design, modeling and implementation stages of the database lifecycle.***
- ***They often join with software architects and system analysts to understand and best address the particular needs of certain businesses or industries.***
- ***They draw the blueprints of a database which technicians and other specialists then use to put the technology together.***
- ***They also develop data models, metadata tables and related database structures for applications***

- ***They are responsible for designing persistent data storage, identifying the data to be stored, choosing the structure to represent and store this data.***

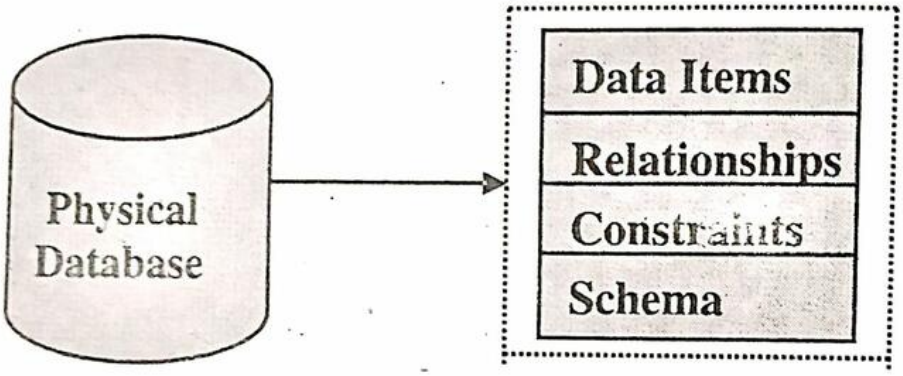
4. End Users

End users are the persons who interact with the applications. They insert, delete and update data in the database. They use the database through applications programs. They perform all operations by using commands provided in the user interface.

Q6.(b) Explain Components of Database.

Ans. A database has the following four components:

1. Data items
2. Relationships
3. Constraints
4. Schema



1. Data Items

Data items refer to a distinct piece of information.

2. Relationships

It represents a correspondence between various data elements.

3. Constraints

These are the predicates that define correct database states.

4. Schema

The overall design of the database is called schema. It describes the organization of data and relationships within the database. The schema consists of definitions of the various types of record in the database, the data

items they contain and the sets into which they are grouped.

The storage structure of the database is described by the storage schema. The conceptual schema defines the stored data structure. The external schema defines a view of the database for particular users.

Q6.(c) Explain the various functional components of DBMS with the help of suitable diagram.

MDU BCA 2018

OR

Components of DBMS **MDU BCA 2015**

Ans. Components / Elements of DBMS

DBMS is a complex software which provides interface for each category of the user. DBMS interprets user commands so that computer system can operate on that command to perform the desired task. The important components of DBMS are:

1. Data Definition Language (DDL) Compiler
2. Data Manager
3. File Manager
4. Disk Manager
5. Query Processor
6. Telecommunication system
7. Data files
8. Data Dictionary

1. Data Definition Language (DDL) Compiler

DDL is used by the database designers or application programmers to specify the contents and structure of the database. DDL compiler converts the data definition statements that are in the source form to object form.

2. Data Manager

Data manager is the central component of the DBMS. Data manager performs the following:

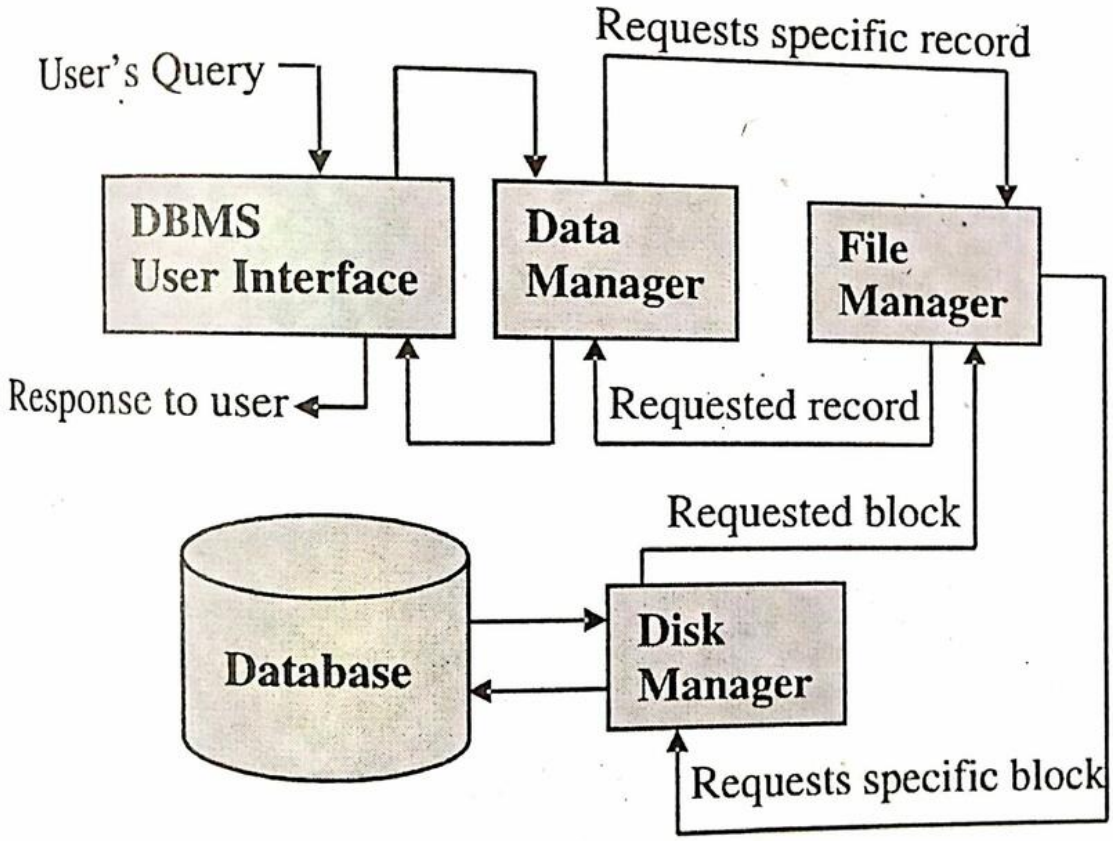
(a) *Maintains the backup and recovery operations.*

(b) *Converts the user queries from the user logical view to a physical file system.*

(c) *Maintains the data consistency, integrity and security.*

(d) *Organizes to provide the synchronization in the simultaneous operations performed by concurrent users.*

(e) *Interfaces with the file manager.*



3. File Manager

File manager:

- *Manages the allocation of file space on disk storage.*
- *Manages data structure to represent information stored on disk.*

- *Receives the request from the data manager for a specific physical record, locates the block containing the required record and then demands for block of data from the disk manager. After receiving the required block transmits the required record to the data manager.*

4. Disk Manager

Disk manager:

- *Performs all the physical input and output operations.*
- *Transfers the block requested by the file manager so that the file manager need not be aware of the physical characteristics of the storage media.*

5. Query Processor

Query processor is the component of the DBMS responsible for generating the best plan or strategy to process the query.

Query processor interprets the online user query and converts it into a series of efficient operations that are carried out one by one by the data manager for execution. The query processor has access to the following information stored in the data dictionary:

- *Number of tuples in the relation.*
- *Size of the record in bytes.*
- *Number of blocks used to store relation.*
- *Number of distinct values that appear in the relation.*

These statistics are used to estimate the cost of different access plans and thus help in selecting the best strategy to process the query.

6. Telecommunication system

Users remote or local, communicate with the computer system by sending and receiving message over communication line. These messages are routed by telecommunication system.

7. Data files

Data files store all the data portion of the database.

8. Data Dictionary

Data dictionary stores the information about the data in database. It contains the information about the entities, attributes, checks and validation. Data dictionary is an integral component of the DBMS and is used to control the database operations, data integrity and accuracy.

Q6.(d) Explain Components of DBMS environment.

Ans. DBMS environment has the following five major components:

1. Hardware
2. Software
3. Data
4. Database Users
5. Procedures

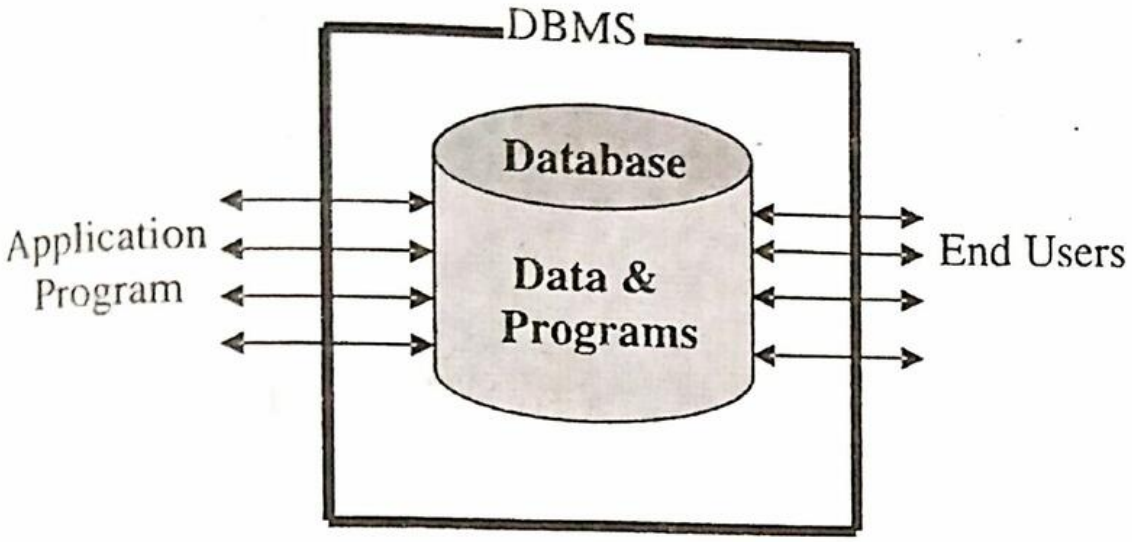
1. Hardware

The hardware is the actual computer system used for keeping and accessing the database. This can range from a single PC to a single mainframe or to a network of computers. Basic hardware components are:

- ***Hardware processor and main memory for the support of execution of the database system.***
- ***Magnetic discs, drums etc. on which the database physically resides.***
- ***On-line terminals for accessing and updating database files.***
- ***Database machines specifically designed to support a database system.***

2. Software

The software used for databases is known as DBMS. All requests made to database by users are handled by this software.



DBMS is a layer of software between the physical database and the users of the system. DBMS allows the users:

- ***To access the files.***
- ***Update the records.***
- ***Insert new records.***
- ***To access the data as per need.***

As the database is accessed by many users, Database management system:

- ***Controls the access of data.***
- ***Ensures data security.***
- ***Helps to maintain the consistency of the data.***

3. Data

The data acts as a bridge between the hardware and software components and the user components. It is the most important component of DBMS environment from the end user point of view. Data are the raw facts on which computer programs work upon. The feature of databases is to separate the data from the programs that

use the data. The database should contain all the data which is needed by the organization. The database contains both the operational data and the meta-data i.e. the 'data about data'.

4. Database Users

A human that interacts with a database is known as its user. Database users store new information into the database and retrieve information from the database. There are three different types of database users depending on the way that they expect to interact with the system. They are:

(a) Database administrators

(b) System analyst/Application programmers

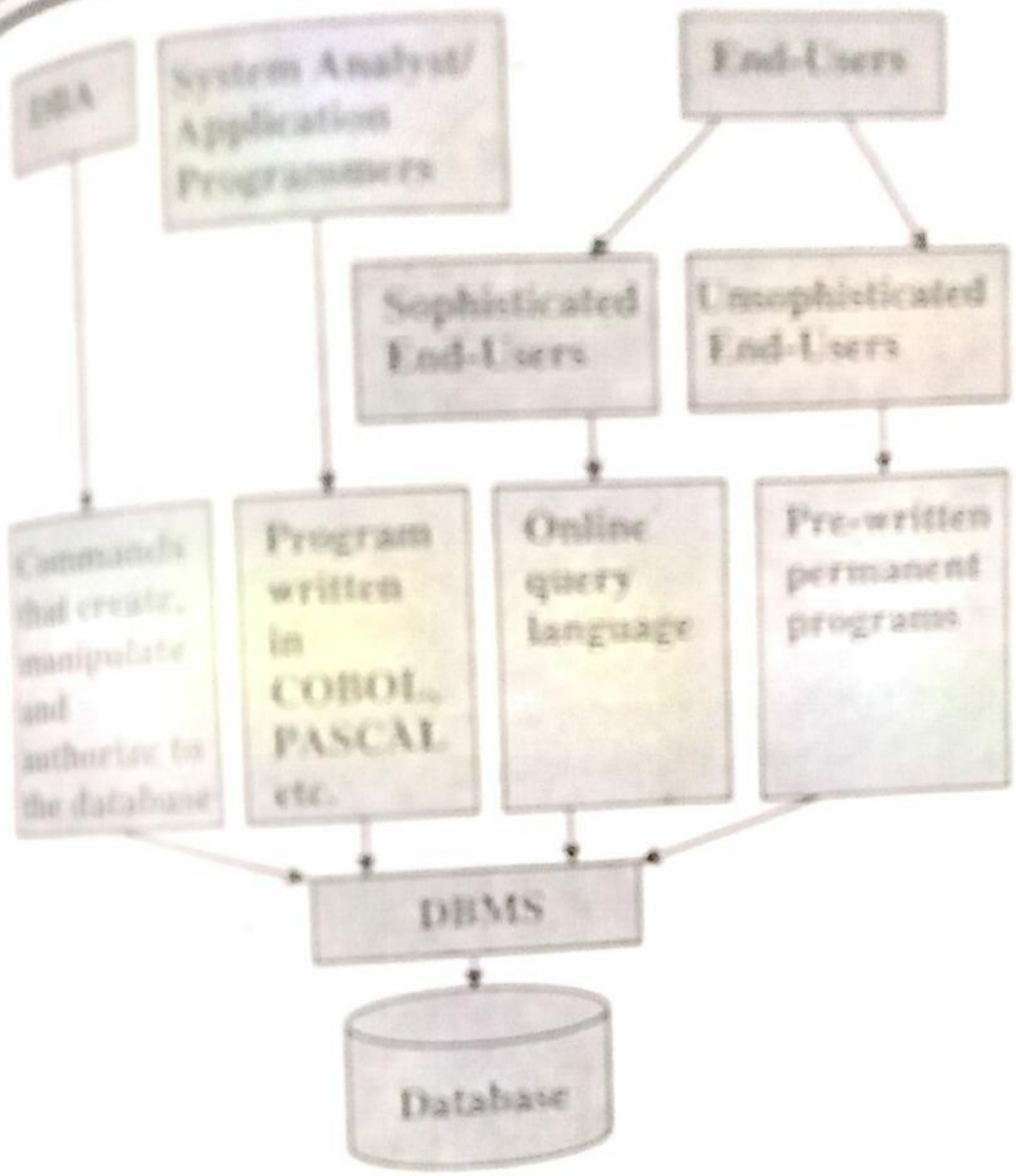
(c) End-users

(a) Database Administrators (DBA)

This user is responsible for the implementation, maintenance and authorizing access to the database. The jobs of DBA include:

- ***Monitoring the usage.***
- ***Co-ordination among users.***
- ***Security systems.***

Other users can access the database only after getting proper access permission from DBA. DBA has overall control of the database system. Sometimes a DBA is also called the Super-User.



(b) System analyst/Application programmers

System analyst determines the requirements of end users and designs the system by taking into account the database environment. Application programmers transform the design into source code of a language. System analyst consults with the DBA for designing the various data structure requirements of the applications. Analysts and programmers nowadays are called software engineers.

(c) End-Users

- **Sophisticated End-Users:** Sophisticated end-users are also engineers, analysts, designers, students etc. but they do not write a program. They access the data by using the query language.

- **Unsophisticated End-Users:** They are also called naïve users. These users need not be aware of the presence of database system or any other system supporting their usage. They neither write application programs nor they use query languages. They interact with the system through already written permanent programs to perform the functions of retrieval, deletion, creation and modification. They work through a menu driven application program that indicates the type and range of response to the users. They are bank terminal operators, information counter operators, reservation counter operators etc.

5. Procedures

The instructions and rules that govern the design and use of the database are referred to as procedures. This may include instructions on:

- ***How to log on to the DBMS.***
- ***Make backup copies of the database.***
- ***How to handle hardware or software failures.***
- ***Start and stop the DBMS.***
- ***Use a particular DBMS facility or application program.***
- ***Reorganize the database across multiple disks.***

Q7.(a) Explain the three-level architecture of DBMS.
MDU BCA 2022, 2016, 2015

OR

Explain three level architecture of database system with suitable diagram. IGU BCA 2018

OR

Discuss architecture of DBMS with an example.
MDU BCA 2014

OR

What do you mean by Database System Architecture? Explain in detail.

OR

Describe the architecture of a database system. Why a database is described to be an integrated one?

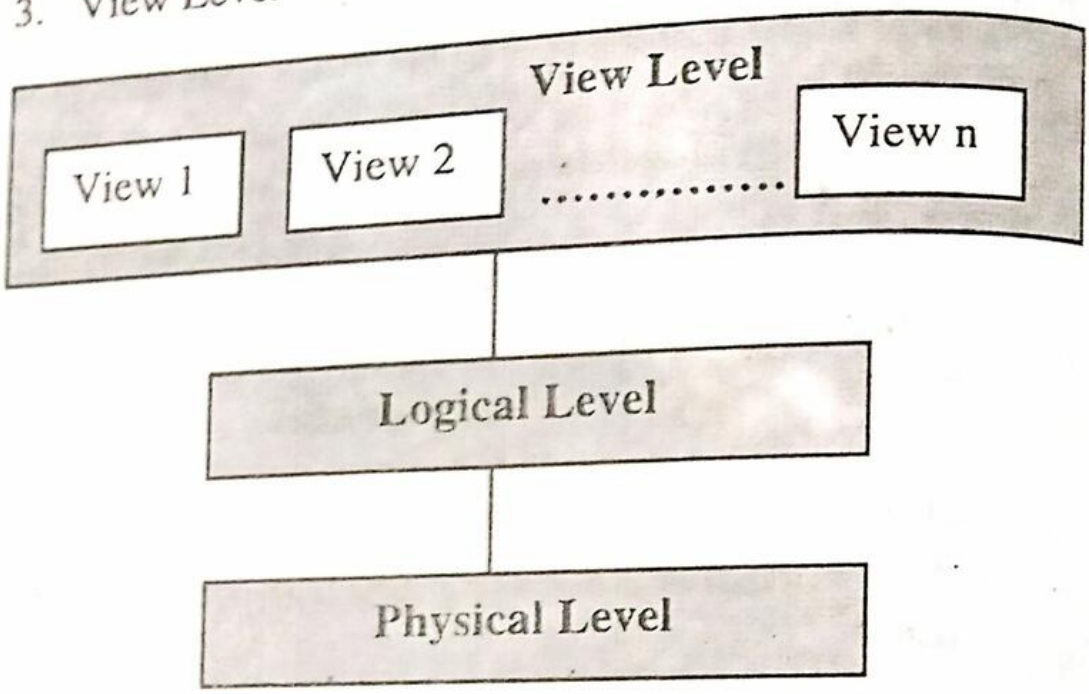
Ans. **Three-level architecture of a DBMS**

A DBMS provides three levels of data is said to follow three level architecture. The goal of the three-schema architecture is to separate the user applications and the physical database. The view at each of these levels is described by a schema. The processes of transforming requests and results between levels are called mappings.

Thus, database system provides its users with an abstract view of the data, i.e., the system hides certain details of how data are actually stored in the databases so that the user interaction with the database is independent of physical data organization. So the main objective of this three-level architecture is to separate each user's view of the database from the way the database is physically represented.

The three levels or layers of DBMS architecture are:

1. Physical Level
2. Logical Level
3. View Level



1. Physical Level

This is the lowest level close to hardware. This level is also known as internal level or storage level.

It describes the physical layout of the data on the storage devices i.e. it describes how data is actually stored on the storage devices.

Since it contains the details of how the data are actually stored, it hides minimum information. It includes:

- ***Data structure.***
- ***File organizations used to store data on storage devices.***
- ***Database Definition Tables.***
- ***Definition of Access paths to files containing the data of the database.***

It interfaces with the operating system access methods to place the data on the storage devices, build the indexes, and retrieve the data and so on.

The security of data is also defined at this level. This view is seen by the system programmer and the system designers.

2. Logical Level

The middle level in the three level architecture is the logical level. It is the next higher level of abstraction.

It is the overall design of the database. It is a complete view of the data requirements of the organization.

Logical level is also called conceptual level. It hides the details of physical storage structures. At the logical level, following are defined:

- ***All record types.***
- ***Relationship existing among these records.***
- ***The constraints on the data.***
- ***Security and integrity information.***

It describes what data is stored without taking physical storage details. For example, the description of an entity should contain only data types of attributes like integer, real, character; and their length like maximum number of digits or characters; but not any storage considerations like the number of bytes occupied. Thus, it describes:

- ***Entities***
- ***Data types***
- ***Relationships***
- ***Constraints***

This view is seen by database administrator (DBA) who decides what information is to be kept in the database.

3. View Level

This is the highest level close to user. View level is also known as external view.

It describes only that part of the database, which is actually needed by the user.

User Interface is placed at this level. This level deals with the way in which individual users view data. Individual users are given different views according to their requirements. A number of users of a database system are not concerned with all the information contained in the database. Instead, they need a part of database. So they will usually access a subset of total data. At view level, parts of the database are described. Thus, view level provides many views of the same database.

View level increases the security of the database. It does not allow the user to access the unnecessary parts of the data. For example, in an examination branch of the University, a clerk can access student information but not staff information. In addition different views may have different representations of the same data. For example, one user may view data in the form (day, month, year) while another may view date as (month, day, year).

Why a database is described to be an integrated one?

A database is desired to be an integrated one because of the following:

- ***To avoid duplicacy of data.***

- *To make database a shareable resource.*
- *The database is completely controlled by a software package called DBMS.*

For example, the three levels of architecture can be given as:

View level	

struct student
{
int roll;
char name[10];
}
	struct student
	{
	char name[10];
	int age;
	};

Logical Level	Student Rollno Numeric(3) Name Character(10) Age Numeric(2) Marks Numeric(3)
Physical Level	Student Length = 20 Roll Type = Byte(2), offset = 6 Name Type = Byte(10), offset = 9 Age Type = Byte(2), offset = 19 Marks Type = Byte(2), offset = 21

Q7.(b) What do you mean by Schema and Instance? Explain difference between external, conceptual and internal schemas.

Ans. Schema

The overall design of the database is called schema, which is specified during database design and changes very rarely.

Database system has several schemas corresponding to each level of abstraction. At the physical level one physical schema, at logical level one logical schema and at the view level, several sub-schemas. In general, database system supports:

- ***One physical / internal schema.***
- ***One logical / conceptual schema***
- ***Several subschema / external schema***

Internal schema: Internal schema is a complete description of the internal model, containing definition of stored records, the methods of representation, the data fields and the indexes used.

Conceptual schema: Conceptual schema describes all the entities, attributes and relationship together with integrity constraints.

External schema: External schema corresponds to different views of the data.

Instance

Data in the database is of dynamic nature. It keeps changing from time to time. The collection of data stored in the database at a particular moment of time is called the instance of a database. It is also called database state or snapshot.

Difference between external, conceptual and internal schemas:

External Schema	Conceptual Schema	Internal Schema
1.External schema describes the external view of three level architecture of DBMS.	1. Conceptual schema describes the conceptual view of three level architecture of DBMS.	1.Internal schema describes the internal view of three level architecture of DBMS.
2.The external schema defines a view or views of the database for particular users.	2. The conceptual schema defines the stored data structures in terms of the database model used.	2.The internal schema defines how and where data are organized in physical data storage.
3.It includes different views of data.	3. It describes all the entities, attributes and relationship together with integrity constraints.	3.It is a complete description of the internal model and contains definition of stored records.
4.It contains the method of describing the objects in the external view from the objects in the conceptual view.	4. It contains the method of deriving the objects in the conceptual view from the objects in the internal view.	4.It contains the method of representing the data fields and the indexes used.

Q8.(a) What is data independence? **MDU BCA 2022**

OR

What do you mean by data independence? Why it is important to maintain data independence in a database? **MDU BCA 2018**

OR

What is data independence and why is it important? **MDU BCA 2016**

OR

What do you mean by Data Independence? Also explain Logical and Physical data independence.

Ans. Data Independence

Data Independence is the capacity to change the schema at one level of a database system without having to change the schema at the next higher level of abstraction.

A major objective for three-level architecture is to provide data independence which means that upper levels are unaffected by changes in lower levels.

The two levels of data independence are:

1. Physical Data Independence
2. Logical Data Independence

1. Physical Data Independence

It is the capacity/capability to change the physical schema without having to change to logical schema.

Changes to internal schema may be needed because some physical files have to be reorganized. The change would be absorbed by the mapping between the logical and physical levels. Physical data independence is

achieved by the presence of the internal level of the database and the mapping or transformation from the conceptual level of the database to the internal level.

2. Logical Data Independence

It is the capacity to change the logical schema without having to change view level.

The conceptual schema may be changed to expand the database (by adding a record type or data item), to change constraints, or to reduce the database (by removing a record type or data item). Only the view definition and the mappings need be changed in a DBMS that supports logical data independence. Changes to constraints can be applied to the conceptual schema without affecting the external schemas or application programs.

Thus, changes at this level are necessary whenever logical structure is changed. The change would be absorbed by the mapping between the view and logical levels. Logical data independence is more difficult to obtain than physical data independence, as it requires the flexibility in the design of database.

Importance of data independence

Data independence is an important characteristic of DBMS as it allows changing the structure of the database without making any changes in the application programs that use the database. Thus, application programs do not depend on any particular physical representation or access technique of the database. Thus, it is important to maintain data independence in a database

Q8.(b) Differentiate between physical and logical data independence. **MDU BCA 2022, 2016, 2015**
Gurugram University BCA 2021

Ans. Following are the differences between physical and logical data independence:

Physical data independence	Logical data independence
1. It is the capacity or capability to change the physical schema without having to change to logical schema.	1. It is the capacity to change the logical schema without having to change view level.
2. The change would be absorbed by the mapping between the logical and physical levels.	2. The change would be absorbed by the mapping between the view and logical levels.
3. It is not so complex.	3. It is complex.
4. It can change internal schema without changing conceptual schema.	4. It can change conceptual schema without having to change external schema.
5. Modifications in physical level occur occasionally whenevereas there is a need to improve performance.	5. Modifications in logical level occur frequently more than that in physical level, whenever there is an alteration in the logical structure of the database.

Q8.(c) What is mapping? Also explain Conceptual / Internal mapping and External / Conceptual mapping.

OR

What types of mapping are used in database systems?

Ans. Mapping

Mapping is the process of transforming requests and results between any of the two levels of logical architecture of a DBMS.

Programs refer to an external schema and are mapped by the DBMS to the internal schema for execution. Data extracted from the internal DBMS level is reformatted to match the user's external view.

Types of mapping

Two types of mapping are used in database system with three different views:

1. Conceptual / Internal mapping
2. External / Conceptual mapping

1. Conceptual / Internal mapping

It exists between conceptual level and internal level. It defines the correspondence between the records and the fields of the conceptual view and the files and data structures of the internal view.

It specifies the method of deriving the conceptual record from the physical database. Many differences may exist between the conceptual and internal views. These differences can be:

- *Representation of numeric values could be different in the two views. One view could consider a field to be numeric and the other could consider it as binary.*
- *Representation of string data can be considered by the two views to be coded differently. One can perceive string data to be in ASCII code and the other can consider it to be in EBCDIC code.*
- *The value for a field in one view could be computed from the values in one or more fields of the other view.*

These differences are indicated and resolved in the mapping.

Thus, to make the conceptual view stable, when the structure of the stored database is changed, the conceptual / internal mapping is also changed accordingly. So, conceptual /internal mapping provides physical data independence for the database.

2. External / Conceptual mapping

It exists between the external level and the conceptual level. It gives correspondence among the records and the relationships of the external and conceptual views.

An external/conceptual mapping defines a particular external view and conceptual view correspondence. It describes the contents of the database as perceived by the user or application program of that view.

The external view is an abstraction of the conceptual view, which in its turn is an abstraction of the internal view.

To make the external level stable, when the structure of the database is modified, the external / conceptual mapping also changes accordingly.

Q9.(a) What are the different ways of classifying a DBMS? Explain in detail.

MDU BCA 2021, 2017

OR

How DBMS can be classified into different categories on the basis of different criteria? Explain.

Ans. Classification of DBMSs

The DBMS can be classified into different categories on the basis of several criteria such as the data model they are using, number of users they support, number of sites over which the database is distributed and the purpose they serve.

1. Based on Data Models

Depending on the data model the DBMSs use, the DBMSs can be categorized as hierarchical, network, relational and object-oriented etc. The most popular data model in use today is the relational data model. Well known DBMSs like Oracle, MS SQL Server, DB2, MySQL support this model. Many current commercial DBMSs are based on relational data model.

Other traditional models are hierarchical data model, or network data model. Some of the old applications still run on the database systems based on these models.

In the recent years, the object-oriented data models have come up though these models do not have widespread use. Some examples of Object-oriented DBMSs are O2, ObjectStore or Jasmine. The relational databases being the most popular, the object oriented concept have been introduced in these databases. This led to the development of a new class of DBMSs called object-relational DBMSs.

2. Based on the number of users

Depending on the number of users supported by the system, DBMSs are divided into two classes:

- Single user system
- Multi-user system

A single user database system supports one user at a time. In this system the database resides on one computer and is only accessed by one user at a time. Here the user performs all the user roles such as designing, maintaining and manipulating the database as per the requirements.

Multi-user systems support multiple users concurrently. In this system multiple users can access the database simultaneously. In this DBMS the data is both integrated and shared.

3. Based on the ways database is distributed:-

Depending on the ways over which the database is distributed, DBMS is divided into two types:

- Centralized database Systems
- Distributed database Systems

With centralized database systems, the system is stored at a single site. Centralized database systems run on a single computer system. Both the database and DBMS software reside at the same computer site. The user interacts with the centralized system through a dummy terminal connected to it.

In distributed database systems the database and DBMS software are distributed in various sites connected by a computer network. Several computers located at different sites communicate with each other through

various communication media such as high speed network or telephone lines. Distributed database systems are of two types namely homogeneous and heterogeneous.

In homogeneous distributed database systems all sites use the same DBMS software. Data is exchanged between various sites and can be handled easily.

In heterogeneous distributed Database Systems different sites use different DBMS software. There is additional software to support data exchange between sites.

4. Based on purpose

Depending on the purpose the DBMSs serve, they can be categorized in two classes:

- General purpose
- Specific purpose

By definition, DBMS is a general purpose software system. However it can be designed for specific purposes. For example, airline or railway reservations. Specific purpose database systems come in the category of online transaction processing systems. Such systems can not be used for other applications without making major changes.

Q9.(b) Explain client server architecture of DBMS.
Gurugram University BCA 2021
MDU BCA 2016

OR

Explain client server architecture.
MDU BCA 2015

Ans. Client server architecture

Client server architecture of database system has two logical components- client and server. A client is a computer system that sends request to the server connected to the network. A server is a computer system that receives the request, processes it and returns the requested information to the client. Client and server are usually present at different sites.

Clients are generally personal computers or workstations and server is large workstations, mini range or mainframe computer system. DBMS resides on server and performs all functions related to database management like data definition, manipulation, integrity, security etc. The applications and tools of DBMS run on one or more client platforms. These servers and client computers are connected to a network.

The client computers have user interfaces that help users to utilize the servers. Users can also run local applications on the client side. The processing power of the computer system at the user's end is utilized by processing the user- interface on that system.

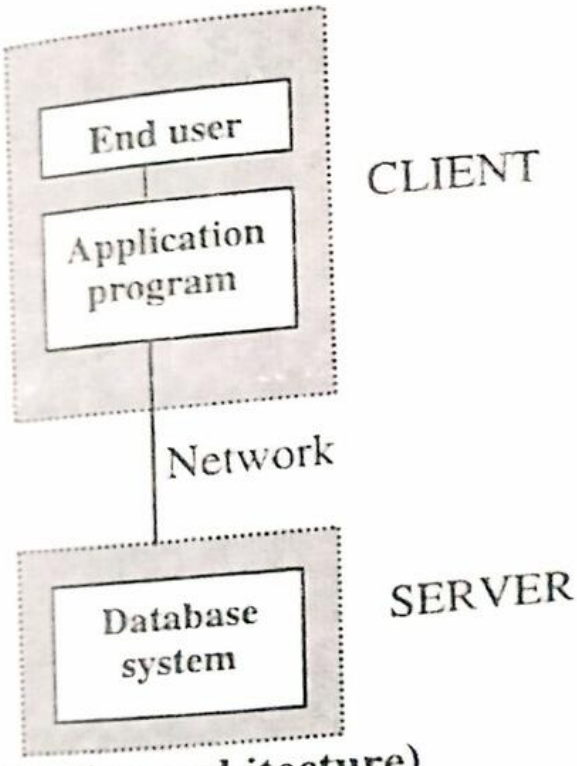
Two approaches to implement client/server architecture are: two-tier architecture and three- tier architecture.

Two-tier architecture

In the two-tier architecture, the user interface and application programs are placed on the client side and

the database system on the server side. The application programs that reside at the client side invoke the DBMS at the server side.

Thus, in this type of architecture, the client invokes database system functionality at server machine through query language. ODBC, JDBC are used for interaction between the client and server.



(Two-tier architecture)

Advantages of two-tier architecture

Following are the advantages of two-tier architecture:

- *Simplest to implement.*
- *Performs well with moderate number of client.*

Disadvantages of two-tier architecture

Following are the disadvantages of two-tier architecture:

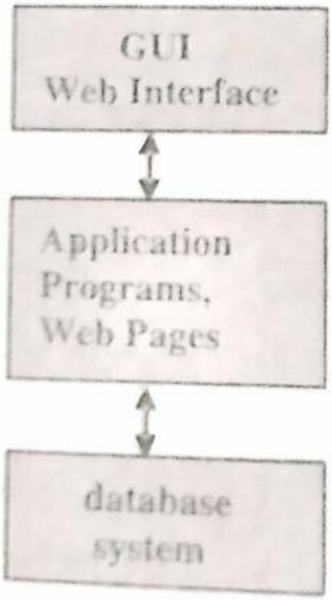
- *It gives poor performance when large number of clients submits their requests.*

- *Difficult to administer and maintain because when applications reside on the client, every upgrade must be delivered, installed and tested on each client.*

Three-tier architecture

In the three-tier architecture, an intermediate layer known as application server or web server is placed between the client and the database server.

The client communicates with the application server, which in turn communicates with the database server. When a client requests for information the application server accepts the request, processes it and sends corresponding database commands to database server. The database server sends the result back to application server which is converted into GUI format and presented to the client.



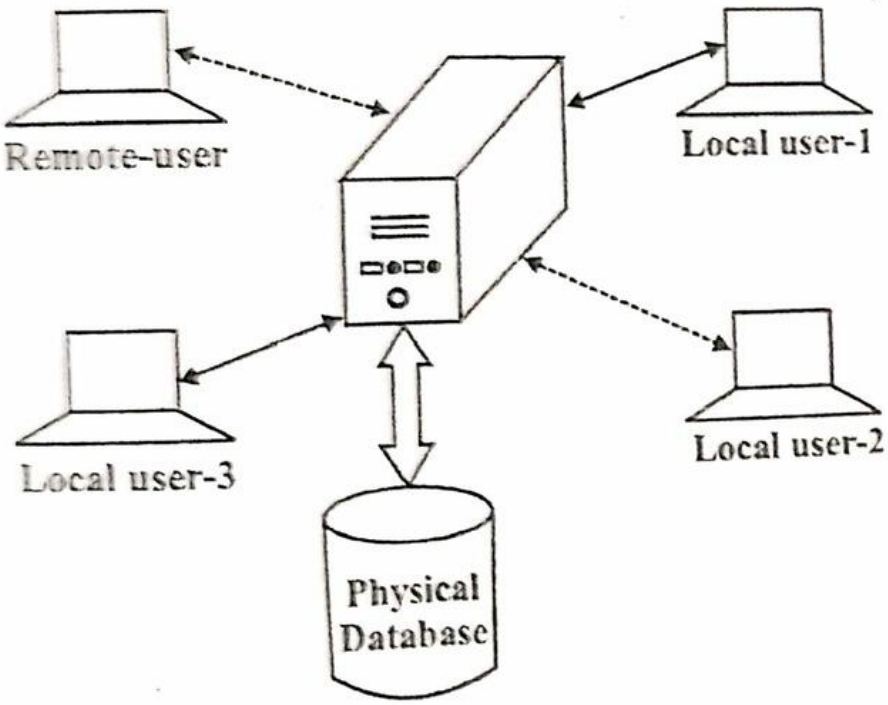
(Three-tier architecture)

The three tier architecture is used when an effective distributed client server design is needed that provides (when compared to the two tier) increased performance, flexibility, maintainability, reusability and scalability while hiding the complexity of distributed processing from the user.

Q9.(c) What is centralized DBMS? How is it useful and used? Explain its disadvantages with examples.

Ans. The centralized database management system consists of a single processor together with its associated data storage devices and other peripherals. It is physically confined to a single location.

Centralized DBMS offers data processing capabilities to users who are located either at the same site or through remote terminals at geographically dispersed sites. The management of the system and its data are controlled centrally from any one or central site. This is shown below in the figure:



Usefulness of Centralized DBMS

- *Single site provides high degree of security, concurrency, backup and recovery control.*
- *Centralized control of data avoids unnecessary duplication of data and effectively reduces the total amount of data storage required.*

- *Centralized control can also ensure that adequate checks are incorporated in the DBMS to provide data integrity.*
- *It allows the sharing of data under its control by any number of application programs or users.*

Disadvantages of Centralized DBMS

Centralized DBMS has the following disadvantages:-

- *The site with the database can become a bottleneck.*
- *Performance degradation due to a growing number of remote locations over greater distances.*
- *Scalability problems associated with the physical limits imposed by a single location like power, temperature conditioning and power consumption.*
- *Possible availability problem. If the site with the database goes down, there can be no data access.*

Q10.(a) **What is data model? Explain different types of data models.** **Gurugram University BCA 2021**
MDU BCA 2018

Ans. **Data Model**

Data model is a tool for describing data and relationships between data.

A number of models for data representation have been developed. The models can enforce a set of constraints to maintain the integrity of the data. Components of a data model are:

- ***A structural part which consists a number of rules for the construction of databases.***
- ***A manipulative part which defines the various operations that can be performed on the data.***

Data models should provide the basic concepts and notations that will allow database designers to communicate their understanding of the organizational data accurately.

The main purpose of a data model is to represent and make the data understandable.

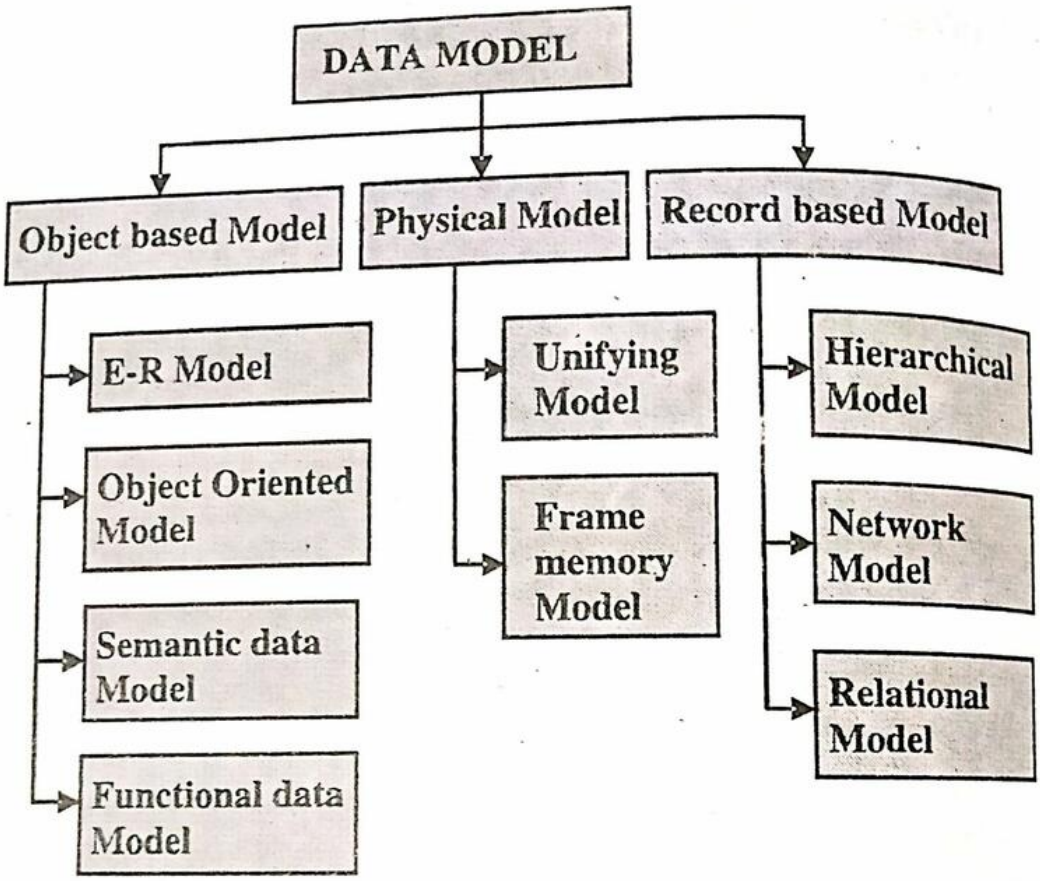
Thus in an organization, data model is an integrated collection of concepts for:

- ***Describing data.***
- ***Manipulating data.***
- ***Relationships between data and***
- ***A set of constraints to maintain the integrity of the data.***

Types of Data Model

The data models are basically divided into three groups:

1. Object based logical models
2. Physical models
3. Record based logical models



1. Object based logical models

These models are used to describe data at view level and logical level.

They use concepts like entities, attributes and relationships. They provide flexible structuring capabilities. Some of these are:

- Entity Relationship Model
- Object Oriented Model
- Semantic Data Model
- Functional Data Model

ER model has emerged as one of the main model to facilitate database design. The object oriented model is based on the collections of objects which describes attributes as the state of the object and the actions that are associated with the object as its behavior. For example dogs have state (name, colour, breed) and dogs have behavior (barking, fetching etc.). Cars have state (color, model etc.) and behavior (braking, changing gears, accelerating).

Semantic data model considers the semantics at the time of operations on the data. Functional data model is categorized as small modules. Data is stored in database as per the module.

2. Physical Models

This data model is used to describe data at the physical level.

These models describe information like record structures, record ordering and access paths. Some of physical models are:

- Unifying Model
- Frame memory Model

3. Record based logical models

These models are used:

- ***To specify the overall logical structure of database.***
- ***To provide a higher-level description of the implementation.***

These are divided into three types:

- Hierarchical Model
- Network Model

- Relational Model

Earlier the common database models were Hierarchical and network models.

The relational model has gained wide acceptance over the other two models in recent years. Relational model has engendered a great deal of additional study covering numerous aspects of database theory and practice.

The hierarchical and network models are still used in a large number of older databases.

Q10.(b) What is object-oriented database model? Also write the advantages and disadvantages of object-oriented database model.

Ans. Object-oriented database model

Object oriented database model is completely based on object oriented approach. This model is based on the collections of objects. Each object is an independent entity used to represent the real world thing. An object also contains a body of codes called as a method.

Object-oriented model represents an entity as a class. An entity may be a person, place or thing. A class represents both object's attributes and the behaviour of the entity. Attributes are characteristic that describe the state of the object. Objects that are similar in characteristics are grouped in a class. A class may be viewed as a type definition for objects, there is combination of data and methods comprising a type definition. A method is an operation, action or a behaviour the object may undertake. For example, consider a book class. It will have book attributes like ISBN, Title, Author, Publisher, Price etc. It will also have methods or actions for a book like UpdatePrice for modifying the price of books.

The one way in which one object can access the data of another object is by invoking a method of that object. This action is called as sending a message of data. Each object has its own unique identity, independent of the value that it contains.

Advantages of the Object-oriented database model

Following are the advantages of object-oriented database model:

1. Capable to handle many different types of data types

2. Enriched modeling capabilities
3. Extensibility
4. Supports schema evolution
5. Supports long-term transactions
6. Combination of object-oriented programming and database technology
7. Applicable to advanced database applications
8. Improves Productivity

1. Capable to handle many different types of data types

An object-oriented database can store any type of data including text, numbers, pictures, voice and videos.

2. Enriched modeling capabilities

The object-oriented data model allows the 'real world' to be modeled more closely. The object, which encapsulates both state and behavior, enables a natural and realistic representation of real-world objects. An object can store all the relationships it has with other objects, including many-to-many relationships. Objects can also be formed into complex objects.

3. Extensibility

One of the main advantages of object orientation is its ability to factor out common properties of several classes and form them into a superclass that can be shared with subclasses. This greatly reduces redundancy within system. Object-oriented database allows new data types to be built from existing types. The reusability of classes promotes faster development and easier maintenance of the database and its applications.

4. Supports schema evolution

The tight coupling between data and applications in an object-oriented database makes schema evolution more feasible.

5. Supports long-term transactions

Object-oriented database uses a different protocol to handle the types of long-duration transaction which are common in many advanced database application.

6. Combination of object-oriented programming and database technology

It provides an integrated application development system by combining the object-oriented database technology with object-oriented programming.

7. Applicable to advanced database applications

In many applications such as Computer-Aided Design (CAD), Computer-Aided Software Engineering (CASE), Office Information System (OIS), and Multimedia Systems, the traditional DBMSs have not been successful. The object-oriented databases with enriched modeling capabilities are suitable for these applications.

8. Improves Productivity

The object-oriented features of inheritance, polymorphism and dynamic binding allow programmers to create objects to provide solutions without having to write code that is specific to each other. These features together enable database application developers to improve productivity.

Disadvantages of the Object-oriented database model

Following are the disadvantages of object-oriented database model:

1. Difficulty in maintenance
2. Not suitable for all applications
3. Lack of universal data model
4. Lack of support for security

1. Difficulty in maintenance

In the real world, the data model changes as the organizational needs change. Therefore it requires to change the definition of objects periodically and to modify the existing databases to ensure the new object definitions. Programmers also need to modify the behavioural code associated with each other. Thus it becomes complex to maintain.

2. Not suitable for all applications

Object-oriented database systems are not suited for all sorts of applications. If they are used where they are not required, then it results in high processing requirements or performance degradation.

3. Lack of universal data model

There is no universally agreed data model. Also there is no standard object-oriented query language.

4. Lack of support for security

Currently, object-oriented databases do not provide adequate security mechanisms. The user cannot grant access rights on individual objects or classes.

Q11.(a) Explain object based data models by giving suitable examples. **IGU BCA 2018**

OR

Describe object-based data model with examples. **MDU BCA 2016, 2015**

Ans. Object-based data model

Object based data model is a model that combines the DBMS characteristics and object oriented approach.

These models are used to describe a data at view level and logical level. They are characterized by the fact that they provide fairly flexible structuring capabilities and allow data constraints to be specified explicitly.

The various types of this model are:

1. Entity relationship model
2. Object oriented model
3. Semantic data model
4. Functional data model

1. Entity relationship model

Entity relationship data model is based on the perception of real world that consist of a collection of basic objects, such as entities, relationship among these objects.

An entity is a thing or object which shows its presence or existence in a nature. For example: student. It is represented by rectangle.

These entities are described in a database by a set of attributes. The attributes are the characteristics of an entity which may act as a field in tables of a database.

The relationship is an association between the entities. It is represented by diamond. The set of entities of a similar type is called as an entity set and set of relationships of similar type is called as relationship set.

The overall logical structure of database can be expressed graphically by an E-R diagram which is built on the following components:

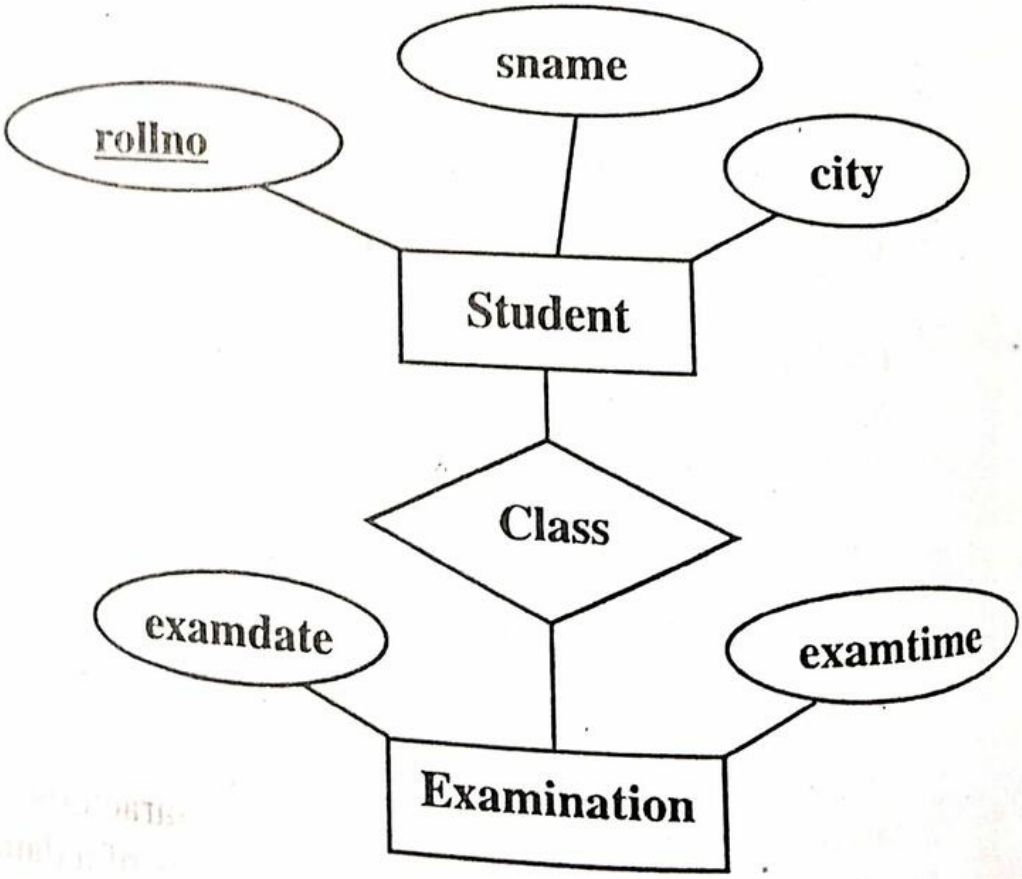
Rectangle: It represents the entity set.

Ellipse: It represents the attributes.

Diamond: It represents relationships among the entity sets.

Lines: Lines link attributes to entity sets and entity sets to relationships.

ER model represents the structure of a database graphically known as ER diagram. It can be shown as:



2. Object oriented model

Object oriented model is completely based on object oriented approach. This model is based on the collections of objects. Each object is an independent entity used to represent the real world thing. An object also contains a body of codes called as a method.

Similar values and methods of an object are grouped together to form a class. A class may be viewed as a type definition for objects, this combination of data and methods comprising a type definition which is similar to a language abstract data type.

The one way in which one object can access the data of another object is by invoking a method of that object. This action is called as sending a message of data. Unlike entities in a ER model each object has its own unique identity, independent of the value that it contains thus two objects containing the same values are nevertheless distinct.

3. Semantic data model

Semantic data model emphasize on semantic while working with data in database. Semantic means grammatical rules and regulations that apply on data. Each time when the data is operated in DBMS, the DBMS checks these semantics. It maintains the database integrity.

4. Functional data model

Functions are also called modules or subroutines. Functional model uses the predefined modules or subroutines while working with data in database. Functions store the data according to their needs and then they are checked and implemented by the DBMS.

Q11.(b) What is a hierarchical model? Also explain the various problems faces by this model in representing relationships.

Ans. Hierarchical Model

A model containing a collection of records connected in the form of a tree is called hierarchical model.

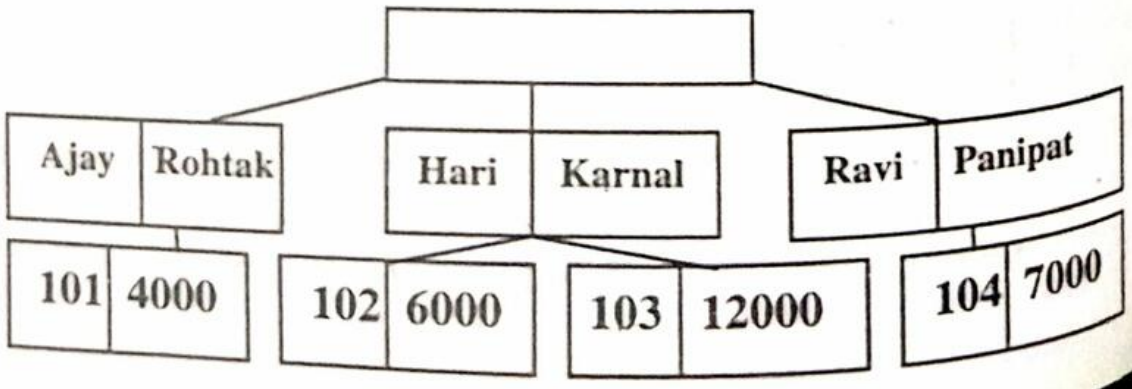
Hierarchical model is the oldest of the three record based logical models. One of the first hierarchical databases Information Management System (IMS) was developed by North American Rockwell company and IBM.

Hierarchical model uses the tree structure to organize the data. It shows the collection of records in the form of tree. The records work as nodes of tree and are also called segments. This structure shows the relationships among data as in the real world using tree structure, thus it is very efficient model.

It shows one to many relationships. It does not allow many to many relationships. It uses one root as parent and many branches as children. It describes the parent to child relationship that is one to many. Each child has only one parent. Child to parent relationship is one to one.

For example, consider a Client_account relationship in a banking system.

Sample database



There are two record types. One is Client with fields name and city, the other is Account with fields client_no and balance. Figure shows a sample database. It shows client Ajay has account no. 101, client Hari has account no.102 and 103, client Ravi has account no. 104. Here the root of the tree is a dummy node. This type of rooted tree is called a database tree and hence collection of such database trees forms a forest.

Various problem faces by this model in representing relationships

Various problem faces by this model in representing relationships are:

1. Implementation Complexity
2. Database management problem
3. Lack of Structural Independence
4. Operational anomalies
5. Inflexible
6. Program complexity
7. Implementation limitations
8. Hard code

1. Implementation Complexity

It is simple and easy to design but it is complex to implement. It requires proper knowledge of data storage characteristics.

2. Database management problem

If one makes any changes in the database structure then there is need to make changes in the entire application program that access the database. Thus to manage the database as well as application program is very difficult.

3. Lack of Structural Independence

There is lack of structural independence because when one changes the structure then it becomes compulsory to change the application program too.

4. Operational anomalies

Hierarchical model suffers from the insert, delete and update anomalies, also retrieval operation is difficult.

5. Inflexible

This is very difficult to represent the non hierarchical relationship in this model.

6. Program complexity

Due to structural dependency it requires that the application programs and the end users who are using this model should have the proper knowledge of how the data is stored physically. This requires knowledge of complex pointer systems.

7. Implementation limitations

This model only represents one to many relationships. It does not represent many to many relationships which are more common on our real life.

8. Hard code

In the hierarchical model the links are permanently established and cannot be modified. These links are hard coded in data structure. This hard code makes the hierarchical model rigid and complex.

Q12.(a) What is mapping cardinalities? Explain various types of mapping cardinalities.

MDU BCA 2018

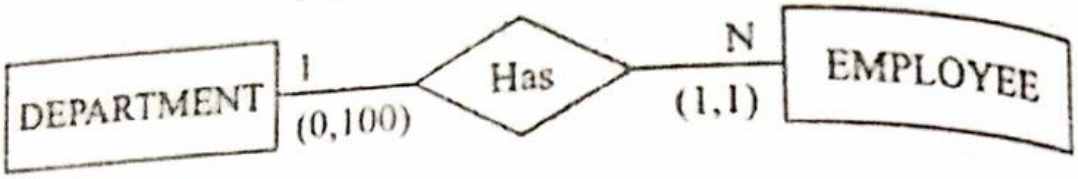
Ans. *Mapping cardinalities or cardinality ratios express the number of entities to which another entity can be associated via a relationship.*

Mapping cardinalities are the most useful in describing binary relationship sets. For binary relationship set R between entity sets A and B, the mapping cardinality must be one of the following:

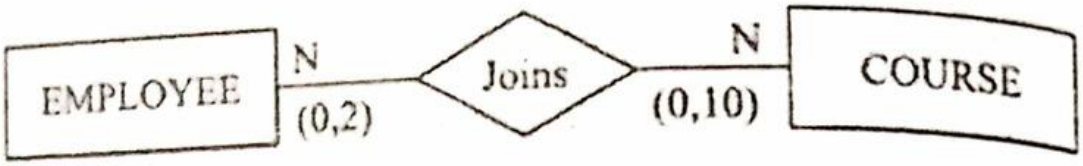
- **One to One:** An entity in A is associated with at most one entity in B and an entity in B is associated with at most one entity in A.
- **One to Many:** An entity in A is associated with any number of entities in B. An entity in B, however, can be associated with at most one entity in A.
- **Many to One:** An entity in A is associated with at most one entity in B. An entity in B, however, can be associated with any number of entities in A.
- **Many to Many:** An entity in A is associated with any number of entities in B, and an entity in B is associated with any number of entities in A.

For example, if the company policy does not allow more than 100 employees in a department, the cardinality rule governing the DEPARTMENT-EMPLOYEE relationship is expressed as "One department can have a maximum of 100 employees". A sc the company policy allows each employee to join a maximum of 2 courses at a time. At present the company offers 10 courses. The cardinality is indicated by placing the appropriate numbers beside the entities as shown below:

One-to-many Relationship



Many-to-many Relationship



An important point is that the number of associated entities may be variable. For example, an employee can enroll for one or two courses at a time. He also has the choice of not getting enrolled for any of the courses. Similarly, a department can have a maximum of 100 employees. But it is quite possible that the number of employees in a department is 0, if the department is in its formative stages.

12.(b) What do you mean by attributes? Describe the types of attributes that occur in the E-R model by giving suitable examples.

ns. Attributes

Attributes are the properties or characteristics of an entity i.e. every entity has some basic attributes that characterize it.

In simple words, an attribute of an entity is a particular property that describes the entity.

For example, an employee entity may have employee number, name, address etc. as attributes. A student entity may have rollno, name, class, semester as attributes.

The attribute value is the actual data contained in the attribute. For example, 101, RAVI, BCA, I are the actual data stored in the attributes rollno, name, class and semester.

Thus, an attribute is description that is used to identify, qualify, classify or otherwise express the set of an entity occurrence. For each attribute, set of permitted values are available called as domain. The attribute which uniquely defines the occurrence of an entity is called primary key.

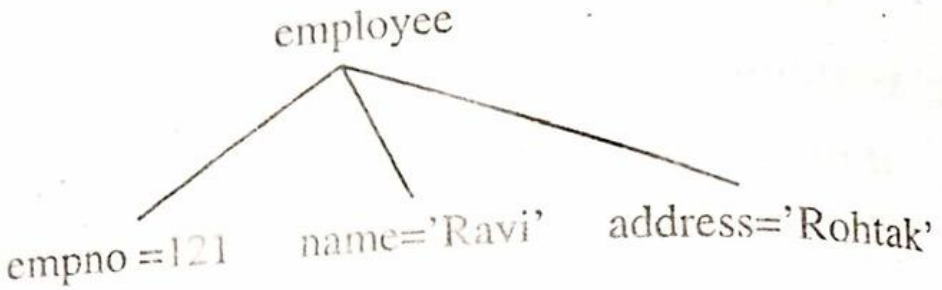
The attribute values describing an entity will constitute a significant portion of the data stored in the database.

Several types of attributes occur in the E-R model. These are:

1. Simple and Composite attribute

In simple attribute each entity has a single atomic value for the attribute. In other words the attribute which cannot be divided into smaller subparts is called simple attribute.

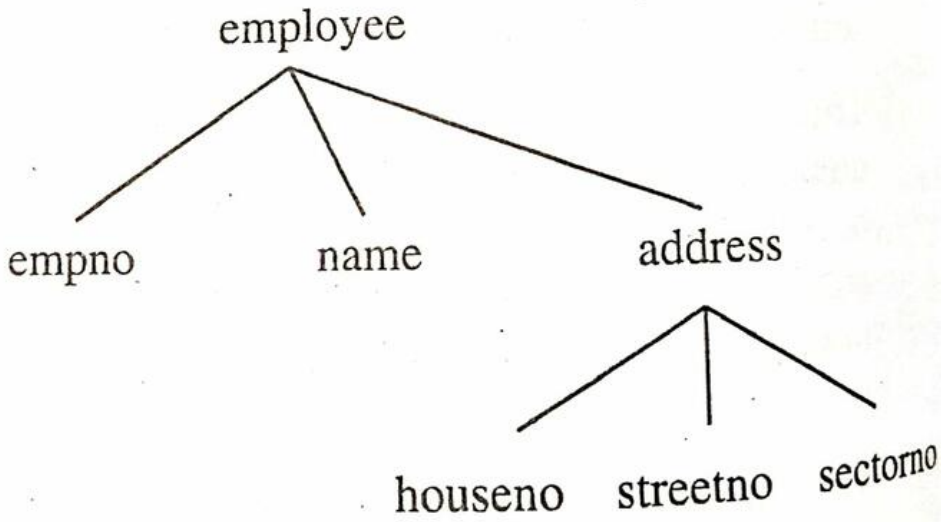
For example, shown below is an entity employee with its attribute values



Thus, simple attribute represents a single property, i.e., it is not divided into subparts. Simple attributes are sometimes called atomic attributes.

The attributes, which can be divided into smaller independent attributes, are called composite attributes.

For example, composite attribute address can be further divided into houseno, streetno, sectorno attributes.



Composite attribute appears as hierarchy and helps to group together related attribute

2. Single-valued and multi-valued attributes

An attribute which has a single value for a particular entity is known as single valued attribute.

For example, the attribute 'empno' can have a single number only.

An attribute which has more than one values is called multivalue attribute.

For example, PreviousDegrees attribute of a Student entity may have more than one values B.A. and M.A. etc.

A multiple value attribute is enclosed between braces as {PreviousDegrees}

3. Null attributes

A null value is used when an entity does not have a value for an attribute.

For example, if a student does not have any degree then degree attribute value will be null or if it is not known it is again null.

4. Stored attribute & Derived attribute

An attribute which cannot be derived from another attribute(s) is known as stored attribute.

If the value of attribute is derived from the values of other related attributes it is called derived attribute.

For example, consider the employee entity set with attributes start_date and employment_period. start_date represents the joining date and employment_period represents his total service. The value of employment_period can be derived from the value for start_date and the current_date. Here start_date is referred as stored attribute.

Q12.(c) What do you mean by the term relationship? Explain the categories of relationships.

Ans. Relationship

A relationship is an association among entities.

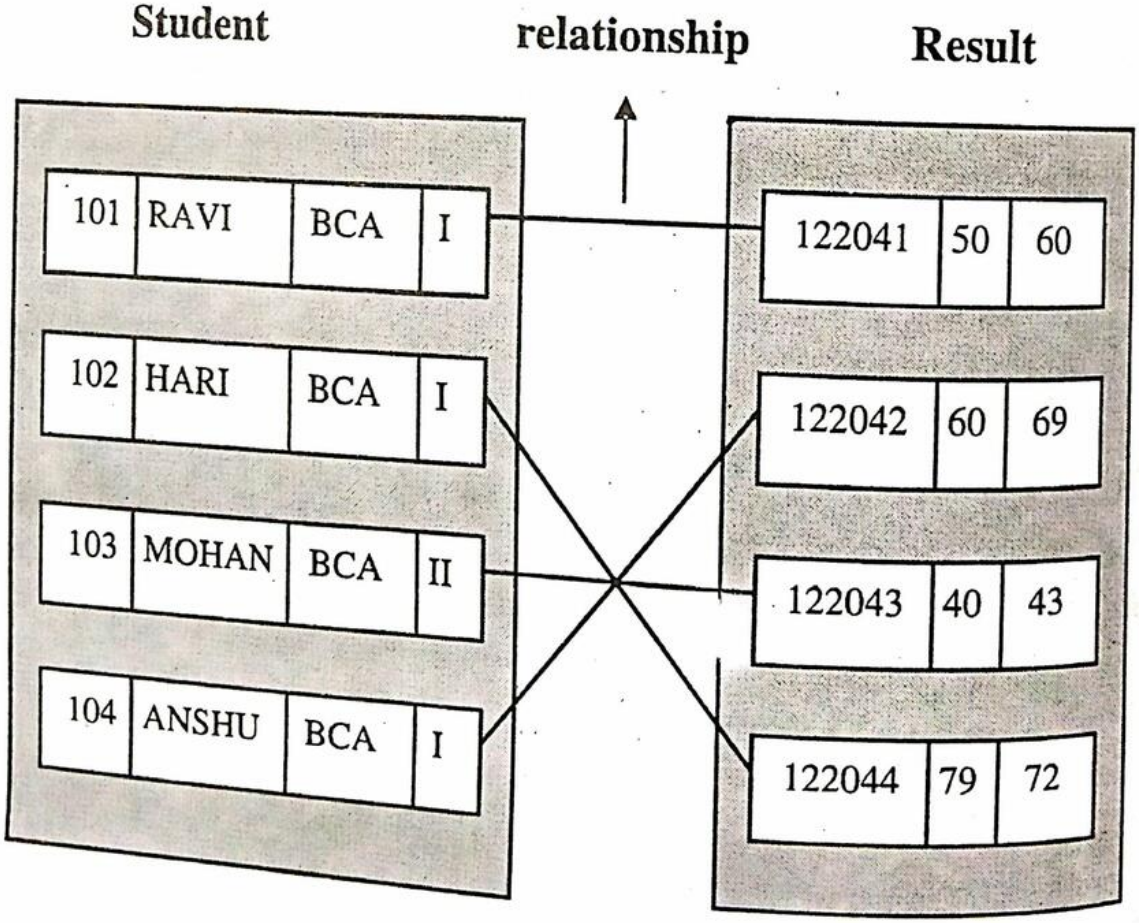
For example, in the figure, a relationship is that associates student Ravi with examrollno 122041, marks 50 in Physics and 60 in Computer.

A relationship set is a set of relationships of same type.

If $A_1, A_2, \ldots, A_n$ are n entity sets, then a relationship set R is a subset of

$$\{ (a_1, a_2, \ldots, a_n) \mid a_1 \in A_1, a_2 \in A_2, \ldots a_n \in A_n \}$$

where $(a_1, a_2, \ldots a_n)$ is a relationship.



A relationship relates two or more distinct entities with a specific meaning.
For example, EMPLOYEE Ram Singh WORKS_FOR Computer DEPARTMENT. WORKS_FOR is relationship type in which EMPLOYEE and DEPARTMENT participate.

The degree of a relationship type is the number of participating entity types. WORKS_FOR relationship is of degree two. It is binary relationship.

Thus, the degree of a relationship is the number of entities associated with the relationship. The n-ary relationship is the general form for degree n. Binary relationship is the most common relationship in the real world.

Q13.(a) Design an E-R diagram for library management system? Make your own assumptions about the system. MDU BCA 2021

OR

What is ER diagram? Draw the ER diagram of library management system.

MDU BCA 2016

Ans. ER diagram

An ER diagram is a graphical tool that demonstrates the interrelationships among various entities of a database. It is used to represent the overall logical structure of the database.

Thus a visual way to represent a database is with an entity-relationship (E-R) diagram. While designing ER diagrams, the emphasis is on the schema of the database and not on the instance. This is because the schema of the database is changed rarely; however, the instances in the entity and relationship sets change frequently. Sc, ER diagrams are more useful in designing the database.

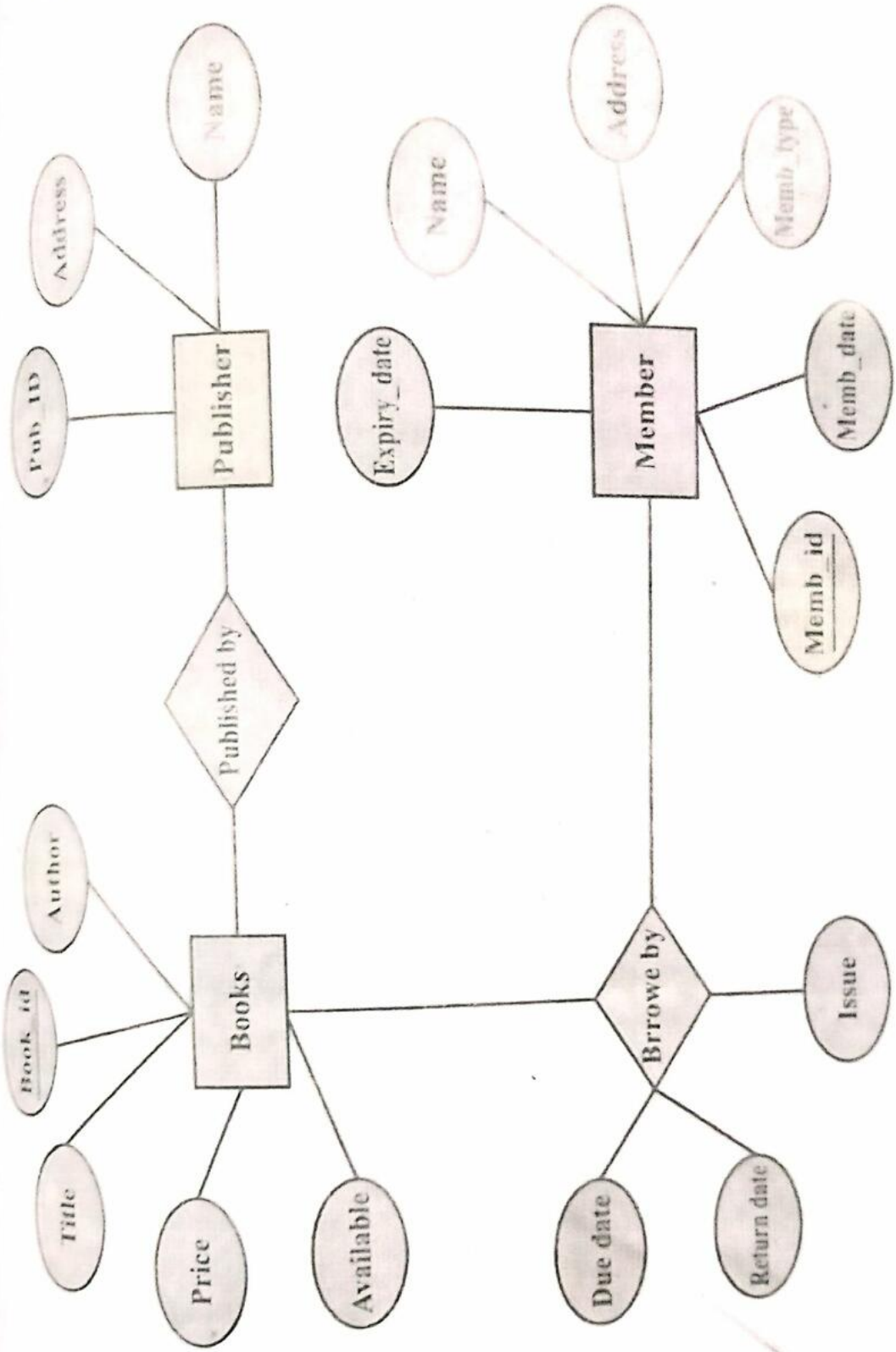
An ER diagram serves several purposes as given below:

- ***It is used to communicate the logical structure of the database to the end users.***
- ***It helps the database designer in understanding the information to be contained in the database.***
- ***It serves as a documentation tool.***

Thus, ER diagram is a graphical logical structure of a database which represents:

- ***All the entities involved in the logical structure.***
- ***Constituents of the entities.***
- ***Relationship between the entities.***
- ***Types of mapping between relations.***

ER diagram of library management system



Q13.(b) What is ER diagram? Draw the ER diagram of school management system.

MDU BCA 2015

Ans. ER diagram

An ER diagram is a graphical tool that demonstrates the interrelationships among various entities of a database. It is used to represent the overall logical structure of the database.

Thus a visual way to represent a database is with an entity-relationship (E-R) diagram. While designing ER diagrams, the emphasis is on the schema of the database and not on the instance. This is because the schema of the database is changed rarely; however, the instances in the entity and relationship sets change frequently. So, ER diagrams are more useful in designing the database.

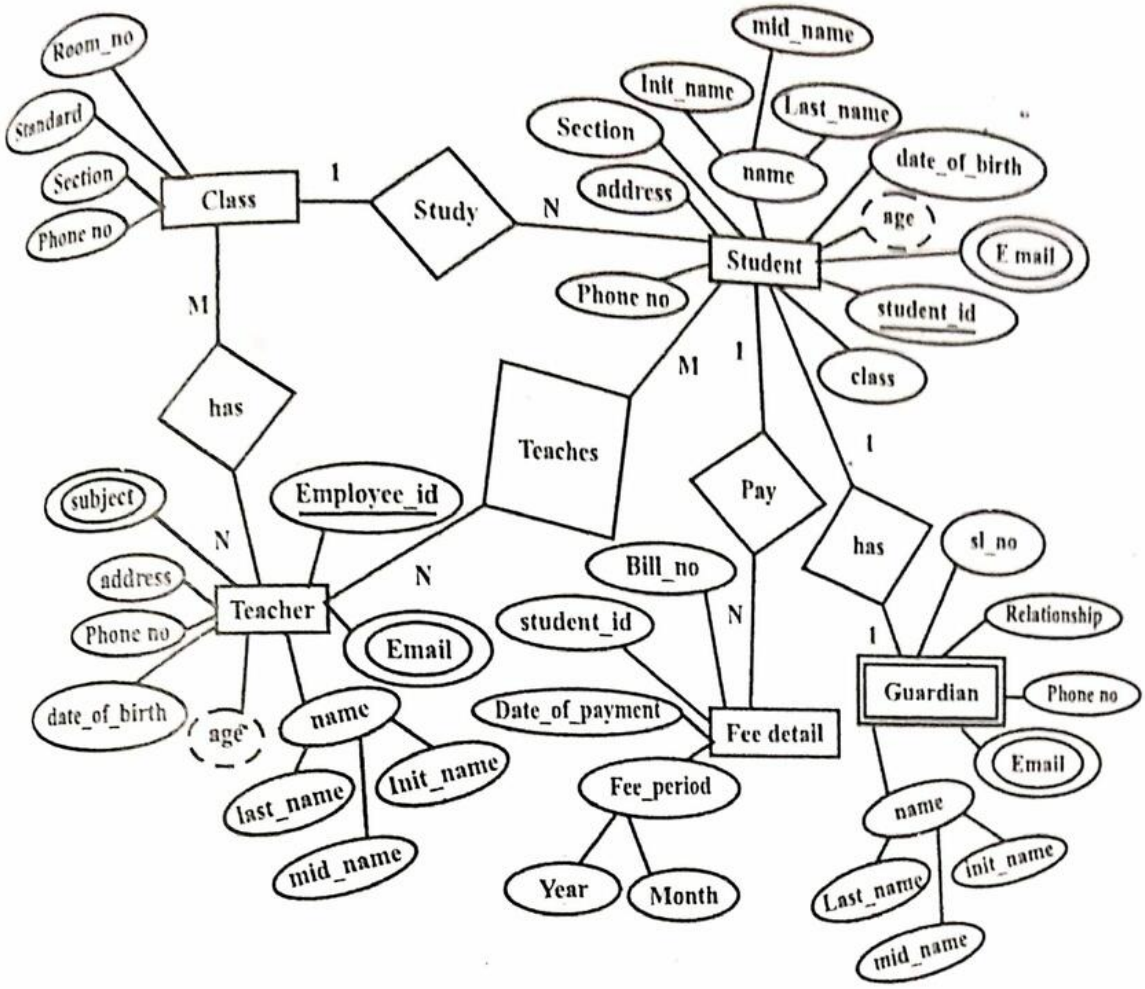
An ER diagram serves several purposes as given below:

- ***It is used to communicate the logical structure of the database to the end users.***
- ***It helps the database designer in understanding the information to be contained in the database.***
- ***It serves as a documentation tool.***

Thus, ER diagram is a graphical logical structure of a database which represents:

- ***All the entities involved in the logical structure.***
- ***Constituents of the entities.***
- ***Relationship between the entities.***
- ***Types of mapping between relations.***

ER diagram of school management system



Q13.(c) Define the term E-R diagram. Explain the various types of relationships in an E-R diagram. Draw an E-R diagram for taking your own example.

Ans. ER diagram

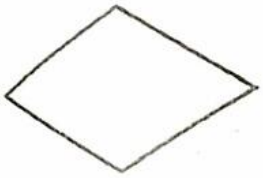
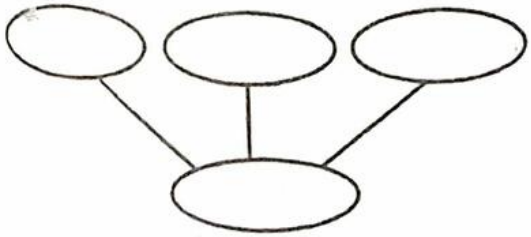
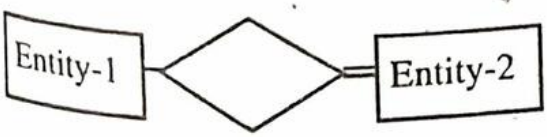
ER diagram is a graphical logical structure of a database. It represents:

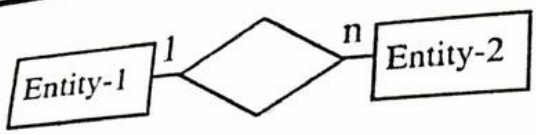
- *All the entities involved in the logical structure.*
- *Constituents of the entities.*
- *Relationship between the entities.*
- *Types of mapping between relations.*

The symbols used to draw an ER diagram are:

- *Entities are represented by labeled rectangular boxes. The label is the name of the entity.*
- *Weak entity types are represented by double rectangular boxes.*
- *Relationship types are represented by diamond shaped boxes.*
- *A line connecting two entities represents relationship. The name of the relationship is written above the line.*
- *Attributes are represented by ellipses.*
- *Key attributes have their names underlined.*
- *Multivalued attributes are represented by double ellipses.*
- *Derived attributes are represented by dotted ellipses.*

The symbols used to design an ER diagram are shown below:

Symbol	Meaning
	Entity Type
	Weak Entity Type
	Relationship Type
	Attribute
	Key Attribute
	Multivalued Attribute
	Composite Attribute
	Derived Attribute
	Entity-2 is totally participating in Relationship type R



Cardinality ratio 1:n between Entity-1 & Entity-2 in Relationship type R

Example: Construct an ER diagram for a Car Insurance Company that has a set of customers, each of whom owns one or more cars. Each car has associated with it any number of accidents.

For this ER diagram, the entities are CUSTOMER, CAR, ACCIDENT

For this ER diagram:

(a) The attributes of CUSTOMER entity are Customer Code, Name, Address, Phone No etc. Suppose Customer Code be the primary key for CUSTOMER entity type.

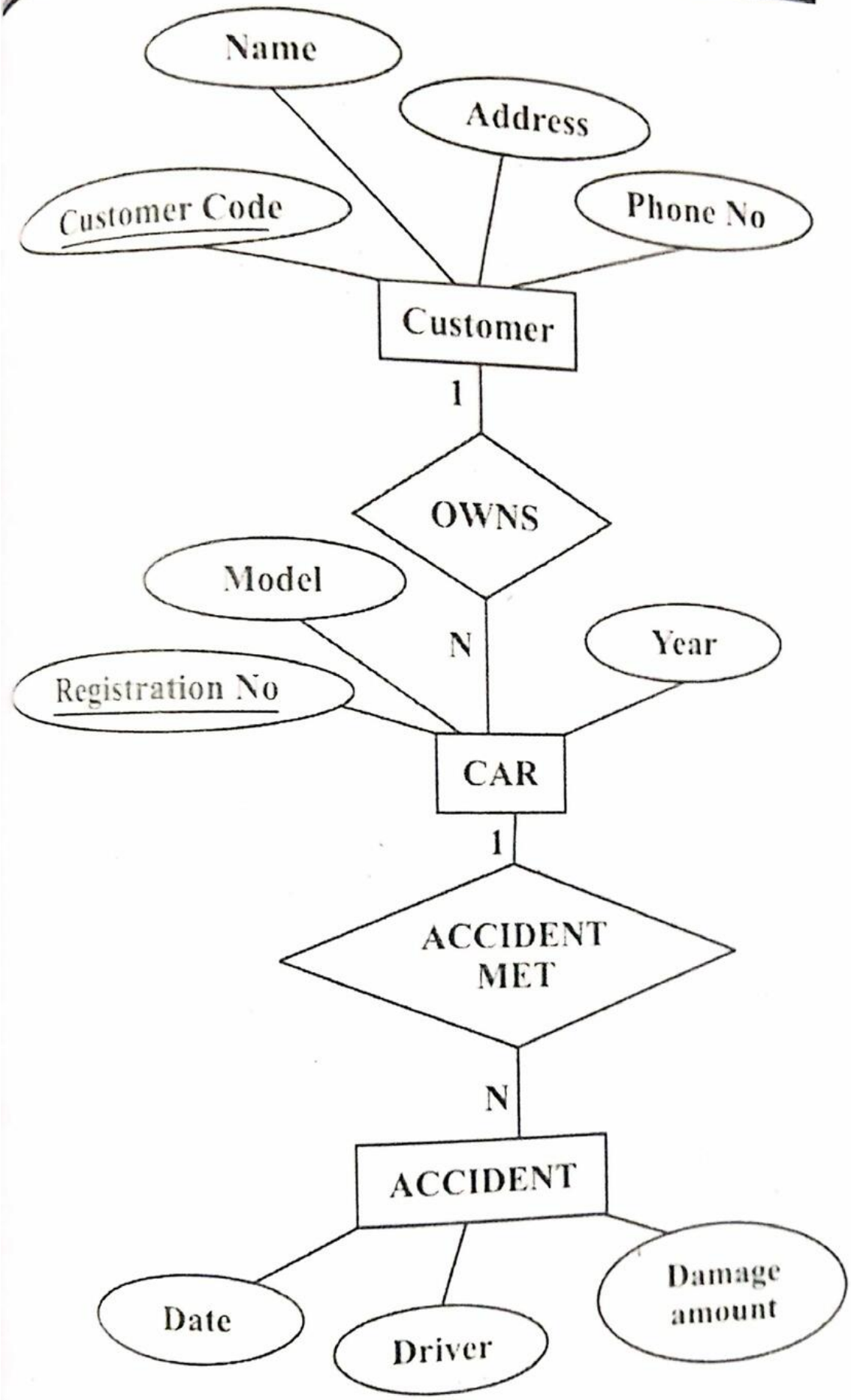
(b) The attributes of CAR entity are Registration No, Model, Year etc. Let Registration No be the primary key for CAR entity type.

(c) The attributes of ACCIDENT entity are Date, Driver, Damage Amount etc.

The relationship types are:

(a) OWNS: 1:n relationship between CUSTOMER and CAR.

(b) ACCIDENT MET: 1:n relationship between CAR and ACCIDENT.



(ER diagram for Car Insurance Company)

Q13.(d) Write note on Data Abstraction and Data Integrity/Integration.

Ans. Data Abstraction

Abstraction is hiding of implementation details from the users.

Since non-computer professionals also use database, thus database complexity must be hidden from them. Moreover users are of different capabilities and data needed by them is also of different levels. Thus for smooth running of database systems, hide the complexity of database system from the end users.

Thus abstraction principle is applied to the DBMS and DBMS hides the complex details of how the data is stored in DBMS. It allows different users to concentrate only on their respective subparts.

The various levels of abstraction are:

1. Physical Level
2. Logical Level
3. View Level

1. Physical Level

This is the lowest level close to hardware. This level is also known as internal level or storage level.

It describes the physical layout of the data on the storage devices i.e. it describes how data is actually stored on the storage devices.

Since it contains the details of how the data are actually stored, it hides minimum information. It includes:

- ***Data structure.***

- *File organizations used to store data on storage devices.*
- *Database Definition Tables.*
- *Definition of Access paths to files containing the data of the database.*

It interfaces with the operating system access methods to place the data on the storage devices, build the indexes, retrieve the data and so on. The security of data is also defined at this level. This view is seen by the system programmer and the system designers.

2. Logical Level

The middle level in the three level architecture is the logical level. It is the next higher level of abstraction.

It is the overall design of the database. It is a complete view of the data requirements of the organization.

Logical level is also called conceptual level. It hides the details of physical storage structures. At the logical level, following are defined:

- ***All record types.***
- ***Relationship existing among these records.***
- ***The constraints on the data.***
- ***Security and integrity information.***

It describes what data is stored without taking physical storage details.

For example, the description of an entity should contain only data types of attributes like integer, real, character; and their length like maximum number of digits or characters; but not any storage considerations like the number of bytes occupied.

Thus, it describes:

- *Entities*
- *Data types*
- *Relationships*
- *Constraints*

This view is seen by database administrator (DBA) who decides what information is to be kept in the database.

3. View Level

This is the highest level close to user. View level is also known as external view.

It describes only that part of the database, which is actually needed by the user.

User Interface is placed at this level. This level deals with the way in which individual users view data. Individual users are given different views according to their requirements. A number of users of a database system are not concerned with all the information contained in the database. Instead, they need a part of database. So they will usually access a subset of total data. At view level, parts of the database are described. Thus, view level provides many views of the same database.

View level increases the security of the database. It does not allow the user to access the unnecessary parts of the data.

For example, in an examination branch of the University, a clerk can access student information but not staff information. In addition different views may have different representations of the same data. For

example, one user may view data in the form (day, month, year) while another may view date as (month, day, year).

Data Integrity/Integration

Data Integrity means data in database is always accurate. It also implies that incorrect information cannot be stored in the database.

In a database system, better data integrity is obtained by imposing consistency constraints on the database.

For example:

1. A student database has the information regarding marks obtained in an examination. A student cannot obtain marks more than100 – the maximum marks in one subject. Integrity constraints can be specified so that database will accept marks only in the range of 0 to 100 per subject.

2. The database of a college till graduation will have the data for BA, BSc, BCA, Bcom classes only. If a user enters the data for MSc/MCA class then this incorrect/invalid data entry must not be stored in the database. To enforce this integrity constraints are imposed easily on the database instead of file system where these constraints are imposed on all the applications separately.

Q14.(a) Define Data Model. Explain Hierarchical model and Network model in detail.

Gurugram University BCA 2021
MDU BCA 2016

Ans. Data Model

Data model is a tool for describing data and relationships between data.

A number of models for data representation have been developed. The models can enforce a set of constraints to maintain the integrity of the data.

Components of a data model are:

- ***A structural part which consists a number of rules for the construction of databases.***
- ***A manipulative part which defines the various operations that can be performed on the data.***

Data models should provide the basic concepts and notations that will allow database designers to communicate their understanding of the organizational data accurately..

The main purpose of a data model is to represent and make the data understandable.

Thus in an organization, data model is an integrated collection of concepts for:

- ***Describing data.***
- ***Manipulating data.***
- ***Relationships between data and***
- ***A set of constraints to maintain the integrity of the data.***

Hierarchical Model

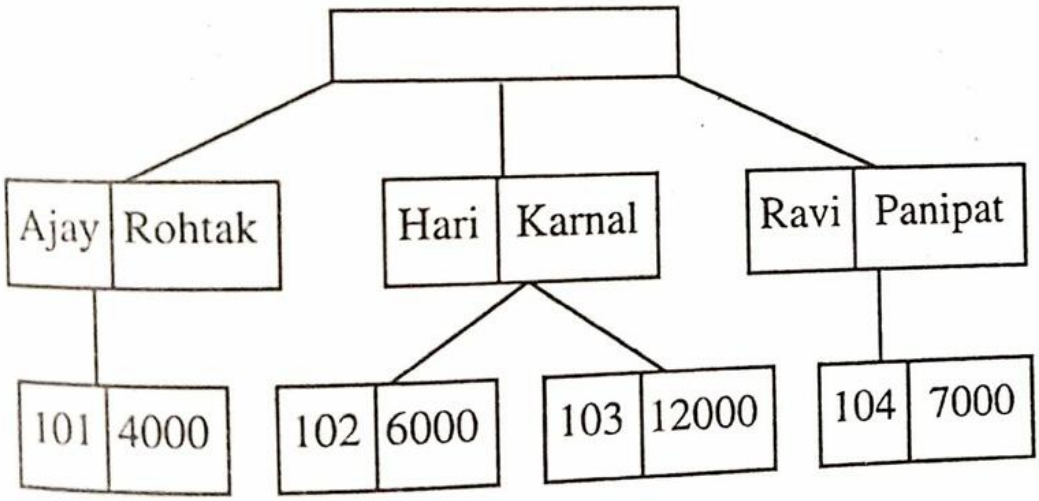
A model containing a collection of records connected in the form of a tree is called hierarchical model.

Hierarchical model is the oldest of the three record based logical models. One of the first hierarchical databases Information Management System (IMS) was developed by North American Rockwell company and IBM.

For example, consider a Client_account relationship in a banking system. There are two record types. One is Client with fields name and city, the other is Account with fields client_no and balance.

Figure shows a sample database. It shows client Ajay has account no. 101, client Hari has account no.102 and 103, client Ravi has account no. 104

Sample database



Here the root of the tree is a dummy node. This type of rooted tree is called a database tree and hence collection of such database trees forms a forest.

Operations on Hierarchical Model

The operations that can be performed on Hierarchical model are:

(i) Insert operation

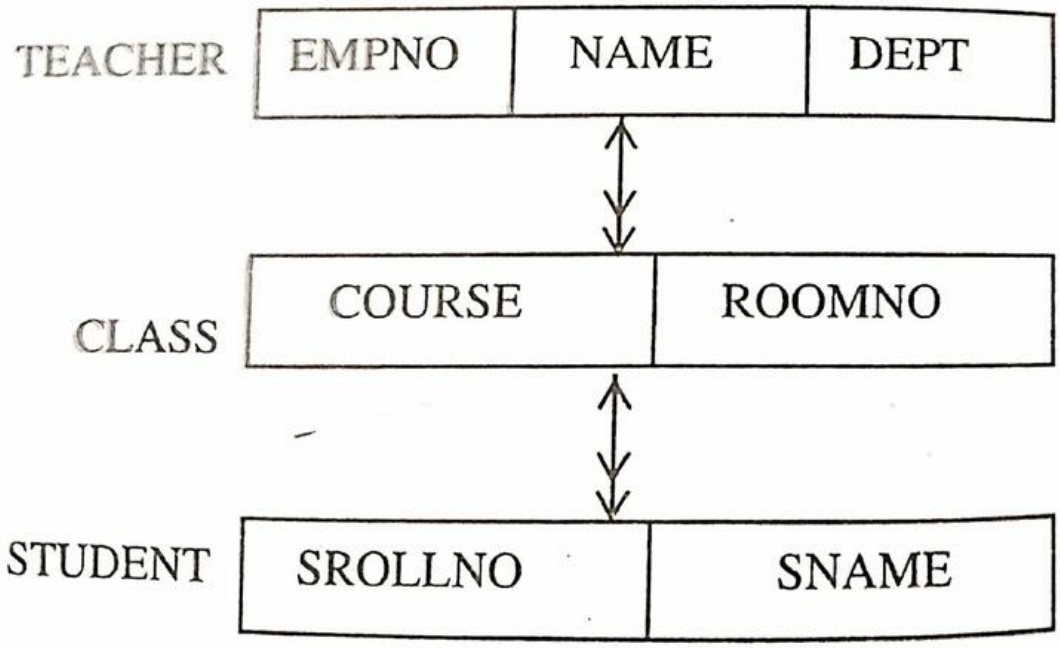
(ii) Delete operation

(iii) Update operation

To understand the operations on Hierarchical model, consider the following data structure diagram for a tree representing the TEACHER, CLASS & STUDENT.

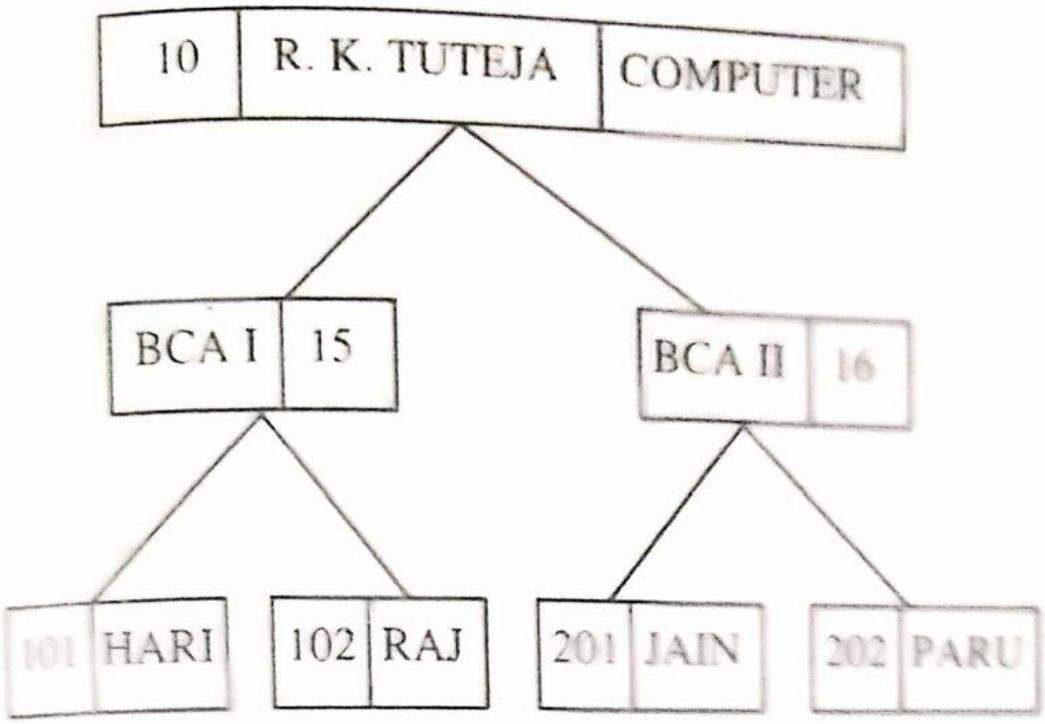
Here, the three record types are:

- TEACHER with fields EMPNO, NAME, DEPT
- CLASS with fields COURSE, ROOMNO
- STUDENT with fields SROLLNO, SNAME



TEACHER is the root node. CLASS as a child of TEACHER which shows there is one to many relationship between each TEACHER record and its associated CLASS records. Similary STUDENT is a child of CLASS.

Figure shows a sample database:



(i) Insert operation

It is not possible to insert a new class BCA III unless some teacher is available at root level. A node cannot exist without a root. Thus insert anomaly exists for those children which has no corresponding parents.

(ii) Delete operation

In hierarchical model, deletion of parent causes the deletion of children records. For example to remove the class BCA II causes the deletion of student with SROLLNO 201 and 202. Thus deletion is difficult.

(iii) Update operation

Update operation is time consuming because:

- ***Search problem will occur.***
- ***Multiple updations for different occurrences.***

Thus, hierarchical model suffers from insertion anomalies, deletion anomalies and updation anomalies.

Advantages of Hierarchical Data Model

Advantages of hierarchical data model are:

- *Simple and easy to use.*
- *Promotes data integrity as child is referred by its parents.*
- *Easy access to data.*
- *First model that is provided and enforced, data security by the DBMS.*
- *It is very efficient when large number of 1:N relationship exist and when user require large number of transaction using data whose relationship is fixed.*
- *Data with hierarchical relationships can be mapped on this model.*

Limitations of Hierarchical Model

Limitations of Hierarchical model are:

- *Non-hierarchical relationships are difficult to represent on this model. Thus it is inflexible.*
- *It is complex to design, develop and implement. The database designers must have complete knowledge of the physical data storage characteristics.*
- *The processing is sequential along the branches of the tree. Thus it takes more time to access the nodes.*
- *Data independence is limited because of structured dependence.*
- *Requires extra storage space for the pointers from parents to the children.*

- *Deletion of parent node deletes its children nodes.*
- *Changes in relationship are time-consuming and expensive.*
- *Many to many relationship which is common in real life is difficult to implement.*

Examples of Hierarchical Model

IBM's Information management system (IMS) and system 2000 are examples of Hierarchical database management system.

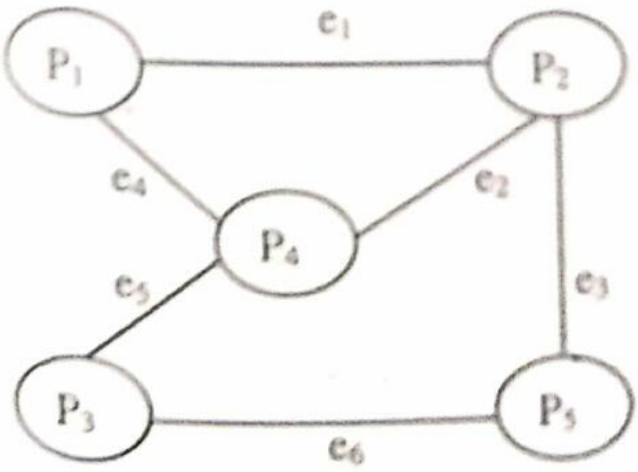
Network Model

A network model is a collection of records that are connected to each other through links. This model is an improvement over the hierarchical model.

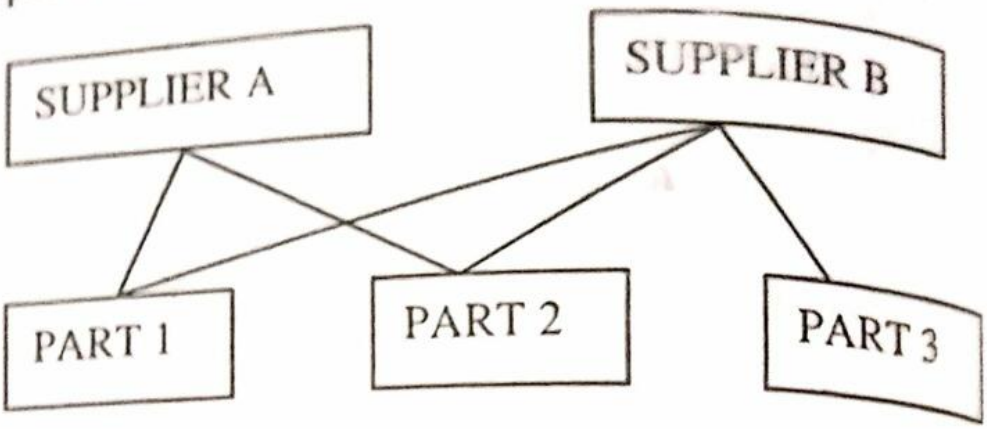
It differs from a hierarchical model as:

- *No concept of root node.*
- *Many-to-many relationship.*
- *A node can have more than one parent node.*

Figure shows a network consisting of nodes P_1, P_2, P_3, P_4, P_5 and edges e_1, e_2, e_3, e_4, e_5 and e_6.



For example, a network structure with only two record types SUPPLIER and PART is shown below:



Operations on Network Model:-

The operations that can be performed on Network model are:

(i) Insert operation

(ii) Delete operation

(iii) Update operation

(i) Insert operation

From the figure, it is clear that new supplier or part can be easily inserted.

To insert a new record, create a new record occurrence. For example SUPPLIER C can be inserted in network model that does not supply any part. Similarly a new part can be inserted which is not supplied by any supplier.

(ii) Delete operation

Delete operation is very simple. To delete the information of any record occurrence that record can be deleted by removing the corresponding pointers and connectors.

For example to remove PART 1, delete the connector record occurrence linking this part.

(iii) Update operation

Updating a record is also easier process. For example suppose SUPPLIER A supplies PART 3 in place of PART 1. This change can be done simply by changing link of SUPPLIER B from PART 1 To PART 3.

Thus Network model does not suffer from the insert anomalies, delete anomalies and update anomalies. But since each above operation needs the modification of pointers, this makes the network model complicated and complex.

Advantages of Network data Model

Advantages of network data model are:

- ***Many-to-many relationship can be implemented.***
- ***It is efficient and flexible.***
- ***Data integrity, i.e., it does not allow a member to exist without an owner.***
- ***Easier access as compared to hierarchical data model.***
- ***Simple and easy to design.***
- ***This model is based on the standards formulated by the DBTG. These standards included DDL (Data Definition Language) and DML (Data Manipulation Language) and thus enhancing database administration and portability.***

Limitations of Network Data Model

Limitations of network data model are:

- *Complexity increases as the number of links increases.*
- *Extra storage memory is required for pointers.*
- *General purpose Query facility is not available.*
- *Maintenance of this model is expensive because graph structures are made for each record.*
- *New queries can not be implemented.*
- *High level language is required to program the database.*
- *Insertion, deletion and updation operations of any record require large number of pointers adjustment.*

Example of Network Data Model

UNIVAC's DMS 1100 is an example of network database model.

Q14.(b) Explain Relational model in detail.

Ans. Relational Model

The hierarchical and network data models are unstable due to pointers. Incase of system errors, the chain of addresses between the records could be damaged which results in reduced data integrity.

Relational model is a record based logical model. It was proposed by Dr E. F. Codd in 1970. It has now gained wide acceptance.

A relational model is defined as a database that allows to group its data items into one or more independent tables that can be related to one another by using fields common to each related table.

Relational tables show only the logical relationship. End users need not know the exact physical structure of a table or relation. It is the primary data model for commercial data processing applications. Its success has led to its applications outside data processing in systems for computer-aided design and other environments.

Relational model simplifies the database structure. It uses tables. No physical connection like pointers are used. A table is called a relation and is assigned a unique name. A table consists of rows and columns. A row represents a record. Row is called a tuple. A tuple in a table represents a relationship among a set of values.

Column is called attribute. The column values must be single valued in the sense that it has no arrays or lists. The values in each column are of same type, may be integer or character etc. Each attribute has a set of permitted values called the domain of that attribute. The domain of all attributes is required to be atomic i.e. the

elements of a domain are to be indivisible. The number of tuples in a relation is known as cardinality. The number of attributes in a table is known as degree of the tuple or relation.

Operations on Relational Model

The operations that can be performed on Relational model are:

(i) Insert operation

(ii) Delete operation

(iii) Update operation

To understand the operations on Relational model, consider the relation STUDENT given below:

STUDENT

Rolino	Regdno	Name	Class	Address
101	05NRG01	HARI	BCA II	ROHTAK
102	05NRG02	RAVI	BCA II	ROHTAK
103	05NRG03	ANIL	BCA II	KARNAL
104	05NNG01	AJAY	BCA III	KARNAL
105	06NRG01	HARISH	BCA I	PANIPAT
106	06NRG02	MOHAN	BCA I	ROHTAK
107	06NRG03	VIJAY	BCA I	ROHTAK

(i) Insert operation

A new student record can be inserted very easily. So the insert operation can be performed without any anomaly.

(ii) Delete operation

Deletion is also easy. A student record can be deleted very easily. So the deletion operation can be performed without any anomaly.

(iii) Update operation

Updation is also easy. For example to change the Address of student whose Rollno is 102 from ROHTAK to KARNAL.

Advantages of Relational Model

Advantages of relational model are:

1. Ease of Use

Since tabular structure is simple and familiar, it is easy to use and understand. Even first time users find it attractive.

2. Flexibility

This model is very flexible because the information which is needed from different tables can be easily manipulated by using the operations like project and join.

3. Precision

Mathematical operations on tables can be applied. The usage of relational algebra and relational calculus for the manipulation of relations ensures clarity.

4. Data Independence

Data independence is achieved more easily with normalization in a relational database. Thus this model achieves data independence making the database design, maintenance and usage much easier than the other models.

5. Query capability

Relational data model provides excellent support for queries with the help of inbuilt query language. This

easy-to-use query capability is one of the main reasons for the popularity of this model.

6. **Security**

Allows security control and authorization by moving sensitive attributes in a table into a separate relation with its own authorization controls.

Limitations of Relational Model

The relational model has very minor limitations as compared to the advantages. Some of the limitations are:

- *The size of database becomes large, it increases the response time.*
- *It does not maintain physical connection among the records.*

Example of Relational Model

Oracle is example of a relational database management system.

Q14.(c) Differentiate between Network model and Hierarchical model. MDU BCA 2022, 2015

OR

What are the main differences between Hierarchical and Network models?

Gurugram University BCA 2021

Ans. Following are the differences between network and hierarchical model:

Network Model	Hierarchical Model
1. Network model is a collection of records connected to each other through links, i.e., it is based on graph structure.	1. Hierarchical model is a collection of records connected in the form of a tree, i.e., it is based on tree structure.
2. Many–to–many relationship can be expressed in this model.	2. One–to–many relationship can be expressed in this model.
3. Relationship between records is in the form of links or pointers.	3. Relationship between records is parent to child.
4. Implementation is complex due to the use of pointers. Complexity increases as the number of link increases.	4. It is simple, easy to use and natural method of implementing hierarchical relationships.

Network Model	Hierarchical Model
5. Network model does not suffer from the insert anomalies, delete anomalies and update anomalies.	5. Hierarchical model suffers from insertion anomalies, deletion anomalies and updation anomalies.
6. Searching a record is easy as there are multiple access paths. Thus in this model easier access as compared to hierarchical data model.	6. Searching a record is not easy since the processing is sequential along the branches of the tree. Moreover it takes more time to access the nodes.
7. This type of model is useful for representing such records which have many to many relationships.	7. This type of model is useful only when there is some hierarchical character in the database.

Q14.(d) **Differentiate between hierarchical model and relational model.**

IGU BCA 2018

Ans. Following are the differences between hierarchical model and relational model:

Hierarchical Model	Relational Model
1. Hierarchical model is a collection of records connected in the form of a tree.	1. Relational model stores records in the form of tables.
2. One–to–many relationship can be expressed in this model.	2. Many–to–many relationship can be easily expressed in this model.
3. Relationship between records is parent to child.	3. Relationship between records is represented by a relation which have a key field from each record involved in the relationship.
4. General purpose Query facility is not available.	4. General purpose Query facility is available.
5. To represent links among the records, pointers from parents to the children are used. Thus relations among the records are physical.	5. In relational model, relations among the records are not physical. Here data are stored in tables consisting of rows and columns.

Hierarchical Model	Relational Model
6. Searching a record is not easy since the processing is sequential along the branches of the tree. Moreover it takes more time to access the nodes.	6. Searching a record is very easy as a unique key field is used to search a data element.
7. Hierarchical model suffers from insertion anomalies, deletion anomalies and updation anomalies.	7. Relational model does not suffer from the insert anomalies, delete anomalies and update anomalies

Q15.(a) **Discuss database relations and their properties with examples.** MDU BCA 2014

OR

What is a relation? Enumerate the properties of a relation.

Ans. Relation

Relation is essentially a simple table. It may be defined as set of rows (tuples), each row therefore has the same columns (attributes). Since a relation is a sort of tuple, there is no ordering associated with the tuples.

A database relation is used to represent information about any entity and its relationship with other entities in the form of attributes (columns) and tuples (rows).

In relational data model, the data is organized into tables i.e. rows and columns. These tables are called relations. A row in a table represents relationship among a set of values.

Properties of relation

A relation has the following properties:

- *In a relation rows can be in any order.*
- *Columns can be present in any order.*
- *All the rows should be different.*

  The value of each column should come from some common domain.
- *Number of columns of a relation is called its degree.*
- *Number of rows of a relation is called its cardinality.*

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
105	HARPREET	9712	PANIPAT
106	JAGDEEP	625	ROHTAK
107	HANI	7250	SONIPAT

In the above example, the relation Account has degree 4 and cardinality 7.

Q15.(b) What do you mean by key? Explain different types of key with suitable example.

Gurugram University BCA 2021
MDU BCA 2016, 2015

Ans. Key

A key is an attribute (also known as column or field) or a combination of attribute that is used to identify records.

Sometimes one might have to retrieve data from more than one table, in those cases he/she requires to join tables with the help of keys.

The purpose of the key is to bind data together across tables without repeating all of the data in every table.

For example if a table has id, name and address as the column names then each one is known as the key for that table. One can also say that the table has 3 keys as id, name and address. The keys are also used to identify each record in the database table.

Keys are fundamental to relational databases. In fact, without keys, relational databases will not be usable at all.

The power of relational databases comes from the fact that one can split related data into different tables and logically link them together by using keys.

Different types of Keys

Consider a relation STUDENT. Let its attributes as Rollno, Regdno, Name, Class, Address.

STUDENT

Rollno	Regdno	Name	Class	Address
101	05NRG01	HARI	BCA II	ROHTAK
102	05NRG02	RAVI	BCA II	ROHTAK
103	05NRG03	ANIL	BCA II	KARNAL
104	05NNG01	AJAY	BCA III	KARNAL
105	06NRG01	HARISH	BCA I	PANIPAT
106	06NRG02	MOHAN	BCA I	ROHTAK
107	06NRG03	VIJAY	BCA I	ROHTAK

Primary Key

An attribute which recognize a tuple uniquely is called a primary key.

For example, Rollno is a primary key in STUDENT relation.

In some cases, two or more attributes together can form the primary key, such type of key is called concatenated key. In such cases no single attribute can be called as the primary key.

The value of primary key in any tuple cannot be null.

Using primary key in a relation:

- *Relationship between the various relations of the database can be established.*
- *The DBMS can quickly search and access data from the relations.*

Secondary Key

A secondary key does not uniquely identify a tuple of a relation.

For example, Name, Class and Address are the secondary keys in STUDENT relation.

Candidate Key

There may be more than one attributes in a relation that recognize a tuple uniquely. These attributes are called candidate keys.

For example, in the relation STUDENT, Rollno and Regdno are candidate keys.

Alternate Key

Out of candidate keys, one is chosen as a primary key. Candidate key which is not primary key is called alternate key.

For example, if Rollno is taken as primary key then Regdno is the alternate key.

The significance of defining an alternate key is as follows:

- *The DBMS creates and uses an index based on the alternate key.*
- *Searching based on an alternate key is quicker than searching based on a non-key column, because of the index.*
- *Unlike a primary key, an alternate key can have duplicates.*

Foreign key

Foreign keys are extremely important in the context of table inter-relation-ships.

If a non key attribute in one relation appears as the primary key in another relation, it is called foreign key.

For example, consider relation Account and Branch of a banking organization database.

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
105	HARPREET	9712	PANIPAT
106	JAGDEEP	625	ROHTAK

Branch

Distt	State
ROHTAK	HARYANA
SIRSA	HARYANA
PANIPAT	HARYANA
HISSAR	HARYANA
KARNAL	HARYANA
AMBALA	HARYANA
JHAJJAR	HARYANA

Distt of relation Account is foreign key since it is primary key of relation Branch.

Q16.(a) Explain integrity rule/constraints. Describe their importance. **MDU BCA 2022, 2015**

OR

Discuss entity integrity and referential integrity constraints. Why each is considered important? **MDU BCA 2017**

Ans. Integrity rule/Constraints

Integrity rule/constraints are basically the rules. These rules must be followed to have an accurate database.

There are two integrity constraints:

1. Entity Integrity Rule
2. Referential Integrity Rule

1. Entity Integrity Constraint

No attribute of a primary key can have a null value. This is because primary key values are used to identify the individual tuples. This constraint is known as Entity Integrity Constraint.

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
107	HARPREET	9712	PANIPAT
		625	ROHTAK
	JAGDEEP	7250	SONIPAT

Not allowed

Entity Integrity ensure that there is no duplicate records in the table and each field that recognizes each record in the table must have unique value and not having null values.

Entity Integrity specifies that every instance of entity have the unique values, i.e., primary key must be kept and must have the values other than null values.

2. Referential Integrity Constraint

It states that "If a foreign key in relation R_1 refers to the primary key of relation R_2, then every value of the foreign key in relation R_1 must be available in relation R_2".

Example:

Account

Accountno	Name	Balance	Distt
101	RAVI	40500	ROHTAK
102	HARI	70000	ROHTAK
103	MOHAN	10000	HISSAR
104	RAVINDER	10761	SIRSA
105	HARPREET	9712	PANIPAT
106	JAGDEEP	625	ROHTAK
107	HANI	7250	SONIPAT

Branch

Distt	State
ROHTAK	HARYANA
SIRSA	HARYANA
PANIPAT	HARYANA
HISSAR	HARYANA
KARNAL	HARYANA
AMBALA	HARYANA
JHAJJAR	HARYANA

Distt of relation Account is foreign key. Thus Distt Sonipat is not allowed in Account relation because it is not available in Branch relation.

Referential Integrity is a property of data which when satisfied, requires every value of one attribute of a relation to exist as a value of another attribute in a different relation.

For referential integrity to hold in a relational database, any field in a table that is declared a foreign key can contain only values from a parent table's primary key. For instance, deleting a record that contains a value referred to by a foreign key in another table would break referential integrity.

Referential Integrity is used to maintain the consistency among tuples of the two relations.

Importance of integrity constraints

Integrity constraints are an important component of the relational database machinery. They are often defined as conditions that a database instance must satisfy at all times. Thus, integrity constraints has permeated database practice and nowadays their use is everywhere in all modern database management systems.

Q16.(b) Out of three models: Hierarchical, Network and Relational data model, which data model do you select?

Ans. The data model that best suits an organization depends on the following factors:

1. *The organization's primary goals and requirements.*
2. *The volume of daily transactions.*
3. *The estimated number of enquiries made by the organization.*

Out of these three models, the relational data model is most widely used because

- *It can be used for representing most of the real world objects and the relationships among them.*
- *Security and integrity are maintained easily by the relational data model.*
- *The use of relational model for database design increases the productivity of application programs since it eliminates the need to change the application programs when a change is made to the database.*
- *Relational tables show only the logical relationship. End users need not know the exact physical structure of a table or relation.*

Network data model is also free from anomalies but due to its complex nature it is not a preferred model.

Since hierarchical model suffers from lot of anomalies, it is useful only for those cases which are hierarchical in nature.

Q17.(a) What are the various set operational in relational algebra? Explain with example.

MDU BCA 2022

OR

What are the various operators in relational algebra? Explain with examples.

MDU BCA 2015

Ans. Relational Algebra

Relational algebra is a set of operations that can be used to manipulate relations.

It is a procedural query language. It takes one or more than one relations as input and produces a new relation as output. Thus the result of a query in relational algebra is always a relation.

The basic operations in relational algebra are:

1. Select
2. Project
3. Cartesian Product
4. Union
5. Set Difference
6. Set Intersection
7. Join
8. Division

1. Select (σ) Operation

To select tuples of a relation depending upon a condition being true, the operation is known as a select operation.

The symbol sigma (σ), a Greek letter, is used to denote select operation. The format of select operation is given below:

$\sigma_{<cond>}$ (<relation>)

where

<cond> : is the condition that must be satisfied.
<relation> : is the relation on which the select operation is applied.

e.g. To find all the tuples of relation Student where age is greater than 17

Student

Rollno	Name	Class	Age
101	Hari	BCA I	17
102	Ravi	BCA I	18
103	Mohan	BCA II	18
104	Ajay	BCA II	18
105	Anil	BCA I	17
106	Harish	BCA III	19
107	Anshul	BCA I	18

A query in relational algebra will be expressed as:

$\sigma_{age > 17}$ (Student)

The result of such a query will be the following relation:

Rollno	Name	Class	Age
102	Ravi	BCA I	18
103	Mohan	BCA II	18
104	Ajay	BCA II	18
106	Harish	BCA III	19
107	Anshul	BCA I	18

The comparison operators allowed in the condition expression are:

$=, \neq, <, \leq, >, >$

Connectives and ($\wedge$), or ($\vee$) can be used to combine two or more conditions.

e.g. **To find all the tuples of relation Student where age is equal to 17 and class is 'BCA I'.**

For this a query in relational algebra will be expressed as:

$$\sigma_{age = 17 \wedge class = \text{"BCA I"}} (\text{Student})$$

The result of such a query will be the following relation:

Rollno	Name	Class	Age
101	Hari	BCA I	17
105	Anil	BCA I	17

2. Projection (π) Operation

A projection operation on a relation produces a relation with certain columns left out i.e. it produces the relation minus certain columns.

Projection is denoted by the symbol π (Pi), a Greek letter. The attribute list is specified as a subscript to π that should appear in the result.

The format of this operation is given below:

$\pi_{a1, a2, \ldots, an}$ (<name>)

where

a1, a2, ..., an : is the list of attributes to be projected

<name> : is the name of the relation.

e.g. (i) To have a relation showing rollno and name from the relation Student, the query is:

$$\pi_{rollno, name} (\text{Student})$$

The result is the following relation:

Rollno	Name
101	Hari
102	Ravi
103	Mohan
104	Ajay
105	Anil
106	Harish
107	Anshul

(ii) To find the rollno, name, class of the students with age greater than 17, the query is:

$$\pi_{\text{rollno, name, class}} (\sigma_{\text{age} > 17}(\text{Student}))$$

The result is the following relation:

Rollno	Name	Class
102	Ravi	BCA I
103	Mohan	BCA II
104	Ajay	BCA II
106	Harish	BCA III
107	Anshul	BCA I

(iii) To find class of the students, the query is:

$$\pi_{\text{class}} (\text{Student})$$

The result is the following relation:

Class
BCA I
BCA II
BCA III

Thus, the resulting relation has only the name of classes with the duplicate entries removed.

3. Cartesian Product (×) Operation

The Cartesian product of two relations A and B is a relation which is concatenation of every tuple of relation A with every tuple of relation B.

The cartesian product of relation A having m tuples and relation B having n tuples has m × n tuples. The product is denoted as A × B.

e.g.(i) Consider two relations A and B and their cartesian product C then C = A × B

A

a_1	a_2	a_3
x_1	x_2	x_3
y_1	y_2	y_3
z_1	z_2	z_3

×

B

b_1	b_2
p_1	p_2
q_1	q_2

=

C

a_1	a_2	a_3	b_1	b_2
x_1	x_2	x_3	p_1	p_2
x_1	x_2	x_3	q_1	q_2
y_1	y_2	y_3	p_1	p_2
y_1	y_2	y_3	q_1	q_2
z_1	z_2	z_3	p_1	p_2
z_1	z_2	z_3	q_1	q_2

Thus, the relation C has the attributes of both the relations A and B and tuple of relation A appears with all tuples in relation B.

(ii) Let relation Student has four tuples and relation Test has two tuples as shown below:-

Student

Rollno	Name	Class	Age
101	HARI	BCA I	17
102	RAVI	BCA I	18
103	MOHAN	BCA II	18
104	AJAY	BCA II	18

Test

Date	Time
30/03/08	9.00
03/04/08	14.00

Student × Test will have 8 tuples as shown below:

Rollno	Name	Class	Age	Date	Time
101	HARI	BCA I	17	30/03/08	9.00
101	HARI	BCA I	17	03/04/08	14.00
102	RAVI	BCA I	18	30/03/08	9.00
102	RAVI	BCA I	18	03/04/08	14.00
103	MOHAN	BCA II	18	30/03/08	9.00
103	MOHAN	BCA II	18	03/04/08	14.00
104	AJAY	BCA II	18	30/03/08	9.00
104	AJAY	BCA II	18	03/04/08	14.00

4. Union (∪) Operation

Two relations are union compatible if

- ***The degree of two relations is same***
- ***Their corresponding attributes are defined on the same domain.***

The union operation can be applied to two relations if they are union compatible. The union of two relations A and B, denoted as A∪B, is the set of all tuples that belong to A or B or both. In the resultant relation, the duplicate tuples are eliminated.

e.g. Consider two relations Musicgp and Sportgp as given below:

Musicgp

Rollno	Name	Class	Age
101	HARI	BCA I	17
102	RAVI	BCA I	18
103	MOHAN	BCA II	18
104	AJAY	BCA II	18
105	ANIL	BCA I	17
106	HARISH	BCA III	19
107	ANSHUL	BCA I	18

Sportgp

Rollno	Name	Class	Age
104	AJAY	BCA II	18
201	BAJENDER	BCA III	20
205	RAJVIR	BCA III	20
211	RAMU	BCA I	17
225	RAJU	BCA III	19

Musicgp ∪ Sportgp =

Rollno	Name	Class	Age
101	HARI	BCA I	17
102	RAVI	BCA I	18
103	MOHAN	BCA II	18
104	AJAY	BCA II	18
105	ANIL	BCA I	17
106	HARISH	BCA III	19
107	ANSHUL	BCA I	18
201	BAJENDER	BCA III	20
205	RAJVIR	BCA III	20
211	RAMU	BCA I	17
225	RAJU	BCA III	19

5. Set Difference (–) operation

The set difference operation can be applied to two relations if they are union compatible.

The difference between two relations A and B is the set of all tuples that belong to A and not to B.

e.g. Consider two relations Musicgp and Sportgp.

(i) Musicgp – Sportgp is the set of tuples for students who are in Musicgp and are not in Sportgp.

Musicgp – Sportgp =

Rollno	Name	Class	Age
101	HARI	BCA I	17
102	RAVI	BCA I	18
103	MOHAN	BCA II	18
105	ANIL	BCA I	17
106	HARISH	BCA III	19
107	ANSHUL	BCA I	18

(ii) To obtain the name of the students who are in music group but not is sport group, the query is written as:

$$\pi_{name}(\text{Musicgp}) - \pi_{name}(\text{Sportgp})$$

The result of this querry is

Name
HARI
RAVI
MOHAN
ANIL
HARISH
ANSHUL

6. Set intersection (∩) Operation

If two relations A and B are union compatible then they can participate in an intersection operation.

The intersection of two relations A and B is defined as the set of all tuples that belong to both A and B. It is denoted by the symbol '∩'.

e.g. Consider two relations Musicgp and Sportgp.

(i) Musicgp $\cap$ Sportgp

Rollno	Name	Class	Age
104	AJAY	BCA II	18

(ii) To obtain the name of the students who are in music group as well as in sport group, the query is written as:

$$\pi_{name}(\text{Musicgp}) \cap \pi_{name}(\text{Sportgp})$$

The result of this query is

Name
AJAY

7. Join ($\bowtie$) Operation

It is a binary operation and combines two relations into a single relation. It is denoted by the symbol $\bowtie$.

It is equivalent to taking the Cartesian product of two relations and then performing a suitable selection from the Cartesian product. There are many ways to combine two relations to form a new relation. In general each join operation takes tuples from two relations and combine them together to form a single tuple where the tuples satisfy the specified condition(s).

Equijoin:

In equijoin operation the join condition includes one or more equality comparison involving attributes from two relations A and B.

e.g. Consider the relations Student and Position.

Student

Rollno	Name	Class	Age
101	HARI	BCA I	17
102	RAVI	BCA I	18
103	MOHAN	BCA II	18
104	AJAY	BCA II	18
105	ANIL	BCA I	17

Position

SID	Rank
103	1
105	2

The Cartesian product of Student and Position is shown below:

Student × Position

Rollno	Name	Class	Age	SID	Rank
101	HARI	BCA I	17	103	1
101	HARI	BCA I	17	105	2
102	RAVI	BCA I	18	103	1
102	RAVI	BCA I	18	105	2
103	MOHAN	BCA II	18	103	1
103	MOHAN	BCA II	18	105	2
104	AJAY	BCA II	18	103	1
104	AJAY	BCA II	18	105	2
105	ANIL	BCA I	17	103	1
105	ANIL	BCA I	17	105	2

To know the rank of each student in the class, join Student tuples with matching Position tuples. Such a join is denoted as Student tuple to an Position tuple if Rollno of student equals SID of Position.

The query is written as:

Student ⋈ Rollno = SID (Position)

Rollno	Name	Class	Age	SID	Rank
103	MOHAN	BCA II	18	103	1
105	ANIL	BCA I	17	105	2

(Equijoin)

Two attributes Rollno and SID are identical.Natural join eliminates the redundant join attributes.

Rollno	Name	Class	Age	Rank
103	MOHAN	BCA II	18	1
105	ANIL	BCA I	17	2

(Natural Join)

Normally, unless otherwise specified, the join means natural join.

8. Division (÷) Operation

Division operation is applied to queries that have the phrase "for all". It is denoted by ÷

The division operator divides a dividend relation A of degree m+n by a divisor relation B of degree n, the result produced is a relation of degree m.

e.g. Consider the following two relations Branch and Account

Branch

Branch_name	State
Rohtak	Haryana
Karnal	Haryana
Jalandhar	Punjab
Ludhana	Punjab

Account

Accountno	Customer_name	Branch_name
27421	HARI	Rohtak
28242	RAVI	Karnal
27437	JAGIT	Rohtak
47232	MANPREET	Jalandhar
48247	MANJEET	Ludhana
26242	HARI	Karnal

Consider a query, to find the names of those who are customers for all the branches in the state Haryana.

(i) First to find all the branch_names in Haryana, the query is written as:

$\pi_{\text{branch_name}} (\sigma_{\text{state = "Haryana"}} (\text{Branch}))$

The result of this query is:

Branch_name
Rohtak
Karnal

(ii) Secondly, find the customer_name and branch_name from the relation Account.

The query is written as

$\pi_{\text{customer_name, branch_name}} (\text{Account})$

The result of this query is:

Customer_name	Branch_name
HARI	Rohtak
RAVI	Karnal
JAGIT.	Rohtak
MANPREET	Jalandhar
MANJEET	Ludhana
HARI	Karnal

(iii) Finally, to find the names of those who are customers for all the branches in the state Haryana, the query is:

$$\pi_{\text{customer_name, branch_name}} (\text{Account}) \div \pi_{\text{branch_name}} (\sigma_{\text{state = "Haryana"}} (\text{Branch}))$$

The result of this query is:

Customer_name
HARI

Q17.(b) Explain the operators of relational calculus with the help of examples.

Ans. Relational Calculus

Relational Calculus is a non-procedural query language. In it, the query is expressed as a formula consisting of a number of variables and an expression involving these variables. How this formula is evaluated, there is no specified rule. Everything depends upon the DBMS to transfer these non procedural queries into equivalent procedural queries.

The two forms of relational calculus are:

1. Tuple relational calculus
2. Domain relational calculus

1. Tuple relational calculus

Tuple relational calculus is basically used to select a set of tuples for which a given formula is true.

The formula is specified in expression. The expression is used in defining the result of a query, updating the query or viewing the query. Any query in tuple relational calculus is expressed as: { **a** | P(**a**) } i.e. the set of all tuples **a** such that the formula or predicate P is true for **a**.

Tuple relational calculus may include the following:

(a) Comparison Operators

Comparison operators are:

= equal to.	¬ = not equal to
> greater than	>= greater than or equal to
< less than	<= less than or equal to

(b) Boolean Operators

Boolean operators are:

$\wedge$ AND

$\vee$ OR

$\neg$ NOT

(c) Quantifiers

Quantifiers are:

$\exists$ there exists

$\forall$ for all

Formula or predicate are built from atoms using the following rules:

- An atom is a formula.
- If F_1 and F_2 are formulae then $\neg F_1$, $\neg F_2$, $F_1 \wedge F_2$, $F_1 \vee F_2$ and $F_1 \Rightarrow F_2$ are also formulae.

An atom may have the following forms:

(i) $a \in R$

where

- a is tuple variable.
- R is relation.

(ii) $a_1[K_1]$ © $a_2[K_2]$

(iii) $a_1[K_1]$ © constant

where

- K_1 is an attribute corresponding to tuple variable a_1.
- K_2 is an attribute corresponding to tuple variable a_2.
- © is comparison operator.

(iv) a[K] denotes the value of tuple a on attribute K.

Example: Consider the following relation Student

Student

Rollno	Name	Class	Age
101	HARI	BCA I	17
102	RAVI	BCA I	18
103	MOHAN	BCA II	18
104	AJAY	BCA II	18
105	ANIL	BCA I	17
106	HARISH	BCA III	19
107	ANSHUL	BCA I	18

(i) To find the tuples of Student relation where the class is BCA I. The query is formed as:

$$\{ a \mid a \in \text{Student} \wedge a[\text{class}] = \text{"BCA I"} \}$$

This query has two atoms

- $a \in$ Student &
- a[class] = "BCA I"

connected by 'and' operator.

This query selects the tuples that belong to relation Student and have "BCA I" in class attribute.

(ii) To find the tuples of Student relation that have age greater than 17. The query is formed as

$$\{ a \mid a \in \text{Student} \wedge a[\text{age}] > 17 \}$$

(iii) To get only the names of all the students who have age greater than 17. The query is formed as

$$\{a \mid \exists\, b \in \text{Student}\ (a[\text{name}] = b[\text{name}] \wedge b[\text{age}] > 17)\}$$

This query is read as:

"The set of all tuples a such that there exist tuple b in relation Student for which the value of tuple a and tuple b for the name attribute are equal and tuple b has value of age attribute greater than 17."

The result of this query has only one attribute name since a is defined only on name attribute.

Free Variable

A variable is said to be free variable if it is not quantified by '∃' or '∀' operators.

e.g. $\{ a \mid a \in \text{Student} \wedge a[\text{age}] > 17 \}$

In this example a is a free variable.

Bound Variable

A variable is said to be bound variable if it is quantified by '∃' or '∀' operator.

e.g. $\{a \mid \exists\, b \in \text{Student}\ (a[\text{name}] = b[\text{name}] \wedge b[\text{age}] > 17)\}$

In this example a is a bound variable.

2. Domain relational calculus

In domain relational calculus, domain variables are used which can take values from an attribute domain, instead of entire tuple or tuple elements.

Any query in domain relational calculus is expressed as:

$\{ < a_1, a_2, \ldots, a_n > \mid f(a_1, a_2, \ldots, a_n) \}$

where

- $a_1, a_2, \ldots, a_n$ are domain variables.
- $f(a_1, a_2, \ldots, a_n)$ represents a formula.

It may include the following:

(a) Comparison Operators

Comparison operators are:

= equal to.	¬ = not equal to
> greater than	>= greater than or equal to
< less than	<= less than or equal to

(b) Boolean Operators

Boolean operators are:

∧ AND
∨ OR
¬ NOT

(c) Quantifiers

Quantifiers are:

∃ there exists
∀ for all

Formula or predicate are built from atoms using the following rules:

- An atom is a formula.
- If F_1 and F_2 are formulae then $\neg F_1$, $\neg F_2$, $F_1 \wedge F_2$, $F_1 \vee F_2$ and $F_1 \Rightarrow F_2$ are also formulae.

An atom of domain relational calculus has one of the following forms:

(i) $a_1, a_2, \ldots, a_n \in R$

where

- $a_1, a_2, \ldots, a_n$ are domain variables or domain constants corresponding to n attributes of relation R
- R is relation.

(ii) a_1 © a_2

where

- a_1 and a_2 are domain variables.
- © is a comparison operator.

(iii) a_1 © c

where

- a_1 is domain variable.
- c is a constant in the domain of the attribute for which a_1 is a domain variable.
- © is a comparison operator.

Example: Consider the relation Student(rollno, name, class, age)

(i) To find the rollno, name, class and age of relation Student having age greater than 17, the query is formed as:

$\{ < a_1, a_2, a_3, a_4> \mid < a_1, a_2, a_3, a_4> \in \text{Student} \wedge a_4 > 17\}$

Here a_1, a_2, a_3, a_4 are domain variables corresponding to attributes rollno, name, class, age.

(ii) To find all classes in which student have age greater than 17. the query is formed as

$\{< a_3> \mid \exists\, a_1, a_2, a_4 (< a_1,a_2,a_3,a_4> \in \text{Student} \wedge a_4 > 17\}$

Here a_1, a_2, a_3, a_4 are domain variables corresponding to attributes rollno, name, class, age.

Q18.(a) Explain by giving examples, the conditions that are necessary for a relation to be in 1NF, 2NF, 3NF, BCNF, 4NF. MDU BCA 2022, 2015

OR

What is the need of normalization? Define and discuss 1NF, 2NF, 3NF and BCNF by giving suitable example for each. MDU BCA 2018

OR

Define normalization. How is it useful and used? Explain by giving examples, the conditions that are necessary for a relation to be in 1NF, 2NF, 3NF, BCNF. MDU BCA 2016

OR

What is normalization? Explain the different types of normalization with suitable example.

Ans. Normalization

It is a design technique that is widely used in designing relational model.

Normalization is a process that removes the following undesirable properties in a relation:

- ***Repetition of information i.e. redundancy.***
- ***Inability to store some information i.e. insertion anomaly.***
- ***Loss of information in deletion i.e. deletion anomaly.***
- ***Problem in updations.***

Normalization is basically a decomposition method in which a relation having undesirable dependency is split into two or more relations and thus removes the undesirable dependencies.

1. First Normal Form (1NF)

A relation is said to be in 1NF if the values in the domain of each attribute of the relation are atomic.

A value is said to be atomic only if it is indivisible, for example, set of integers. Thus, any normalized relation is in 1 NF.

Example: Consider the relation FIRST (S#, STATUS, CITY, P#, QTY)

FIRST

S#	STATUS	CITY	P#	QTY
S_1	30	Delhi	P_1	275
S_1	30	Delhi	P_2	175
S_1	30	Delhi	P_3	375
S_1	30	Delhi	P_4	175
S_1	30	Delhi	P_5	100
S_1	30	Delhi	P_6	100
S_2	20	Rohtak	P_1	275
S_2	20	Rohtak	P_2	375
S_3	20	Rohtak	P_2	175
S_4	30	Delhi	P_2	175
S_4	30	Delhi	P_4	275
S_4	30	Delhi	P_5	375

Here it is assumed that:

- ***Each supplier has a unique supplier number (S#).***
- ***A supplier can supply different parts.***
- ***STATUS is functionally dependent on CITY.***
- ***The primary key of FIRST relation is the combination of (S#, P#).***

The following functional dependencies hold in FIRST relation:

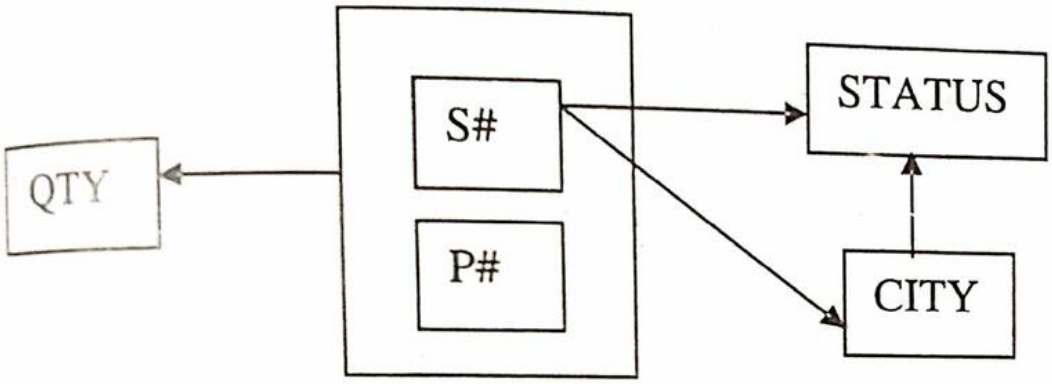
S# → CITY

S# → STATUS

CITY → STATUS

(S#, P#) → QTY

Figure shows the functional dependency diagram for this relation.



The relation FIRST is in 1NF.

Consider another relation Bookrecord (Bookno, Book_name, Authors)

Bookrecord

Bookno	Book_name	Authors
101	Fundamental	Suman, Ajay
102	Data Structure	Supriya, Anshul
103	DBMS	Ravi, Hari

The above relation is not in 1 NF since the values in the attribute Authors are not atomic.

A relation that is only in 1 NF leads to complex functional dependencies. It also leads to a number of other anomalies in updation.

The relation FIRST which is in 1 NF has the following anomalies:

(i) Inserting

The facts like a particular supplier is located in a particular city cannot be entered until that supplier supplies at least one part.

For example, the relation FIRST does not show supplier S_5 is located in Karnal. The reason is that S_5 does not supplies any part.

(ii) Deleting

If a particular supplier is deleted, the information that the supplier is located in a particular city is also destroyed. For example, if the tuple with S# value S_3 and P# value P_2 is deleted, the information that S_3 is located in Rohtak is also lost.

(iii) Updating

The CITY value for a given supplier appears many times in the relation FIRST. This redundancy causes update problems.

The solution of these problems is 2 NF.

2. Second Normal Form (2NF)

A relation is said to be in second normal form (2 NF) if it satisfies the following conditions:

- ***It is in 1 NF.***
- ***Every non-key attribute should be fully functional dependent on primary key.***

An attribute is non-key if it does not participate in the primary key.

The relation FIRST is not in 2 NF though it is in 1 NF. It can be reduced into relations that are in 2 NF. Infact

every relation that is in 1 NF can be reduced into a set of relations that are in 2 NF form.

Reduction of 1 NF relation into 2 NF relation is done by projecting some attributes into another relation.

The relation FIRST is reduced into two relations SECOND(S#, STATUS, CITY) and SP(S#, P#, QTY).

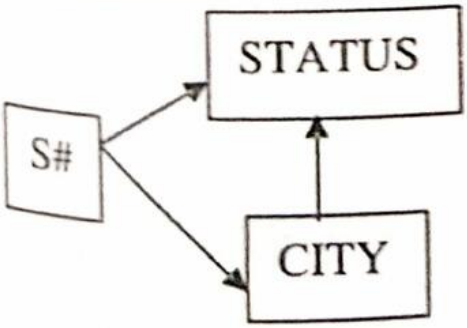
SECOND

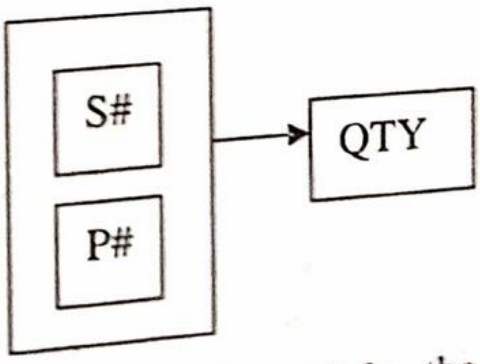
S#	STATUS	CITY
S1	30	Delhi
S2	20	Rohtak
S3	20	Rohtak
S4	30	Delhi
S5	15	Karnal

SP

S#	P#	QTY
S_1	P_1	275
S_1	P_2	175
S_1	P_3	375
S_1	P_4	175
S_1	P_5	100
S_1	P_6	100
S_2	P_1	275
S_2	P_2	375
S_3	P_2	175
S_4	P_2	175
S_4	P_4	275
S_4	P_5	375

The functional dependency diagrams for these two relations are:





These two relations SECOND and SP satisfy the conditions of 2 NF and hence are in 2 NF. These

relations overcome all the update problems involved with relation FIRST.

Now

(i) Even though S_5 does not supply any part, the information that S_5 is located in Karnal can be entered, by inserting the appropriate tuple in the relation SECOND.

(ii) One can delete the tuple with S# value S_3 and P# value P_2 by deleting the appropriate tuple from relation SP. There is no lose of information that S_3 is located in Rohtak.

(iii) The city for a given supplier appears once. Thus one can change the city for a supplier by changing it once.

Relation SP is alright but relation SECOND still causes problems due to transitive functional dependence on S#. In SECOND, S# determines CITY and CITY determines STATUS then transitively, S# determines STATUS.

The relation SECOND which is in 2 NF has the following anomalies:

(i) Inserting

One cannot enter the fact that a particular city has a particular status value until a supplier from that particular city. For example, one can not enter the status of Panipat until a supplier from Panipat.

(ii) Deleting

To delete a particular supplier, the information that the city has that particular status value is destroyed. For example, if one deletes the tuple S_5, the information that the status for Karnal i.e. 15 will be lost.

(iii) Updating

The status value for a given city in relation SECOND appears many times. This redundancy causes update problems.

The solution of these problems is 3 NF.

3. Third Normal Form

A relation is said to be in third normal form (3 NF) if

- *It is in 2 NF.*
- *Every **non-key attribute** is **non-transitively** dependent on primary key.*

The relation SECOND is in 2 NF but not in 3 NF. Thus this relation is reduced into SC(S#, CITY) and CS(CITY, STATUS) as shown below:

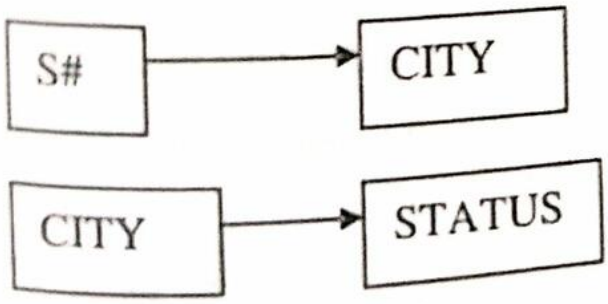
SC

S#	CITY
S1	Delhi
S2	Rohtak
S3	Rohtak
S4	Delhi
S5	Karnal

CS

CITY	STATUS
Delhi	30
Rohtak	20
Karnal	15

The corresponding functional dependency diagrams are shown below:



Relation SC, CS and SP are in 3 NF.

4. Boyce-Codd Normal Form (BCNF)

A normalized relation is in Boyce-Codd Normal form if every determinant is a candidate key.

A determinant is an attribute in a relation on which some other attribute of the relation is fully functionally dependent.

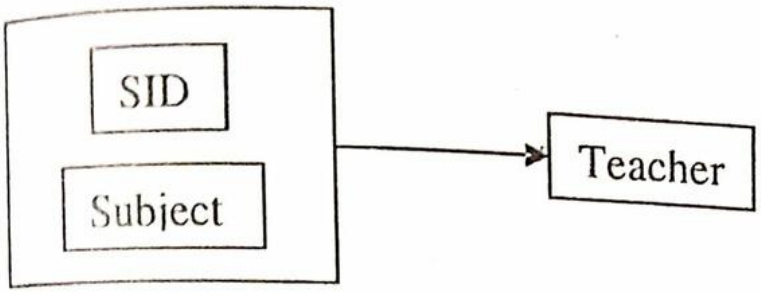
Every BCNF is in 3 NF. Relation FIRST has three determinants. S#, CITY and the combination (S#, P#). Out of these only (S#, P#) is a candidate key. Hence FIRST is not in BCNF. Relation SECOND is also not in BCNF because the determinant CITY is not a Candidate key. Relations SP, SC and CS are each in BCNF because in each case the primary key is the only determinant in the relation.

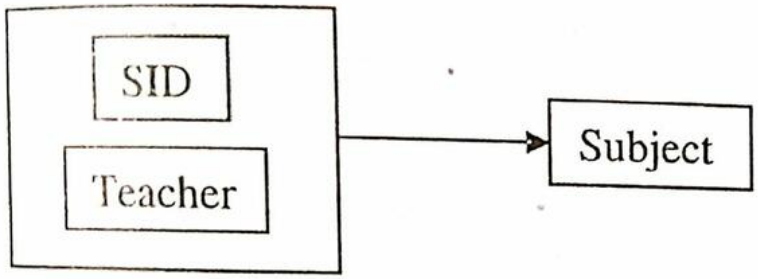
For example, consider the relation Guide(SID, Subject, Teacher)

- It is assumed that
  - A student can select one or more subjects.
  - A teacher teaches only one subject.
  - A subject can be taught by many teachers.
- Since students can select several subjects, SID does not determine subject. Also students can be taught by several teachers, SID does not determine Teacher. Thus SID cannot be a primary key.
- The two possible composite keys are (SID, Subject) and (SID, Teacher).
- Since a teacher teaches only one subject. Thus teacher determine subject i.e. teacher is a determinant.

Guide

SID	Subject	Teacher
101	English	Ravi
101	Maths	Hari
102	English	Ravi
102	Hindi	Ramesh
103	Maths	Ravinder





In the relation Guide, there are three determinant (SID, SUBJECT), (SID, Teacher) and Teacher. Out of these (SID, Subject), (SID, Teacher) can be candidate key. Hence relation Guide is not BCNF.

Moreover if one deletes student 103's tuple, there is loss of information that Ravinder teaches Maths. This is deletion anomaly. Similarly one can not store the information that Harnaam teaches Computer if there is no student in computer subject. This is insertion anomaly.

Thus Guide relation can be decomposed into two relations Std_guide (SID, Subject) and Teacher_sub (Teacher, Subject)

Std_guide

SID	Subject
101	English
101	Maths
102	English
102	Hindi
103	Maths

Key: (SID, Subject)

Teacher_sub

Teacher	Subject
Ravi	English
Hari	Maths
Ramesh	Hindi
Ravinder	Maths

Key : Teacher

Thus relations Std_guide and Teacher_sub are in BCNF.

5. Fourth Normal Form

*A relation is said to be in **fourth normal form** (4 NF) if*

- *It is in BCNF.*
- *It has no multi valued **dependencies.***

Given a relation R with attributes A, B and C. Multivalued dependency represents a dependency between these attributes such that

- A leads to multiple values of C and B
- B and C are independent of each other.

MVD between attributes A, B and C in a relation R can be indicated as

$$A \twoheadrightarrow B \quad (\text{A multidetermines B})$$

$$A \twoheadrightarrow C \quad (\text{A multidetermines C})$$

Multivalued dependency in a relation is due to first normal form, which disallows an attribute in a row from having a set of values.

For example, consider the relation Student(SID, Subject, Activity)

Student

SID	Subject	Activity
101	English	Skating
101	Maths	Skating
101	English	Cricket
101	Maths	Cricket
102	Computer	Swimming

Here SID leads to multiple values of Subject and multiple values of Activity. Subject and Activity are independent of one another.

These multivalued dependencies can be indicated as:

$$SID \twoheadrightarrow Subject$$
$$SID \twoheadrightarrow Activity$$

To remove this problem decompose the relation as:

SID	Subject
101	English
101	Maths
102	Computer

SID	Activity
101	Skating
101	Cricket
102	Swimming

Usefulness of Normalization

Normalization is useful to remove the various anomalies present in the relation. Normalization of a database helps in modifying the design at later times and helps in being prepared if a change is required in the database design. Normalization raises the efficiency of the database in terms of management, data storage and scalability.

Q18.(b) Write short note on various types of functional dependencies with examples.

OR

Explain functional dependency, full functional dependencies, partial dependencies, transitive dependencies and multi valued dependencies with the help of suitable examples.

Ans. Functional Dependency

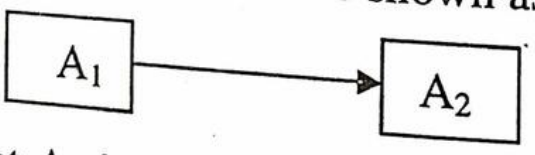
Functional dependency is the relationship between the attributes or fields of a relation.

An attribute A_2 of relation R is said to be functionally dependent on another attribute A_1 of the same relation if there is only one value of A_2 corresponding to A_1.

In other words whenever two tuples of R, agree on their A_1 value then they also agree on their A_2 value. Mathematically for any two tuples t_1 and t_2 of R

$$t_1[A_1] = t_2[A_1] \Rightarrow t_1[A_2] = t_2[A_2]$$

Diagrammatically this can be shown as:



Saying that A_2 is functionally dependent on A_1 is same to say that A_1 determines A_2.

Example: Consider a relation Item (Item_code, Item_name, Price, Qty).

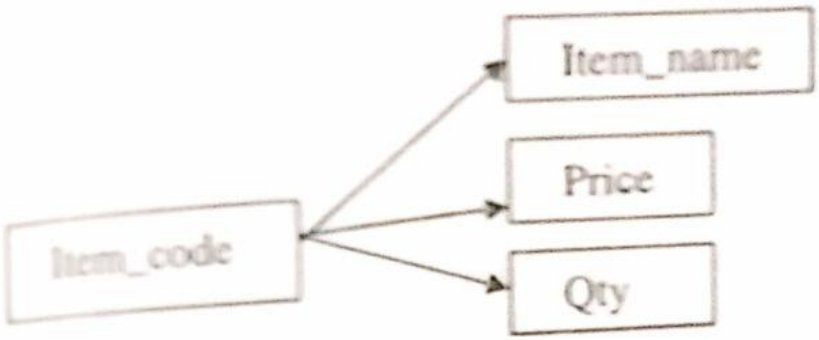
Item

Item_code	Item_name	Price	Qty
101	Pen	10	50
102	Pencil	2	100
103	Eraser	1	50
104	Sharpener	2	75

Here, each of the attributes Item_name, Price, Qty is functionally dependent on the attribute Item_code.

Thus Item_code ⟶ Item_name
Item_code ⟶ Price
Item_code ⟶ Qty

The functional dependency diagram of relation Item can be shown as:



Types of functional dependencies

Various types of functional dependencies are:

1. Fully functional dependency
2. Partial dependency
3. Transitive dependency
4. Multi valued dependency
5. Join dependency

1. Fully functional dependency

In a relation R, an attribute or a collection of attributes Y is said to be fully functionally dependent on another collection of attributes X if it is functionally dependent on whole of X but not functionally dependent on any subset of X.

Example: Consider the relation Result(Rollno, Course_code, Term, Grade)

Result

Rollno	Course_code	Term	Grade
5001	101	1	A
5001	102	2	B
5001	103	3	A
5002	101	1	C
5002	104	2	B
5002	107	3	A
5003	101	1	A
5003	105	2	A
5003	106	3	C

Here, it is assumed that:

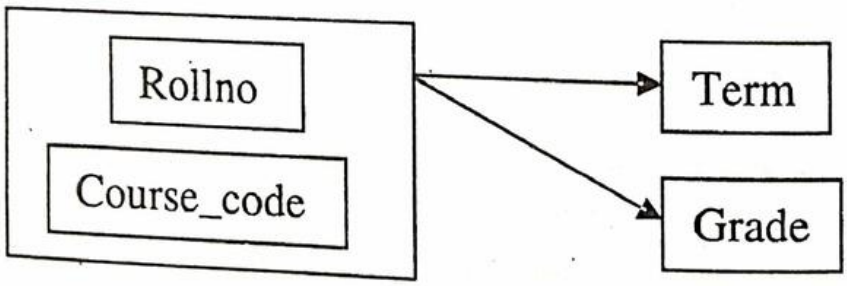
- A course can be offered to different students in different terms and
- A student can take a course only once.

Thus, the attributes Term and Grade are individually fully functional dependent upon the Primary key (Rollno,Course_code).

Rollno, Course_code ⟶ Term

Rollno, Course_code ⟶ Grade

The fully functional dependency diagram of relation Result can be shown as:



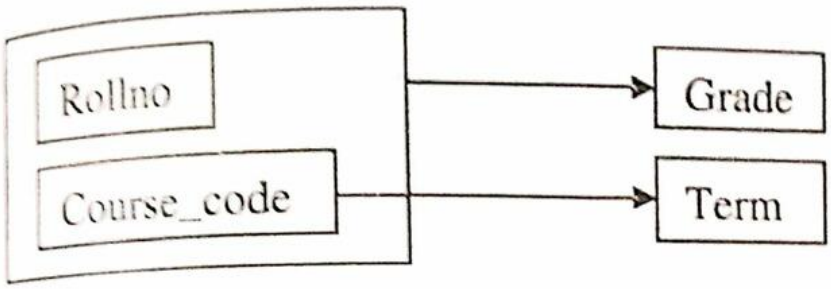
2. Partial Dependency

If a dependency will not follow the rules of fully functional dependency then it is called partial functional dependency.

For example, if it is assumed that a course is offered in only one term, then the attribute Term becomes functionally dependent on Course_code only.

Thus it is a partial functional dependency because Term is not fully functionally dependent on the primary key(Rollno, Course_code).

In this case, the functional dependency diagram will be:



3. Transitive dependency

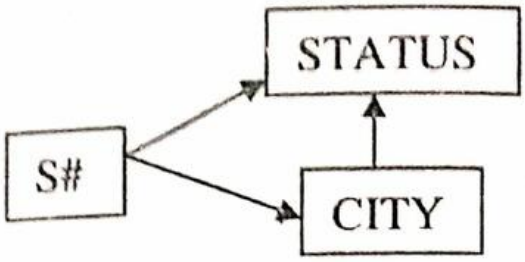
Let A, B and C are the set of attributes of the relation R. Let $A \rightarrow B$, $B \rightarrow C$ *and* $A \rightarrow C$. *If all these conditions are true, then attribute C is transitively dependent on attribute A.*

If any of these functional dependencies is not true then attribute C is not transitively dependent on attribute A.
Consider the following relation SECOND.
Here S# → City, City → STATUS and S# → STATUS

SECOND

S#	STATUS	CITY
S1	30	Delhi
S2	20	Rohtak
S3	20	Rohtak
S4	30	Delhi
S5	15	Karnal

Figure shows the functional dependency diagram for this relation.



Attribute STATUS is transitively dependent on attribute S#. If the relation SECOND is reduced into SC(S#, CITY) and CS(CITY, STATUS), then there does not exist any transitively dependency as shown below:

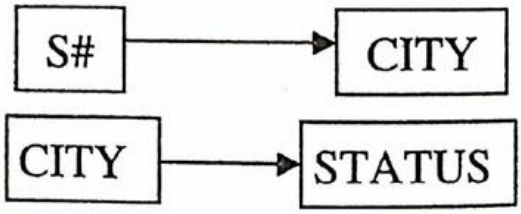
SC

S#	CITY
S1	Delhi
S2	Rohtak
S3	Rohtak
S4	Delhi
S5	Karnal

CS

CITY	STATUS
Delhi	30
Rohtak	20
Karnal	15

The corresponding functional dependency diagrams are shown below:



4. Multivalued Dependencies

Given a relation R with attributes A, B and C. Multivalued dependency represents a dependency between these attributes such that

- A leads to multiple values of C and B
- B and C are independent of each other.

MVD between attributes A, B and C in a relation R can be indicated as

$A \longrightarrow\!\!\!\!\rightarrow B$ (A multidetermines B)

$A \longrightarrow\!\!\!\!\rightarrow C$ (A multidetermines C)

Multivalued dependency in a relation is due to first normal form, which disallows an attribute in a row from having a set of values.

Example: Consider the relation

Student(SID, Subject, Activity)

Student

SID	Subject	Activity
101	English	Skating
101	Maths	Skating
101	English	Cricket
101	Maths	Cricket
102	Computer	Swimming

Here SID leads to multiple values of Subject and multiple values of Activity. Subject and Activity are independent of one another.

These multivalued dependencies can be indicated as:

$SID \longrightarrow\!\!\!\!\rightarrow Subject$

$SID \longrightarrow\!\!\!\!\rightarrow Activity$

5. Join dependency

Let R be a relation and it is decomposed into {R1, R2, R3, ……, Rn}. The relation R satisfy the join dependency if and only if joining R1 to Rn = R.

Example: Consider the relation SPJ(S#, P#, J#)

SPJ

S#	P#	J#
S10	P10	J20
S10	P20	J10
S20	P10	J10
S10	P10	J10

Project it into 3 projections as: SP, PJ and JS

SP

S#	P#
S10	P10
S10	P20
S20	P10

PJ

P#	J#
P10	J20
P20	J10
P10	J10

JS

J#	S#
J20	S10
J10	S10
J10	S20

Join Over P#

S#	P#	J#
S10	P10	J20
S10	P10	J10
S10	P20	J10
S20	P10	J20
S20	P10	J10

Join over(J#, S#)

S#	P#	J#
S10	P10	J20
S10	P10	J10
S10	P20	J10
S20	P10	J20
S20	P10	J10

When joined these three relations give original form of SPJ.

18.(c) "No loss decomposition is an aid to relational data base design". Is it true? If yes then justify it through an appropriate example.

Ans. The statement "Non loss decomposition is an aid to relational data base design holds true".

Decomposition is the process of splitting a relation into two or more relations.

Decomposition which results into relations without loosing any information is known as loosless decomposition or non loss decomposition.

The decomposition that results in loss of information is known as lossy decomposition.

Example:

Consider the relation Supplier(S#, Status, City)

Supplier

S#	Status	City
S1	100	Delhi
S2	50	Hissar
S3	80	Rohtak
S4	70	Karnal
S5	100	Mumbai

If this relation is decomposed into two parts as:

Supplier1

S#	Status
S1	100
S2	50
S3	80
S4	70
S5	100

Supplier2

S#	City
S1	Delhi
S2	Hissar
S3	Rohtak
S4	Karnal
S5	Mumbai

In this decomposition no information is lost. We can say that:

S5's status is 100 and city is Mumbai

S4's status is 70 and city is Karnal

S3's status is 80 and city is Rohtak

S2's status is 50 and city is Hissar

S1's status is 100 and city is Delhi

Here all the information is preserved. Thus this is loss less decomposition.

But if this relation is decomposed into two parts as:

Supplier1

S#	Status
S1	100
S2	50
S3	80
S4	70
S5	100

Supplier2

Status	City
100	Delhi
50	Hissar
80	Rohtak
70	Karnal
100	Mumbai

In this decomposition the information about status of each supplier is preserved but information about city of each supplier is lost so it is lossy decomposition.

For example, if we have to find the city of supplier S1, we are unable to find it.

Thus, the information regarding the city of the suppliers has been lost in this case, this is a lossy decomposition.

Therefore, lossless decomposition is more desirable because one can get all information after decomposition.

Q.(a) What is SQL? Explain its use, purpose and importance through appropriate examples.

A. SQL

Structured Query Language (SQL) is an advanced relational database language to help users to extract information from a database easily.

It was originally developed in 1970 at IBM's San Jose Research laboratory. It was originally called Structured English QUEry Language or SEQUEL. The capability of an RDBMS is "Structured Query Language" as it caters to most of the routine queries placed by the user on the database.

The American National Standards Institute (ANSI) adopted SQL as the standard language for RDBMS in 1986. In 1987, SQL was adopted for use with RDBMSs, as an international standard by ISO (International Organization for Standardization).

Purpose of SQL

A database language like SQL is needed:

1. ***To create database objects such as relations, indexes etc.***
2. ***To retrieve or extract data from the database which is called querying the database.***
3. ***To perform data management tasks like insertion, modification and deletion of data from the database.***

Importance/Use of SQL

1. ***SQL is a well-defined language to interact with the database in a simple and efficient manner.***
2. ***SQL is easy to learn and can manage complex problems.***

3. *SQL is an English like language as it uses words like Select, Insert, Delete, From, Where etc. as part of its command set.*

4. *SQL is a non-procedural language. In it, the information to be retrieved is specified, rather than how to retrieve it. In other words SQL does not require to specify access methods to data in the database.*

5. *SQL provides automatic navigation to the data.*

6. *SQL provides a small and concise set of commands.*

7. *SQL saves time and reduces the amount of programming required to perform complex queries.*

8. *SQL processes set of records rather than just one record at a time.*

9. *SQL can be used by a range of users like:*
   - *Application programmers*
   - *Management personnels,*
   - *DBA and*
   - *All other types of end users*

10. *Applications written in SQL can be easily ported across systems.*

11. *SQL provides a variety of commands for tasks like:*
    - *Inserting, deleting and updating rows in a table.*
    - *Security administrators.*
    - *Querying data.*
    - *To Guarantee database consistency.*
    - *Controlling access to the database.*

Thus SQL is a simple and powerful language used to create, access and manipulate data and structure in the database.

Q19.(b) What is SQL? What are the major components of SQL? **MDU BCA 2018**

Ans. SQL

Structured Query Language (SQL) is an advanced relational database language to help users to extract information from a database easily.

It was originally developed in 1970 at IBM's San Jose Research laboratory. It was originally called Structured English **QUE**ry **L**anguage or SEQUEL. The capability of an RDBMS is "Structured Query Language" as it caters to most of the routine queries placed by the user on the database.

The American National Standards Institute (ANSI) adopted SQL as the standard language for RDBMS in 1986. In 1987, SQL was adopted for use with RDBMSs as an international standard by ISO (International Organization for Standardization).

Components of SQL

The components of SQL are:

1. Data Definition Language (DDL)

DDL helps a user in defining the data structure in the database. It provides commands for defining relations, deleting relations, creating indices and modifying relations. It defines the physical characteristics of each record. It is used to define content and structure, format of the database. It describes data type and name of each element in the database.

Thus, if a user wants to create a relation then it can be done with the help of DDL. DDL commands are:

- CREATE TABLE
- ALTER TABLE
- DROP TABLE
- CREATE VIEW

DDL also includes commands for specifying access rights to relations and views.

2. Data Manipulation Language (DML)

DML helps a user in manipulation of data in the database i.e. It provides the way to process the data that is already existing in the database.

It provides commands for accessing, inserting, deleting and updating the rows of tables of the database. It accesses the data by the name specified in DDL. The DML statements issued in the form of queries are handled by a DML compiler.
DML commands are:

- INSERT
- DELETE
- UPDATE
- SELECT

There are basically two types of DML:

(i) Interactive DML

It includes commands for accessing, inserting, deleting and updating rows.

(ii) Embedded DML

It can be used in general purpose programming languages such as C, C++, VC++, VB, Pascal etc.

Q19.(c) Write SQL command syntax for create, alter, drop, insert, select using suitable examples.

Ans. 1. CREATE TABLE command

All data in a relational database is stored in the form of relations, also called tables. CREATE TABLE command is used to create the empty table i.e. a table without rows.

Syntax of CREATE TABLE command are:

Syntax 1

```
CREATE TABLE <table_name>
(
field_name1  field_type (width),
field_name2  field_type (width),
        :
        :
field_namen  field_type (width)
);
```

<table_name and field_names are supplied by the users. Field_type is the data type of the corresponding attribute or column with which it is specified. Field_type of a column is chosen according to the requirement. For example emp_no must be of NUMBER data type.

```
e.g. SQL> CREATE TABLE  employee
                (
                    emp_no  number (5),
                    name  char (15),
                    joining_date  date
                );
```

This will create the employee table with three columns emp_no, name and joining_date as shown below:

employee

emp_no	name	joining_date

When a table is created, it must have atleast one column. Also in the beginning, table is empty, it has no data, only the definition of table is stored in the database. This definition is called schema of that table.

Syntax 2

As the fields are named, certain constraints can be specified to ensure accuracy and consistency of data in a relational database. Constraints are the means by which invalid data entry into the table can be prevented. The common constraints include PRIMARY KEY, NOT NULL and CHECK constraints.

```
CREATE TABLE <table_name>
(
field_name1  field_type (width)  PRIMARY KEY,
field_name2  field_type (width)  NOT NULL,
                  :
                  :
field_namen  field_type (width), CHECK (field_namen
                                        in ('a', 'b', 'c'))
);
```

PRIMARY KEY Constraint

It specifies one or more columns that make up the primary key of the table.

The primary key constraint ensures that the values of column cannot be null and also the values in the column will be unique.

NOT NULL Constraint

A NULL is a value that is unknown, unavailable, unassigned or inapplicable. A NULL is neither a zero nor a blank space because zero is a numeric value and blank space is a character. Also, columns of any data type can contain NULLS.

The NOT NULL constraint ensures that the values of a column can not be null.

CHECK Constraint

CHECK constraint is used to check the validity of data i.e. when data is entered into particular table column, the data in the column is limited to specific values like a, b or c.

2. ALTER TABLE Command

ALTER TABLE command can be used to make the following changes to any table:

- *Add new columns.*
- *Drop a column.*
- *Modify existing columns*
  - *Decrease length (Here all values in the column must be null)*
  - *Change data type (Here all values in the column must be null)*
- *Add new integrity constraints*

Syntax of ALTER TABLE command are:

```
ALTER TABLE <table_name>
        ADD ( field_name field_type (width));
```

```
ALTER TABLE <table_name>
        MODIFY ( field_name  field_type (width));

ALTER TABLE <table_name>
        DROP ( field_name);
```

e.g. To add a new column Pincode to the table employee, the command is:-

```
ALTER TABLE employee
        ADD ( Pincode   number (6));
```

3. DROP TABLE Command

DROP TABLE command is used to delete the table. A table can be deleted when it is no longer required.

Dropping a table not only deletes the data contained in the table but it also removes the definition of its structure from the database.

Syntax is

```
DROP TABLE <table_name>;
```

<table_name> is the name of table which is no longer required. Once this command is executed, the identity of the specified table is lost from the database. This command also frees the memory occupied by the table definition and data contained.

e.g. To delete the table employee, the command is:

```
DROP TABLE  employee;
```

Above command will remove the employee table from the database.

4. INSERT Command

This command inserts rows in a table. Values can be inserted for all the columns or for the selected columns. The syntax of this command is given below:

```
INSERT INTO <table_name>
        [(column1_name, ……, column_name)]
            VALUES (value,……,value);
```

Only one row is inserted at a time using this command. The column names may be omitted if all the values of corresponding columns are to be entered. Here the values listed in the VALUES clause should be according to the order and data type of columns in the table. A value must be provided for each column in the table.

e.g.

```
SQL> INSERT INTO DEPT
        VALUES ( 1000, 'ACCOUNTING', 'ROHTAK' );
```

DEPT table

DEPTNO	DNAME	LOC
1000	ACCOUNTING	ROHTAK

The column names are not omitted if the values of all the columns are not entered.

e.g.

```
SQL> INSERT INTO DEPT( DNAME, LOC )
        VALUES ( 'ACCOUNTING', 'ROHTAK' );
```

DEPT table

DEPTNO	DNAME	LOC
	ACCOUNTING	ROHTAK

5. SELECT Command

The SELECT command is the most popular SQL command to query a table in an endless number of ways.

It is used to retrieve information already stored in the database. The syntax of SELECT command is:

```
SELECT ........
FROM .........
[WHERE .........]
[GROUP BY .........
[HAVING........]
[ORDER BY .......]]
```

The main component of a SELECT statement are:

- ***The SELECT clause which shows the list of columns to be listed.***
- ***The FROM clause which enables to select database table to get the information from.***

All other clauses of SELECT statement are optional. The simplest form of SELECT statement is:

```
SELECT (column_name1, column_name2,....,
        column_namen) FROM tablename;
```

e.g. Consider the following table employee:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

(i) Selecting all columns

Query:- What data are in the employee table?

```
SQL > SELECT *
            FROM employee ;
```

Once the above command is obeyed, the table will be:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

The asterisk (*) is used to select all columns in the table. This is very useful when the columns names are not known. Thus, a wild card (*) character indicates to view data from every column in the table.

(ii) Selecting **a specific column**

```
SQL > SELECT Name
            FROM employee ;
```

Once the above command is obeyed, the table will be:

Name
RAJIV
MOHAN
RAVINDER
BALVINDER
RAJBIR
ASHU

(iii) Selecting **multiple columns**

```
SQL > SELECT Emp_no, Name, Design
            FROM employee ;
```

Once the above command is obeyed, the table will be:

Emp_no	Name	Design
101	RAJIV	CLERK
102	MOHAN	SALESMAN
103	RAVINDER	MANAGER
105	BALVINDER	CLERK
106	RAJBIR	CLERK
108	ASHU	SALESMAN

(iv) Select from where

It is one of the most important clause available in SQL. By specifying a WHERE clause, specific rows can be chosen. When a WHERE clause is present, the database program goes through the entire table one row at a time and checks each row to determine if the condition is true with respect to that row.

e.g.

```
SQL > SELECT  Name
        FROM  employee
          WHERE Basic = 6400 ;
```

Once the above command is obeyed, the table will be:

Name
MOHAN
ASHU

(d) Using example illustrate 'in', 'between' and 'is null' used with WHERE clause.

Ans. Consider the following table employee:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

(i) List of values using IN

The IN operator selects rows that match one of the values in the list. Which employees are either clerk or salesman?

```
SQL > SELECT  Name, Design
      FROM employee
      WHERE Design IN ('CLERK','SALESMAN');
```

Once the above command is obeyed, the table will be:

Name	Design
RAJIV	CLERK
MOHAN	SALESMAN
BALVINDER	CLERK
RAJBIR	CLERK
ASHU	SALESMAN

(ii) A range of values using BETWEEN

The BETWEEN operator selects rows that contain values within a range. The range has a lower limit and upper limit.

Which employees have basic between 5900 and 9000?

```
SQL > SELECT  Name, Design, Basic
      FROM  employee
      WHERE Basic BETWEEN 5900 AND 9000;
```

Once the above command is obeyed, the table will be:

Name	Design	Basic
MOHAN	SALESMAN	6400
RAVINDER	MANAGER	9000
ASHU	SALESMAN	6400

(iii) NULL values

To find the NULL values in a table use IS NULL operator. Consider the table STUDENT given below:

STUDENT

Rollno	Name	Marks	Grade
101	Hari	78	B
102	Ravi	98	A
103	Mohan	15	

To list the Rollno, Name for students who have not been assigned any grade, the command is:

```
SQL > SELECT  Rollno, Name
      FROM STUDENT WHERE Grade IS NULL ;
```

Result of the above command is

Rollno	Name
103	Mohan

Q20.(a) What is query processing? How is it used and useful? Discuss its strategies with examples.

MDU BCA 2014

Ans. Query Processing

A user may specify a query to the system, it is necessary to find the best method to respond the query using the existing database.

Query processing is the technique of selecting the best method to be used in responding to a database request.

Generally there are different methods for computing the query. Each method of expressing the query suggests a plan to find the answer.

Firstly a user's query is converted into an internal standard representation. Subsequently, it is modified to an equivalent query which can be computed more efficiently. Then an access plan for evaluating the query is determined and the query is executed.

Thus query processing refers to a set of activities involved in transforming a high level query written in SQL, QUEL, QBE etc. into some internal representation.

When a query is presented to the system, it is the responsibility of the system to transform the query into an equivalent query which can be computed more efficiently.

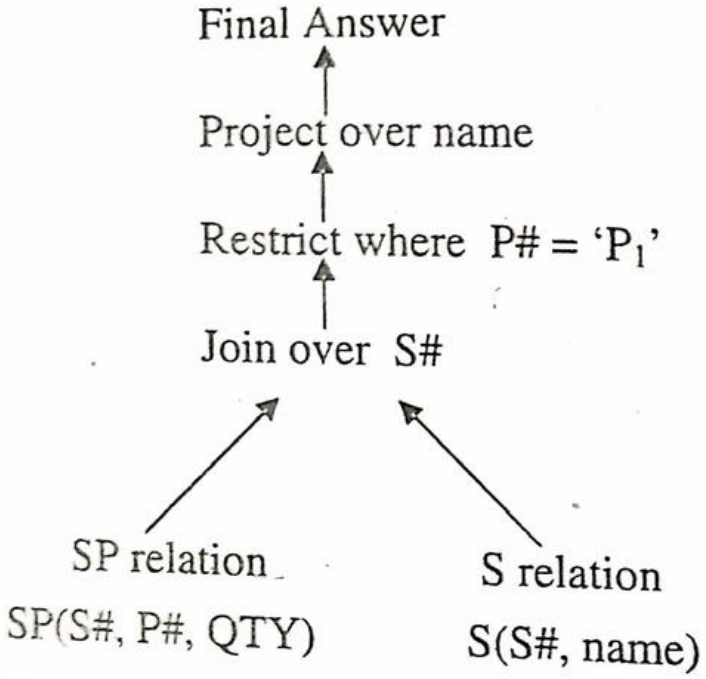
Steps in Query Processing

Query processing is a stepwise process:

(i) **The first step is to transform the query into a standard starting point**

First the query is to be converted into some internal form i.e. more suitable for machine manipulation. The internal form is chosen as a tree data structure called a query tree. It is also possible to represent the query using a graph data structure called a query graph.

e.g. Name of suppliers who supplies part P_1.



(ii) Transform the query

The query is transformed by replacing expression in the query with those that increase performance.

e.g. (P JOIN Q) with some restriction on P.

(P with some restriction on P) JOIN Q is more efficient than the previous one.

(iii) Simplifying the query

The query is then simplified by removing redundant and useless operations.

(iv) Prepare alternate access plans

In this step various plans, to evaluate the transformed query, are generated. The cost of each plan is estimated and the optimal one is chosen and executed.

General processing Strategies

The general query processing strategies that reduce the size of intermediate and final results as well as the processing costs are the following:

(i) Perform selection as early as possible

Selection operation reduces the cardinality of the relation, thus perform selection operations as early as possible.

e.g. **Consider the relations**

Branch (branch_name, assets, branch_city)

Deposit(branch_name, customer_name, balance)

Customer(Customer_name, Customer_city)

The query is "To find the assets and name of all the banks for depositors living in Rohtak".

$$\pi_{\text{branch_name, assets}} (\sigma_{\text{customer_city = "Rohtak"}} (\text{Customer} \bowtie \text{Deposit} \bowtie \text{Branch}))$$

Here, the intermediate result (Customer $\bowtie$ Deposit $\bowtie$ Branch) is very large to keep in main memory. It must be stored on secondary storage device. Thus the system has to access the secondary storage device for reading or writing the intermediate result.

The size of the intermediate result can be reduced by taking only those tuples of the customer relation where Customer_city = "Rohtak".

Now the query is

$$\pi_{\text{branch_name, assets}} ((\sigma_{\text{customer_city = "Rohtak"}} (\text{Customer})) \bowtie \text{Deposit} \bowtie \text{Branch})$$

(ii) Perform projection early

Projection operation also reduces the size of the relations. Consider the same query as above:

$$\pi_{\text{branch_name, assets}} (\sigma_{\text{customer_city = "Rohtak"}} (\text{Customer} \bowtie \text{Deposit} \bowtie \text{Branch}))$$

Here the subexpression

$$((\sigma_{\text{customer_city = "Rohtak"}} (\text{Customer})) \bowtie \text{Deposit})$$

results a relation with attributes (Customer_name, Customer_city, Branch_name, Balance)

The only column needed is Branch_name. Eliminate the not required attributes Customer_name, Customer_city, Balance. Eliminating this will reduce the size of the intermediate result.

Thus the modified query is

$$\pi_{\text{branch_name, assets}} (\pi_{\text{branch_name}} ((\sigma_{\text{customer_city = "Rohtak"}} (\text{Customer})) \bowtie \text{Deposit}) \bowtie \text{Branch})$$

(iii) Combine unary operations

Combine unary operations like

$$\sigma_X (\sigma_Y (R)) \equiv \sigma_X \wedge \sigma_Y (R)$$
$$\pi_X (\pi_Y (R)) \equiv \pi_{X \cap Y} (R)$$

where $X, Y \subseteq R$

(iv) Compute common expressions only once

Common expressions that appear in a query may be computed only once if the cost of storage is less than recomputing it.

Q.20.(b) **What is query optimization? Explain.** **MDU BCA 2022**

OR

What is query optimization? Discuss the significance and different steps followed during query optimization. **MDU BCA 2017**

Ans. **Query Optimization**

To improve the strategy for processing a query is called query optimization. In other words, choosing a suitable one out of many possible execution strategies for processing a query is known as query optimization.

Thus, the goal of the query optimizer is to choose an efficient execution strategy for processing a query. Major focus of the optimizer is to minimize the use of various computer resources such as CPU utilization time, disk I/O, memory etc.

In query optimization:

- First to find an expression that is equivalent to the given expression.
- Second to find the detailed strategy for processing the query which includes
  - (i) How the query will be executed.
  - (ii) The order in which tuples are processed.
  - (iii) How many times the disk access required.

Various Query Optimization Techniques

When a query is presented to the system, it is the responsibility of the system to transform the query into an equivalent query that can be computed more efficiently.

Query optimization is useful as it gives much difference in execution time between a good strategy and a bad one. For optimization of queries, there are two techniques.

(i) Heuristic Rules

(ii) Cost Estimation

(i) Heuristic Rules

Heuristic means it is a rule that works in most of the cases but not guaranteed to work well in every case. This rule records the operations in the query tree or in a query graph to improve the expected performance of the query.

First the internal representation of the query is generated which is then optimized according to heuristic rules. After this, query execution plan is generated to execute groups of operations based on the access paths available on the files involved in the query.

The main heuristic rule is to apply SELECT and PROJECT operations before applying the JOIN operation or other binary operations. These operations reduce the size of a file and thus must be applied accordingly.

(ii) Cost Estimation:-

A query optimizer not only depends on Heuristic rules. Optimizer estimates and compare cost of executing a query using different execution strategies and selects the strategy with the lowest cost estimation. The strategy chosen for a query depends upon:

- ***The size of each relation.***
- ***The distribution of values within columns.***

The following information is used to select a strategy for a query:

- $n_r \rightarrow$ the number of tuples in the relation r.
- Sr $\rightarrow$ the size of a record of relation r in bytes.
- V(A, n) $\rightarrow$ the number of distinct values that appear in the relation r for attribute A.

n_r and Sr helps to estimate the size of a Cartesian product accurately.

As a rule, the Cartesian product $p \times q$ contains $n_p n_q$ tuples and each tuple of $p \times q$ occupies Sp + Sq bytes. V(A,n) estimates how many tuples satisfy a selection predicate like

< attribute> = <value>

For this it is needed how many times each value appeared in a column. Assuming uniform distribution of values it is estimated that query has

$$\frac{n_r}{V(a,r)} \text{ tuples}$$

Thus many query processors use such type of assumption while choosing a strategy. To measure the cost of a query, it is also needed to estimate the number of disk accesses. It depends upon the number of tuples in relations and also on the physical organization of the database.

For simplification the strategy, a query is divided into many subqueries. It also helps to know where a particular subquery appears more than once.

Q20.(c) What is database security? What are the various techniques to secure the database? Explain in detail. **IGU BCA 2018**

OR

What is database security? Why is it important? Also discuss the various security issues. **MDU BCA 2015**

Ans. Database Security

Data security means protection of the data in the database against:

- *Unauthorized access.*
- *Intentional destruction or alteration.*
- *Accidental introduction of inconsistency or accidental disclosure.*

Data security is of prime importance in the DBMS.

Accidental loss of data consistency is due to:

- ***Anomalies due to concurrent access to the database.***
- ***Anomalies due to distribution of data over many computers.***
- ***Crashes during transaction processing.***

Security issues related to database security

1. Privacy

Privacy states that only authorized persons should be allowed to access the database.

2. Database integrity

Database integrity states that database should be protected from improper modifications, either intentional or accidental to maintain database integrity.

3. Database availability

Database availability states that security should not restrict the authorized persons to perform their actions on the part of the database available to them.

Various techniques of database security

Perfect security is unattainable, the objective of data security is to:

- ***Minimize the risk of data loss and disclosure of data to minimum level***
- ***Implement a full recovery if a loss occurs.***

Thus security measures must be taken at various levels to protect the database.

The following four levels of defence are generally recognized for database security:

(i) Human Factor

Users must be authorized carefully. They should be provided with passwords for identification. If the user do not provide satisfactory identification and authorization, the DBMS should sign off the user with a message and keep a record like terminal number, date and time etc.

Moreover disclosure, alteration and destruction is also done by programmers. For this the responsibilities of application programmers, system programmers and operators must be clearcut fixed.

(ii) Physical Security

The computer system must be physically protected from fire, theft or other forms of destruction. To avoid theft physical security include appropriate locks and keys and entry logs to computing facility and terminals.
Precautions against fire are:

- ***Smoking should not be allowed in computer room.***
- ***The site for the computer should be properly chosen so that this site is not adjacent to fire sensitive areas.***
- ***The emergency power-off switch must be easily accessible.***

(iii) Operating System Security

The operating system provides the following features for database security:

- ***Identification and verification of users by assigning an account number and a password to every user.***
- ***Avoids direct access to primary and secondary memories and thus provides protection to data.***

On the other hand, weakness in operating system security may serve as a means of unauthorized access to the database.

(iv) Database System

The users of the database are authorized to access only a limited portion of the database. An application programmer writes only application programs not system programs. Some users are allowed to ask queries but not allowed to change the data.

Thus it is the responsibility of the system to ensure that such types of restrictions are followed.

Importance of database security

Database security is an important issue in database management because of the sensitivity and importance of data and information of an organization. The goal of the database security is the protection of data against threats such as accidental or intentional loss.

In the case of shared data, multiple users try to access the data at the same time. In order to maintain the consistency of the data in the database, database security is needed.

Due to the advancement of internet, data are accessed through World Wide Web, to protect the data against hackers, database security is needed.

Q20.(d) What are different threats of the database? How can you protect the database against misuse? Also discuss the different access control policies.

Ans. **Threats to the database**

Threats are the problems which are related to database. Following are the threats to database:

1. Transaction failure
2. System Failure / System Crash
3. Media Failure

1. Transaction Failure

Two types of errors can cause a transaction failure:

- Logical error
- System error

Logical errors

Logical errors are like wrong input, data not found, overflow. When such error occurs, transaction can not continue with its normal execution.

System error

When system errors occur, the system enters into an undesirable state like deadlocks. Due to such errors also transaction can not continue with its normal execution.

2. System failure

System failure can occur due to:

- *Network errors*
- *Presence of bugs in database software*
- *Malfunctioning of hardware*

The occurrence of such errors in a computer system leads to system failure.

3. Media failure

It includes the hardware crashes. It results in damage of data base portion currently in use. Head crash on the disk is an example of media failure.

DBA is responsible for overall security. DBA develop policies, procedures to control these threats. These are the different methods for controlling the user access to database for security.

Security should be apply to whole enterprise, the data, database, DBMS, users, applications.

To protect the database against misuse, the following are the methods:

1. Authorization
2. Authentication
3. Encryption
4. Firewalls
5. Access control

1. Authentication

The first requirement for security is to know the users. To determine the privileges and access rights of the users, they need to be identified first.

In other words, authentications is a process by which a system verifies a user's identity and a user can request to authenticate by providing a proof of identity or any authentication token.

Passwords are one of the basic forms of the authentication. Passwords are assigned when users are

created. A database stores the passwords of users in the data dictionary in an encrypted format. The users have to provide correct password for accessing database.

2. Authorization

It is a permission given to a user, to access an object or a set of objects.

It is the process through which system obtains information about the authenticated user. It includes information about which operation user may perform and which data objects user can access.

Driver's license is a perfect example of authorization.

A user may have different forms of authorization on database. These are authorization rights:-

- **Read authorization:-** allows only reading not modifications.
- **Insert authorization:-** allows insertion not modifications.
- **Update authorization:-** allows modification not deletion.
- **Delete authorization:-** allows deletion of data.

A user can be assigned all or a combination of these authorization.

3. Encryption

It is an effective and practical way to secure data transmission over network.

This process requires an encryption device that converts the original message in a code and decryption device converts this code to the original message.

4. Firewalls

It is the most important tool for network security and is used by organizations that provide dedicated internet access to their employees.

- *Firewalls control the network traffic flows.*
- *Firewalls can be a single PC or a set of computers.*
- *Firewalls track all the details of the user requests on the network. As per firewall policy every request should be passed through firewall first.*

5. Access control (Different access control policies)

The two methods for access control are:

(i) Database privileges

Privileges means permission to access a particular object in a particular manner.

For example, right to create a table, right to connect to the database, right to select rows from another user's table. Privileges are given to users so that the user can accomplish tasks required for his/her job.

Two types of database privileges are:

- *System privileges*
- *Object privileges*

System privileges refers to the right to perform a particular action or action on the particular type of object.

For example, creating the table, deleting the row of any table.

Object privileges refers the right to perform a particular action on a specific table, view, sequence or procedure.

For example, privilege to delete rows from the table employee.

(ii) Roles

Roles are designed to ease the administrator of end user system. They can be granted to users. There are two types of roles:

- Application role
- Users role

Application role contains all privileges to run an application.

User role contains common privileges required for a group of database users.

Q21.(a) What is concurrency control? How is it implemented? Explain. **MDU BCA 2016**

Ans. Concurrency Control

When two or more than two transactions try to process the same data item simultaneously, such situation is called concurrent processing.

For this concurrent access to a database, it is necessary for the system must control the interaction among the concurrent transactions:

- ***To preserve the consistency of the database.***
- ***To ensure that the modifications made by the transactions are not lost.***

This control is achieved by various techniques called concurrency control techniques.

When many users use the database for read-only, there is no problem but if the transactions are running concurrently to modify some data items, it may lead to inconsistencies or lead to incorrect values. The effect of concurrent updates without concurrency control is explained in the following example.

Example: Two users are in the process of updating the same saving account record. In the beginning Customer A has balance of Rs. 4000.

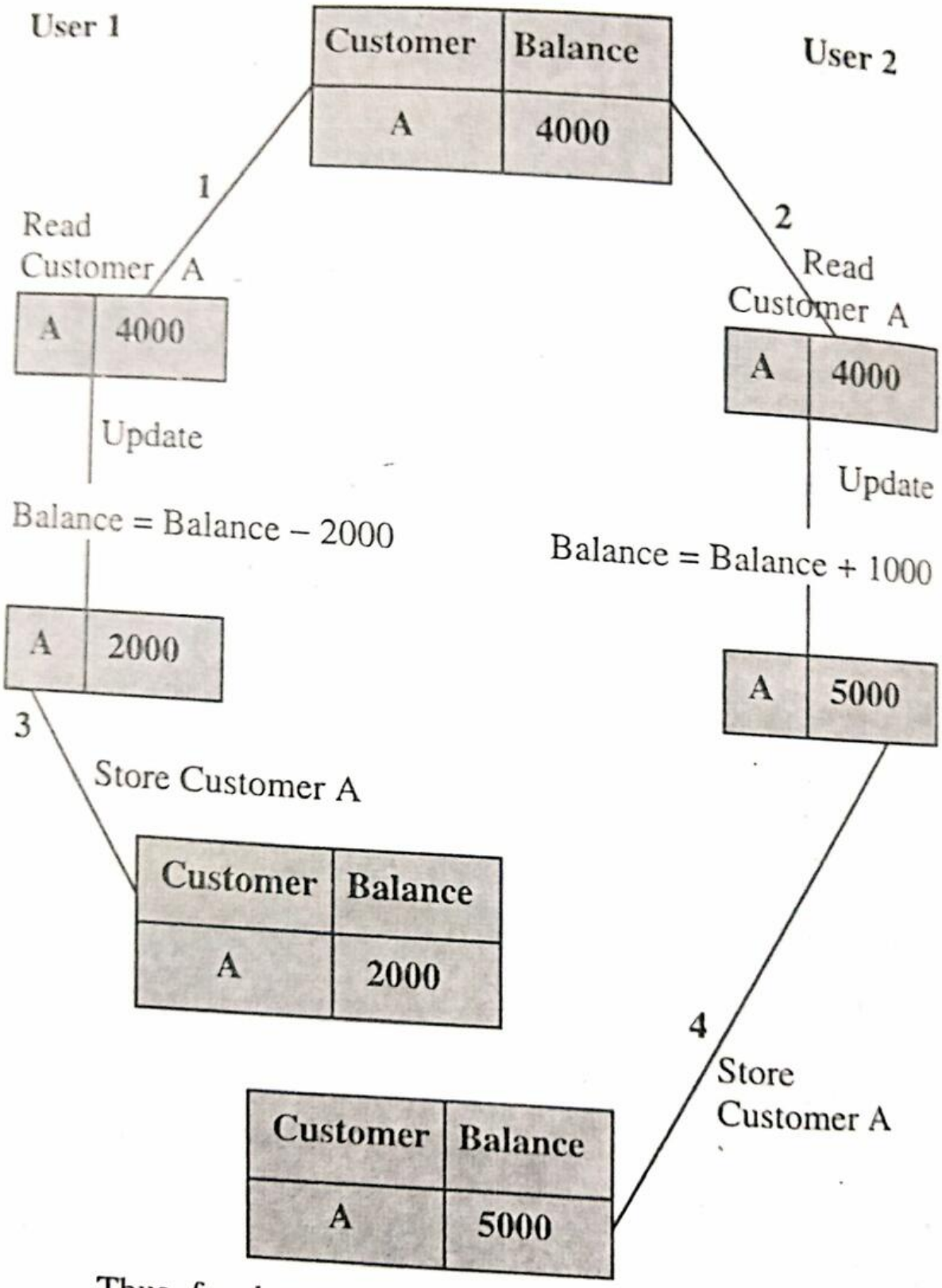
(i) User1 reads this record in his work area and withdraws Rs. 2000.

(ii) Next, User2 reads the same record in his work area and deposits Rs. 1000.

(iii) User1 stores the record and the balance is Rs. 2000.

(iv) User2 stores the record on the record stored by User1 and the current balance is Rs. 5000. This

shows the transaction of User1 has been lost due to interference between these two transactions.



Thus for handling the concurrent processing, various techniques are used. These techniques guarantee simultaneous processing during concurrent processing.

Locking Techniques for Concurrency Control

To avoid the concurrent update problem, the data which is accessed for update must not be shared among users. To stop this type of sharing, the DBMS must incorporate a resource-locking mechanism. That is, the data which are accessed by one user for updating must be "locked" or denied to other users until the update is completed.

A Lock is a variable associated with a data item. It describes the status of the item with respect to possible operations that can be applied to it.

Types of Locks

(i) Binary Locks

A binary lock can have two states. These are locked and unlocked. 1 is used for lock and 0 is used for unlock.

A different lock is associated with each database item X.

- ***If the value of lock on item X is 1, then it means that item X can not be accessed by a database operation.***
- ***If the value of lock on item X is 0, then it means that item X can be accessed when requested.***

Suppose the current value of the lock with item X is LOCK(X) and let the two operations used with binary lock are LOCK_ITEM(X) and UNLOCK_ITEM(X).

- **LOCK_ITEM(X):** To access an item X, the transaction request by using LOCK_ITEM(X) operation. Now two cases arises:
  (a) If LOCK(X) = 0, it will be set to 1 and the transaction will accesss the item X.
  (b) If LOCK(X) = 1, the transaction will have to wait until LOCK(X) = 0.

- UNLOCK_ITEM(X): UNLOCK_ITEM(X) operation sets LOCK(X) to 0 so that X may be accessed by other transaction.

Thus it is clear that a binary lock enforces mutual exclusion on data item i.e. no two transactions can access the same item simultaneously.

Every transaction has to obey the following rules when binary lock is used:

(a) A transaction T must issue

- ***The operation LOCK_ITEM(X) before any read_item(X) or write_item(X) operation.***
- ***The operation UNLOCK_ITEM(X) after all read_item(X) and write_item(X) operations are completed.***

(b) A transaction T will not issue

- ***The operation LOCK_ITEM(X) if it already holds the lock on item X.***
- ***The operation UNLOCK_ITEM(X) unless it already holds the lock on item X.***

Binary locks are simple to implement but the restriction is that at most one transaction can hold a lock on an item.

(ii) Shared/Exclusive OR Read/Write Locks

These locks are generally used in database locking schemes because they provide general locking capabilities.

The lock that allows to read a data item is called read_lock. It is also called shared_lock because other transactions are also allowed to read the item.

The lock that allows to write the data item is called write_lock. It is also called exclusive lock because only a single transaction exclusively holds the lock on the item. Thus

- If LOCK(X) = Read_lock
  then the value of locking transaction will be a list of one or more transactions.
- If LOCK(X) = write_lock
  then the value of locking transaction will be a single transaction.

(iii) Two-Phase Locking

When more transactions execute on a database concurrently, the results produced may not always be correct. A transaction will be correct when it transforms a database from one correct state to another correct state.

If the transactions are processed serially i.e. one at a time, the final result is bound to be correct provided all the transactions are correct individually.

Example: Consider a banking system where two-transactions T_0 and T_1 transferring funds from an account X to Y. The transactions are shown below:

T_0	T_1
Read X	Read X
X = X – 10	X = X – 50
Write X	Write X
Read Y	Read Y
Y = Y + 10	Y = Y + 50
Write Y	Write Y

Suppose current balance in account X is Rs. 100 and Y is also Rs. 100. If T_0 and T_1 execute serially then the final balance using the sequence

$<T_0, T_1>$ is X = Rs. 40 and Y = Rs. 160
& $<T_1, T_0>$ is X = Rs. 40 and Y = Rs. 160.

In case of concurrent transaction, the processing of the transactions is not executed one by one but in interleaved manner, which leads to an incorrect state of the database.

Example: Consider the above example, the concurrent execution of transactions are shown below:-

T_0	T_1
Read X	
X = X – 10	
	Read X
	X = X – 50
	Write X
	Read Y
Write X	
Read Y	
Y = Y + 10	
Write Y	
	Y = Y + 50
	Write Y

Here the final balance in X and Y will be X = Rs. 90 and Y = Rs. 150. This shows that the sum X + Y is not preserved.

Thus, the correctness of a concurrent transaction execution requires that:

- Concurrent execution must provide the same result.
- Have the same effect on the database.

as provided by the serial execution of the same transactions.

A schedule that guarantee this property is called serializable schedule.

Guaranteeing Serializability by two-phase Locking

A transaction is said to be in two-phase locking protocol if all locking operations i.e. read_lock, write_lock precede the first unlock operation in the transaction.

In this scheme, each transaction makes locking and unlocking requests in two phases:

- **An expanding or growing phase**

  In this phase, new locks on the desired data items can be acquired but none can be released.

- **A shrinking phase**

  In this phase, existing locks can be released but no new locks can be acquired.

In a schedule if every transaction follows the two-phase locking protocol, the schedule is guaranteed to be serializable.

For two-phase locking implementation the transaction T_0 and T_1 can be rewritten as T_0' and T_1' as shown below:-

T_0	T_0'	T_1	T_1'
read_lock(X);	read_lock(X);	read_lock(Y);	read_lock(Y);
read_item(X);	read_item(X);	read_item(Y);	read_item(Y);
unlock(X);	write_lock(Y);	unlock(Y);	write_lock(X);
write_lock(Y);	unlock(X);	write_lock(X);	unlock(Y);
read_item(Y);	read_item(Y);	read_item(X);	read_item(X);
Y = X + Y;	Y = X + Y;	X = X + Y;	X = X + Y;
write_item(Y);	write_item(Y);	write_item(X);	write_item(X);
unlock(Y);	unlock(Y);	unlock(X);	unlock(X);

Types of Two-phase Locking

(i) Conservative two-phase locking

It requires a transaction to predeclare all the locks it requires before its execution. If any of the predeclared items cannot be locked the transaction waits until all items are locked. This locking protocol is deadlock free but it is difficult to use in practice.

(ii) Strict two-phase Locking

In this protocol, a transaction does not release any of its write lock until it commits or aborts.

(iii) Rigorous two-phase Locking

In this protocol, a transaction does not release any of its write lock and read locks until it commits or aborts.

Problems in Concurrency through Locking

Locking protocol introduces many problems which the system must be able to resolve. The major problems in concurrency through locking are:

(a) Deadlock

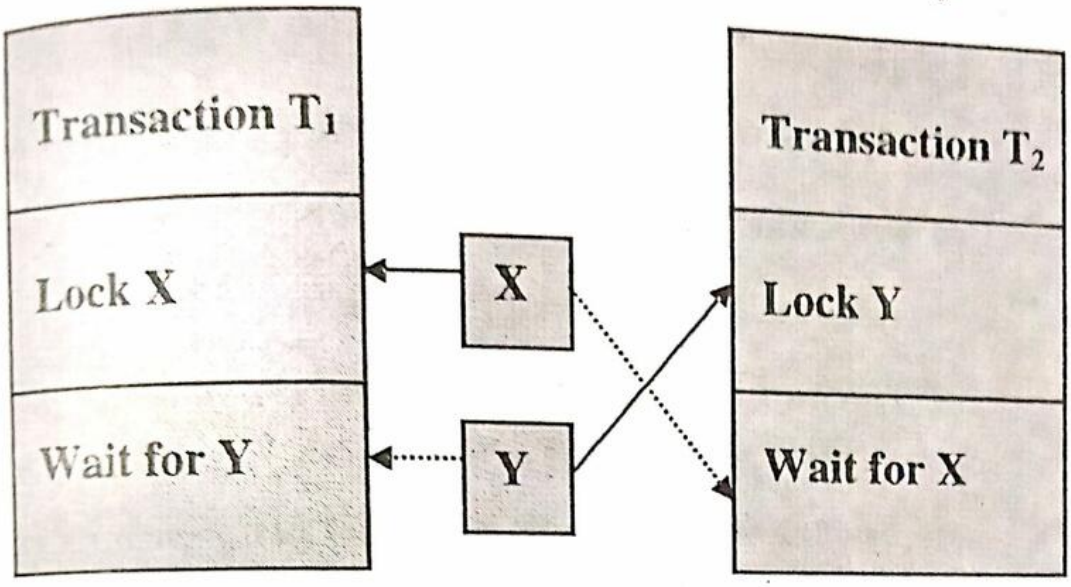
(b) Starvation

(a) Deadlock

Deadlock occurs when each transaction Ti in a set of two or more transactions is waiting for some item that is locked by some other transaction Tj in the set. It means that each transaction in the set is waiting for one of the other transaction in the set to release the lock on the required item.

Example: The following two transactions T_1 and T_2 are dead locked. Transaction T_1 is waiting for Y which is

locked by Transaction T_2 and Transaction T_2 is waiting for X which is locked by transaction T_1. Unless, the DBMS intervenes, both users will wait indefinitely.



There are two approaches to deal with deadlock problems. These are:

- Deadlock Prevention
- Deadlock detection and recovery

Deadlock Prevention

Deadlock prevention means to ensure that the system will never enter a deadlock state. Here, at the beginning of a transaction, all the records required by it are locked. In the above example T_1 would have to lock both items X and Y before the processing of the transaction. Thus locking records in advance prevents deadlock. But in many cases it is not possible to predict in advance how many items will be required to process a transaction.

Deadlock detection and Recovery

This is a very liberal approach. In this approach, the available resources are granted freely and deadlocks are checked occasionally. Detection means discovering a

deadlock. If deadlock exists the system must break or recover the deadlock. This approach involves two steps:

- *First, the deadlocked processes are identified or detected.*
- *The next step is to break or recover the deadlock.*

The various strategies for recovery of deadlock are:

- *Abort all deadlocked processes.*
- *Backup each deadlocked process to some previously defined checkpoint and restart.*
- *Successively abort deadlocked processes until deadlock no longer exists.*
- *Successively preempt resources until deadlock no longer exists.*

(b) Starvation

Starvation occurs when a transaction cannot proceed for an indefinite period of time while other transactions in the system continue normally.

Example: Suppose two transactions T_1 and T_2 try to put a lock on item X, the scheduler allows T_1 to lock it. Before the execution of Transaction T_1 another Transaction T_3 demands for item X. The scheduler allows T_3 to lock on item X. Again Transaction T_4 requests for item X and scheduler allocates item X to T_4, T_2 to wait further. Thus T_2 have to wait indefinitely while there is no deadlock. Such a situation is called starvation.

There are many algorithms to resolve this problem. These are:

- First come – first serve algorithm
- Priority algorithm.

First come – first serve algorithm

This algorithm allocates the resources according to the order of requests made by transactions.

Priority algorithm

This algorithm assigns dynamic priority to the requests and allocates resources according to the priority of the requesting transactions.

Concurrency Control based on Timestamp ordering

Concurrency control problem can be handled by assigning ordered timestamp values to transactions. Timestamp values are assigned to transactions as per their starting time. This means that time stamps are based on the order in which transactions started. In this technique locking is not used. Therefore deadlock can not occur.

Q21.(b) Explain database recovery briefly with examples.

Ans. Database Recovery

Recovery in database system means, recovering the database itself i.e. restoring the database to the most recent consistent state just before the time of failure.

A transaction is a collection of operations that performs a single logical function in a database application. Each transaction is a unit of atomicity.

"All or none" requirement is called Atomicity. In other words atomicity of a transaction means either the transaction is fully completed on the database or none of its part is committed. To preserve the atomicity of a transaction is the main goal of recovery process.

Thus if a transaction does not complete its execution, the recovery process has to make sure that the transaction has no effects on the database by undoing it.

Recovery may be of three types:

(i) Transaction Recovery

(ii) System Recovery

(iii) Media Recovery

(i) Transaction Recovery

Transaction is:

- ***Updation of any information to database.***
- ***To insert some data to database.***
- ***To delete something from database or***
- ***To create or drop some table from database.***

If a transaction executes and a failure occurs before the transaction reaches its termination, it is called transaction failure.

Recovery from transaction failures means that the database is recovered to the recent consistent state just before the time of failure. For this, the system has to kept information about the changes that are applied to data items by the various transactions.

(ii) System Recovery

System failure affects all the transactions currently in progress but do not physically damage the database. Power failure is an example of system failure. In this case database becomes inconsistent and the strategy is to reverse any changes that caused the inconsistency by undoing some operations.

It may also be necessary to redo some operations at restart time that did successfully complete before crash in order to restore a consistent state of the database.

Thus

- ***redo all work done by transactions that completed successfully prior to the crash.***
- ***undo all work done by transactions that started but did not complete prior to the crash.***

(iii) Media Recovery

Media failures cause damage to the database or to some portion of it. Here database is physically damaged like a disk crash.

The recovery method restores a past copy of the database that was backed up to archival. Then using the log to redo all transactions that completed since that backup copy was taken.

Recovery procedures/methods/techniques

For database recovery there are many techniques and the selection of technique depends upon the nature of failure.

Log-based Recovery

The most widely used recovery technique is log-based recovery technique. A log is a file which records all the changes done on the database. The structure of a log-record is implementation dependent and it has the following fields:

- **Transaction name:** The unique name of the transaction. It distinguishes one transaction from another.
- **Data item name:** The unique name of the data item modified by the transaction.
- **Previous value:** The value of data item before it was modified.
- **Current value:** The value of data item after it was modified.

There are many other log-records to identify the data and time of commencement of a transaction, commit or abort of a transaction. Various types of log-records are denoted as:

- ***< Ti, start > Transaction Ti has started.***
- ***< Ti, Xj, V_1, V_2 > Transaction Ti has performed an operation on data item Xj, Xj had V_1 previous value and V_2 as current value.***
- ***< Ti, commit > Transaction Ti has committed.***

Log files may be useful in recovery only when it is itself not lost during the failure. Therefore for recovery from system and disk failures, the log must reside in stable storage.

With the help of log files, there are two different methods in which the transactions may be committed to the database.

(a) Deferred Update

In this technique the updates performed by a transaction are not recorded on the disk until the transaction reaches its commit point. Before reaching the commit, all transactions are stored in memory buffer. If in any case a transaction fails to reach at commit point the buffer is flushed out. It will not change the database in any way so UNDO is not needed.

Deferred update technique is thus to defer or postpone any actual updates to the database until the transaction completes its execution successfully and reaches its commit point.

At the time of transaction execution, the changes are updated and stored only in the log and in the buffers. After the transaction reaches to its commit point and the log is written to disk, the updates are recorded in the database.

To understand it, consider the banking transaction. Let T_0 be a transaction that transfer Rs. 100 from account A to account B. This transaction is defined as follows:

T_0 : read (A, a)
a = a –100
write (A, a)
read (B, b)
b = b + 100
write (B, b)

Let T_1 be a transaction that withdraws Rs. 200 from account D. This transaction is defined as follows:

T_1 : read (D, d)
d = d –200
write (D, d)

The transactions are executed serially i.e. in the order T_0, T_1. Let the values of A, B and D before execution was Rs. 2000, Rs. 4000, Rs. 6000 respectively.

The information contained in the log is shown below:

< T_0, start >
< T_0, A, 1900 >
< T_0, B, 4100 >
< T_0, commit >
< T_1, start >
< T_1, D, 5800 >
< T_1, commit >

As a result of the execution of T_0 and T_1 the state of the log and database corresponding to T_0 and T_1 is shown below:

Log	**database**
< T_0, start >	
< T_0, A, 1900 >	
< T_0, B, 4100 >	
< T_0, commit >	
	A = 1900
	B = 4100
< T_1, start >	
< T_1, D, 5800 >	
< T_1, commit >	
	D = 5800

Any type of failure that results in the loss of information can be handled by the system using the log. The recovery procedure is as follows:

- redo(Ti) sets the values of all data items updated by transaction Ti to the new values. The redo operation must be idempotent which means executing it many times must be equivalent to executing it once.
- The recovery system after the failure takes the help of log to determine which transactions need to be redone. Transaction Ti needs to be redone if and only if the log contains both the record < Ti, start > and the record < Ti, commit>.

(i) Suppose the crash occurs after the log record for the step write (B, b) of T_0 has been written to stable storage.

i.e.

To: read(A, a) a = a – 100 write (A, a) read (B, b) b = b + 100 write (B, b)	The log at the time of crash is given as < T_0, start > < T_0, A, 1900 > < T_0, B, 4100 >

Here as no commit record is present in the log, no redo action is required. The values of A and B will remain Rs. 2000 and Rs. 4000 respectively.

(ii) Suppose the crash occurs after the log record for the step write (D, d) of T_1 has been written to stable storage.

i.e.

To: read(A, a) a = a – 100 write (A, a) read (B, b) b = b + 100 write (B, b) T_1: read(D, d) d = d –200 write (D, d)	The log at the time of crash is given as < T_0, start > < T_0, A, 1900 > < T_0, B, 4100 > < T_0, commit > < T_1, start > < T_1, D, 5800 >

Here as $< T_0$, commit $>$ is present in the log, redo(To) is performed. The values of A, B are Rs. 1900 and Rs. 4100 respectively. The value of account D will remain Rs. 6000.

(b) Immediate Update

In immediate update, the database is updated before a transaction reaches its commit point. However, these operations are recorded in the system log on disk before they are applied to the database. This makes a recovery of data still possible to its original state. This recovery method uses two recovery procedures:

undo (Ti): which restores the value of all data items updated by Transaction Ti to the old values. The undo operation must be idempotent.

redo(Ti): which sets the value of all data items updated by Transaction Ti to the new values. The redo operation must be idempotent.

The transaction Ti needs to be

- undone if the log contains the record < Ti, start > but does not contain the record < Ti, commit >.
- redone if the log contains both the record < Ti, start > and the record < Ti, commit >.

(i) Suppose the crash occurs after the log record for the step write (B, b) of T_0 has been written to stable storage.

i.e.

To: read (A, a)
a = a – 100
write (A, a)
read (B, b)
b = b + 100
write (B, b)

The log at the time of crash is given as

$< T_0$, start $>$
$< T_0$, A, 1900 $>$
$< T_0$, B, 4100 $>$

When the system comes back after failure, it will check the log. After finding the record < T_0, start > in the log but no corresponding < T_0, commit >, it performs the operation undo (T_0).

Thus the values of A and B are restored to Rs. 2000 and Rs. 4000 respectively.

(ii) Suppose the crash occurs after the log record for the step write (D, d) of T_1 has been written to stable storage.

i.e.

T_0:	read(A, a)	The log at the time of crash is given as
	a = a – 100	< T_0, start >
	write (A, a)	< T_0, A, 1900 >
	read (B, b)	< T_0, B, 4100 >
	b = b + 100	< T_0, commit >
	write (B, b)	< T_1, start >
T_1:	read(D, d)	< T_1, D, 5800 >
	d = d –200	
	write (D, d)	

When the system comes back after failure, it will check the log. Here it will perform two recovery actions.

- The operation undo (T_1) as the record < T_1, start > present in the log, but no record < T_1, commit > present.
- The operation redo (T_0) as the log contains both the record < T_0, start> and the record < T_0, commit >.

After the recovery procedure, the values of A, B and D are Rs. 1900, Rs. 4100 and Rs. 6000 respectively.

B.C.A. 3rd Semester (MDU) Examination – November, 2016

Introduction to Database System

Paper : BCA – 203

Time allowed: 3 hours Maximum marks: 80

Note: Question No.1 is compulsory. Attempt four more questions, selecting one question from each unit.

Q1.(a) What is the differentiate between data and information?

Ans. Refer to Q1.3

Q1.(b) What are the components of database system?

Ans. Refer to Q1.13

Q1.(c) What is schema?

Ans. Refer to Q1.28

Q1.(d) What is instance?

Ans. Refer to Q1.30

Q1.(e) What is domain?

Ans. Refer to Q1.69

Q1.(f) What is relationship type?

Ans. Refer to Q1.48

Q1.(g) What is view?

Ans. Refer to Q1.95

Q1.(h) What is function dependency?

Ans. Refer to Q1.85

UNIT - I

Q2. What is database? What are the objectives of database? Also discuss the advantages and disadvantages of database.

Ans. Refer to Q2.(b)

Q3.(a) What do you understand by a Query Language? Distinguish between DDL, DML and DCL. Explain any two DDL & DML command using suitable examples.

Ans. Refer to Q5.(c)

Q3.(b) Explain the role of DBA.

Ans. Refer to Q5.(a)

UNIT - II

Q4.(a) What is database independence and why is it important? What is the difference between logical and physical data independence?

Ans. Refer to Q8.(a) and Q8.(b)

Q4.(b) Explain client server architecture to DBMS.

Ans. Refer to Q9.(b)

Q5.(a) Explain the three-level architecture of DBMS with the help of an example.

Ans. Refer to Q7.(a)

Q5.(b) Describe object-based data model with an example.

Ans. Refer to Q11.(a)

UNIT - III

Q6. Define the term 'data model'. Explain hierarchical model and network model in detail.

Ans. Refer to Q14.(a)

Q7.(a) What is ER diagram? Draw the ER diagram of library management system.

Ans. Refer to Q13.(a)

Q7.(b) What do you mean by key? Explain different types of keys with suitable example.

Ans. Refer to Q15.(b)

UNIT - IV

Q8. Define normalization. How is it useful and used? Explain by giving examples, the conditions that are necessary for a relation to be in 1NF, 2NF, 3NF, BCNF, 4NF.

Ans. Refer to Q18.(a)

Q9.(a) What is concurrency control? How is it implemented? Explain.

Ans. Refer to Q21.(a)

Q9.(b) Differentiate between relational algebra and relational calculus.

Ans. Refer to Q1.67

B.C.A. 3rd Semester (MDU) Examination – November, 2017

Introduction to Database System

Paper : BCA – 203

Time allowed: 3 hours **Maximum marks: 80**

Note: Attempt **five** questions in all. **Question No.1 is compulsory.** In addition to compulsory question, attempt **four** more questions, selecting **one** question from each unit.

Q1.(a) Differentiate file system and DBMS.

Ans. Refer to Q1.12

Q1.(b) Name the five components of DBMS environment and how they relate to each other?

Ans. Refer to Q1.15

Q1.(c) What is mapping? Why it is necessary in DBMS architecture?

Ans. Refer to Q1.42

Q1.(d) Differentiate record-based and object-based data models.

Ans. Refer to Q1.70

Q1.(e) What is the degree of relationship? Give example also.

Ans. Refer to Q1.87

Q1.(f) Discuss the properties of a relation.

Ans. Refer to Q1.86

Q1.(g) Show that if a relational database is in BCNF, then it is also in 3NF.

Ans. Refer to Q1.90

Q1.(h) What is query processing? What are the typical phases of query processing?

Ans. Refer to Q1.100

UNIT - I

Q2.(a) What does defining, manipulating, sharing, maintaining and protecting of a database means?

Ans. Defining a Database

Defining a database involves specifying the data types, structures, and constraints of the data to be stored in the database. The database definition or descriptive information is also stored by the DBMS in the form of a database catalog or dictionary; it is called metadata.

Manipulating a Database

Manipulating a database includes functions such as querying the database to retrieve specific data, updating the database to reflect changes in the world, and generating reports from the data.

Sharing a Database

Sharing a database allows multiple users and programs to access the database simultaneously.

Protecting and Maintaining a Database

Protection includes system protection against hardware or software malfunction (or crashes) and security protection against unauthorized or malicious access. Finally a DBMS must be able to maintain the database system by allowing the system to evolve, as requirements change over time.

Q2.(b) Discuss different languages used in DBMS for storage, manipulation and querying of data.

Ans. Refer to Q5.(b)

Q3.(a) Discuss the capabilities that should be provided by a DBMS.

Ans. Refer to Q4.(a)

Q3.(b) What are different types of database end users? Discuss the main activities of each.

Ans. Following are the different types of database end users:

- **Sophisticated End-Users:** Sophisticated end-users are also engineers, analysts, designers, students etc. but they do not write a program. They access the data by using the query language.

- **Unsophisticated End-Users:** They are also called naïve users. These users need not be aware of the presence of database system or any other system supporting their usage. They neither write application programs nor they use query languages. They interact with the system through already written permanent programs to perform the functions of retrieval, deletion, creation and modification. They work through a menu driven application program that indicates the type and

range of response to the users. They are bank terminal operators, information counter operators, reservation counter operators etc.

UNIT - II

Q4. Differentiate two-tier and three-tier client-server architecture with diagram and how three-tier architecture is appropriate for web applications?

Ans. Refer to 9.(b)

Q5. What are the different ways of classifying a DBMS?

Ans. Refer to Q9.(a)

UNIT - III

Q6. Explain alternatives for specifying structural constraints on relationship types. What are the advantages and disadvantages of each?

Ans. The two alternatives for specifying structural constraints on relationship types are:

1. Cardinality Ratio

The cardinality ratio, which is used for binary relationships to specify the maximum number of relationship instances an entity can be involved in.

Cardinality ratios are the most useful in describing binary relationship sets. For binary relationship set R between entity sets A and B, the mapping cardinality must be one of the following:

- **One to One:** An entity in A is associated with at most one entity in B and an entity in B is associated with at most one entity in A.
- **One to Many:** An entity in A is associated with any number of entities in B. An entity in B, however, can be associated with at most one entity in A.
- **Many to One:** An entity in A is associated with at most one entity in B. An entity in B, however, can be associated with any number of entities in A.
- **Many to Many:** An entity in A is associated with any number of entities in B, and an entity in B is associated with any number of entities in A.

For example, if the company policy does not allow more than 100 employees in a department, the cardinality rule governing the DEPARTMENT-EMPLOYEE relationship is expressed as "One department can have a maximum of 100 employees". Also the company policy allows each employee to join a maximum of 2 courses at a time. At present the company offers 10 courses. The cardinality is indicated by placing the appropriate numbers beside the entities as shown below:

One-to-many Relationship

Many-to-many Relationship

An important point is that the number of associated entities may be variable. For example, an employee can

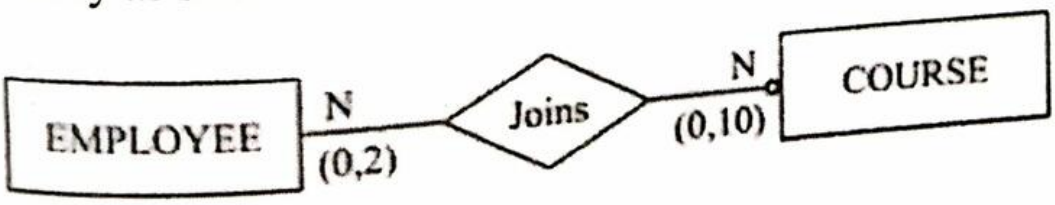
enroll for one or two courses at a time. He also has the choice of not getting enrolled for any of the courses. Similarly, a department can have a maximum of 100 employees. But it is quite possible that the number of employees in a department is 0, if the department is in its formative stages.

2. Participation Constraint

The participation constraint is used to show whether the existence of an entity depends on whether it is related to another entity by relationship type. It also sets the minimum number of relationship instances each entity can participate in.

An entity can participate in a relationship totally or partially. The participation is total (mandatory) if an entity's existence requires the existence of an associated entity in a particular relationship. If the occurrence of one entity does not require the occurrence of another corresponding entity in a relationship, the participation is said to be optional or partial.

As in the above example, the EMPLOYEE can take upto two executive development courses, but he need not take even one. So in the relationship "Employee joins COURSE", it is quite possible for an EMPLOYEE not to join a COURSE. Therefore, COURSE is optional to the EMPLOYER. But a COURSE must be attended by an EMPLOYEE, which makes the EMPLOYEE a mandatory entity. An optional entity is shown by drawing a small circle (o) on the side of the optional entity as shown below:



It is important to fully understand whether an entity is optional or mandatory in a relationship. Failure to do so may result in designs in which unnecessary temporary entities are created. Also consider the fact that the terms mandatory and optional refer to the participation of an entity within the context of a relationship with another entity.

The term optional indicates a condition in which the other participating entity may or may not be associated with occurrences of the optional entity in the relationship. But the term mandatory refers to a condition in which one participating entity must be associated with one or more occurrences of the other participating entity in the relationship.

Q7.(a) Discuss entity integrity and referential integrity constraints. Why is each considered important?

Ans. Refer to Q16.(a)

Q7.(b) What are the reasons that lead to the occurrence of null values in relation?

Ans. ***Value undefined, value unknown and value presently not available are the most common reasons that lead to the occurrence of null values in relation.***

Thus, a special value called the null value may be created when there is no value for an attribute. Null can be used for one of two reasons: either an entry is not applicable or it is not known.

- An example of 'not applicable' would be the attribute Flat_Number of an Address: this applies only to those people who live in flats; the Flat_Number attribute would be null for those people who live in houses.

- An example of 'not known' would be the Height attribute of a Person being recorded as null if the height is unknown.

UNIT - IV

Q8. Differentiate tuple and domain relational calculus. What is meant by safe expression in relational calculus? Give an example.

Ans. The difference between Tuple Relational Calculus (TRC) and Domain Relational Calculus (DRC) may be described as follow:

TRC, the original relational calculus presented by E.F.Codd, specifies queries in terms of variables that range over rows of the relations in the database while DRC specifies queries in terms of variables that range over columns (or domains) of the relations in the database. Commercial language SQL is closely related to TRC while DRC is related to a graphical language that is used in Microsoft Access. It is called Query by Example (QBE) and was designed at IBM Yorktown Height research centre in the 1970's. QBE is quite different than SQL since it uses a graphical interface that shows tables in which a user can specify queries by providing input which essentially provides an example of the output that user wants. It is easy to translate most SQL queries into TRC and most QBE queries into DRC although TRC and DRC do not include functions.

Safe expression in relational calculus

A safe expression in relational calculus is one that is guaranteed to yield a finite number of tuples as its result; otherwise, the expression is called unsafe.

For example, the expression

{t| NOT (EMPLOYEE(t))}

is unsafe because it yields all tuples in the universe that are not EMPLOYEE tuples, which are infinitely numerous.

Thus, an expression of tuple relational calculus containing universal quantifier, existential quantifier or negation condition may lead to a relation of infinite number of tuples. For example, consider an expression given below:

{T | ¬BOOK(T)}

This expression appears to be syntactically correct but it refers to all the tuples in the universe not belonging to BOOK relation, which are infinite in number. These types of expressions are known as unsafe expressions. Therefore, care must be taken while using quantifier symbols and negation operator in a relational calculus expression to ensure safe expressions. A safe expression is an expression, which results in a relation with finite number of tuples.

Q9. What is query optimization? Discuss the significance and different steps followed during query optimization.

Ans. Refer to Q20.(b)

B.C.A. 3rd Semester (MDU) Examination – November, 2018

Introduction to Database System

Paper : BCA – 203

Time allowed: 3 hours **Maximum marks: 80**

Note: Attempt **five** questions in all. **Question No.1** is compulsory. In addition to compulsory question, attempt **four** more questions, selecting **one** question from each unit.

Q1.(a) **What do you mean by data redundancy?**

Ans. Refer to Q1.17

Q1.(b) **Define the term catalog and metadata in DBMS.**

Ans. Refer to Q1.23

Q1.(c) **What is an instance?**

Ans. Refer to Q1.30

Q1.(d) **What do you mean by database schema?**

Ans. Refer to Q1.28

Q1.(e) **Define data integrity.**

Ans. Refer to Q1.66

Q1.(f) **Name any two popular relational database management softwares.**

Ans. IBM DB2, MySQL, Microsoft SQL Server.

Q1.(g) Explain concurrency in database system.

Ans. Refer to Q1.104

Q1.(h) What is the need of database security?

Ans. Refer to Q1.76

UNIT - I

Q2.(a) Discuss the main characteristics of the database approach. How it differs from traditional file system.

Ans. Refer to Q2.(a) and Q3.(a)

Q2.(b) What are the different types of database users who interact with the database system? Explain each in brief.

Ans. A human that interacts with a database is known as its user. Database users store new information into the database and retrieve information from the database. There are three different types of database users depending on the way that they expect to interact with the system. They are:

(a) Database administrators

(b) System analyst/Application programmers

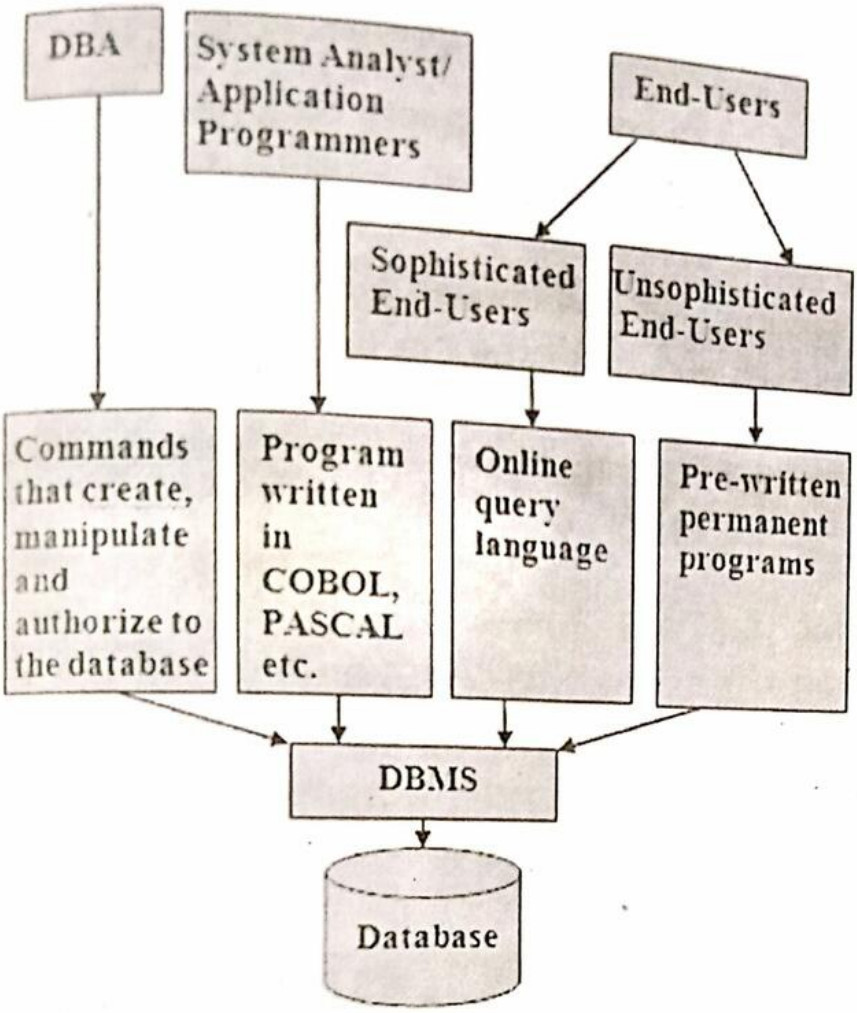
(c) End-users

(a) Database Administrators (DBA)

This user is responsible for the implementation, maintenance and authorizing access to the database. The jobs of DBA include:

- ***Monitoring the usage.***

- *Co-ordination among users.*
- *Security systems.*



(b) System analyst/Application programmers

System analyst determines the requirements of end users and designs the system by taking into account the database environment. Application programmers transform the design into source code of a language. System analyst consults with the DBA for designing the various data structure requirements of the applications.

(c) End-Users

- **Sophisticated End-Users:** Sophisticated end-users are also engineers, analysts, designers, students etc. but they do not write a program. They access the data by using the query language.

- **Unsophisticated End-Users:** They are also called naïve users. These users need not be aware of the presence of database system or any other system supporting their usage. They neither write application programs nor they use query languages. They interact with the system through already written permanent programs to perform the functions of retrieval, deletion, creation and modification. They work through a menu driven application program that indicates the type and range of response to the users. They are bank terminal operators, information counter operators, reservation counter operators etc.

Q3. What do you mean by DBMS? Explain the various functional components of DBMS with the help of suitable diagram. Also discuss the advantages and disadvantages of DBMS.

Ans. Refer to Q4.(a) and Q6.(c)

UNIT - II

Q4. What do you mean by data independence? Why it is important to maintain data independence in a database? Explain with the help of example the differences between logical and physical data independence.

Ans. Refer to Q8.(a) and Q8.(b)

Q5. Explain the client server architecture of database management system. Also write its advantages and disadvantages.

Ans. Refer to Q9.(b)

UNIT - III

Q6.(a) Define entity, entity type, entity set and attribute with the help of example.

Ans. Entity

An entity is a 'thing' in the real world with an independent existence. In other words, anything which exists and is distinguishable from one another is known as an entity.

For example, a student 'Ravi' with roll number 236 is an entity.

An entity may be physical and tangible like an employee or a non-tangible thing with conceptual existence like a bank account. Entities are classified as independent/strong entities and dependent/weak entities. An independent entity is one that does not rely on another for identification. A dependent entity is one that relies on another for identification.

Entity type

A set or a collection of entities that share the same attributes but different values, is known as entity type.

For example, the set of all publishers who publish books can be defined as the entity type PUBLISHER. Similarly, a set of books written by the authors can be defined as the entity type BOOK. A specific occurrence of an entity type is called its instance. For example, the book Data Structure and the publisher Epex Publications the instances of the entity type BOOK and PUBLISHER respectively.

Entity set

An entity set is a set of entities of the same type. The set of all employees of an organization can be defined as

the entity set employees. Similarly the entity set projects represents the set of all the projects undertaken by the organization.

An entity set is represented by a set of attributes. Possible attributes of the employees entity set are emp_no, emp_name and address. Possible attributes of the projects entity set are project_no and project_name.

Entity set serves as a collection of all instances of a particular entity type in the database at any point of time. Thus, this set shares the same type of properties For example: set of all persons, companies, trees etc.

Attributes

Attributes are the properties or characteristics of an entity i.e. every entity has some basic attributes that characterize it.

In simple words, an attribute of an entity is a particular property that describes the entity. For example, an employee entity may have employee number, name, address etc. as attributes. A student entity may have rollno, name, class, semester as attributes. The attribute value is the actual data contained in the attribute. For example, 101, RAVI, BCA, I are the actual data stored in the attributes rollno, name, class and semester.

Thus, an attribute is description that is used to identify, qualify, classify or otherwise express the set of an entity occurrence. For each attribute, of permitted values are available called as domain. The attribute which uniquely defines the occurrence of an entity is called primary key.

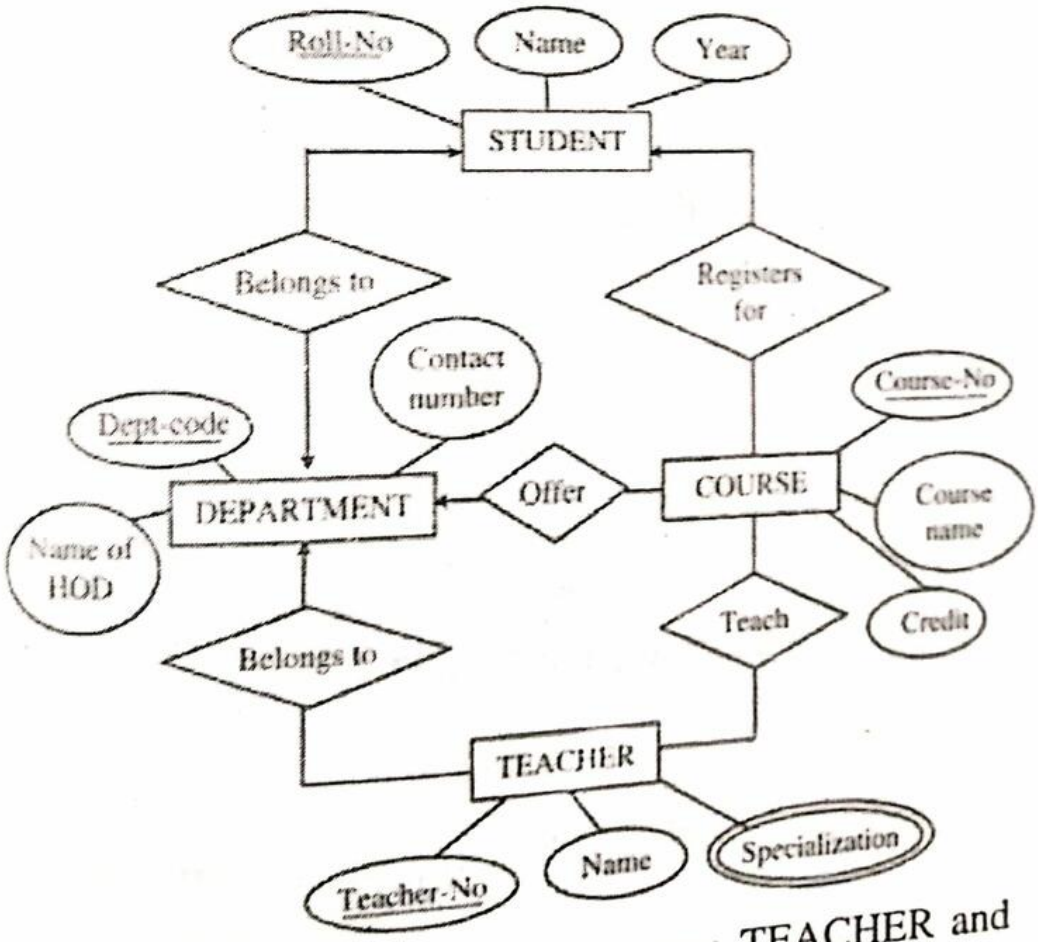
The attribute values describing an entity will constitute a significant portion of the data stored in the database.

Q6.(b) What is mapping cardinalities? Explain various types of mapping cardinalities.

Ans. Refer to Q12.(a)

Q7.(a) Define an E-R diagram for Educational Institute System. Make your own assumptions about the system.

Ans. The E-R diagram is shown in figure. It shows four entity sets namely STUDENT, TEACHER, COURSE and DEPARTMENT. The attribute "Specialization" shown in a double ellipse indicates that it is a multi-valued attribute. All these entity sets are related to each other.



The relationship "Belongs-to" between TEACHER and DEPARTMENT and between STUDENT and DEPARTMENT are joined by one-ended arrows. This specifies that a student or a teacher cannot belong to

more than one department but a department can have more than one student or teacher.

Similarly, each course is offered by only one department but a department can conduct more than one course. The relationships between TEACHER and COURSE and between STUDENT and COURSE are joined by simple lines. This specifies that a teacher can teach more than one course and a course can also be assigned to more than one teacher. Also, students can be enrolled into more than one course and there can be more than one student enrolled in a course.

Hence, all the necessary details about entities, relationships between entities, and constraints can be easily depicted by the E-R diagram.

Q7.(b) Define the term data model? Explain different types of data models.

Ans. Refer to Q10.(a)

UNIT - IV

Q8. What is the need of normalization? Define and discuss 1NF, 2NF, 3NF and BCNF by giving suitable example for each.

Ans. Refer to Q18.(a)

Q9. What is SQL? What are the major components of SQL? Write syntax for creating a table, inserting values in the table, updating values in the table and selecting fields. Use suitable example for each.

Ans. Refer to Q19.(b) and Q19.(c)

B.C.A. 3rd Semester (MDU) Examination – March, 2021

Introduction to Database System

Paper : BCA – 203 (97671)

Time allowed: 3 hours **Maximum marks: 80**

Note: Attempt **five** questions in all. **Question No.1 is compulsory.** Attempt **four** more questions, selecting **one** question from each unit.

Q1.(a) Define the term database.

Ans. Refer to Q1.9

Q1.(b) What are disadvantages of DBMS?

Ans. Refer to Q1.19

Q1.(c) What are the advantages of client server architecture?

Ans. Refer to Q1.39

Q1.(d) What do you mean by data independence?

Ans. Refer to Q1.32

Q1.(e) Define entity integrity constraint.

Ans. Refer to Q1.77

Q1.(f) Explain NULL constraint.

Ans. A NULL is a value that is unknown, unavailable, unassigned or inapplicable. A NULL is neither a zero nor a blank space because zero is a numeric value and blank space is a character. Also, columns of any data type can contain NULLS. To check whether a column is null, a special operator IS NULL can be used.

Q1.(g) What is SQL?

Ans. Refer to Q1.91

Q1.(h) What is View?

Ans. Refer to Q1.95

UNIT - I

Q2.(a) What do you mean by Data? How is it different from information, explain by example.

Ans. Refer to Q1.1 and Q1.3

Q2.(b) What is File Processing System? What are its disadvantages?

Ans. Refer to Q3.(b)

Q3.(a) What is DBMS? What are the main facilities that every DBMS should provide? Explain.

Ans. Refer to Q4.(a)

Q3.(b) Who is DBA? What are its various jobs and responsibilities? Also give the additional duties that may be assigned to DBA.

Ans. Refer to Q5.(a)

UNIT - II

Q. Explain three-view architecture of database system with mapping. How these different views of database are related to the concepts of logical and physical data independence?

Ans. Refer to Q7.(a)

Q5.(a) Write short notes on the following:

(i) Record-based data model

(ii) Object-Oriented data model

Ans. Refer to Q10.(a) and Q11.(a)

Q5.(b) What are the different ways of classifying a DBMS? Explain in detail.

Ans. Refer to Q9.(a)

UNIT - III

Q6.(a) Design an E-R diagram for library management system? Make your own assumptions about the system.

Ans. Refer to Q13.(a)

Q6.(b) Differentiate between network model and relational model with their relative merits and demerits.

Ans. Following are the differences between network and relational model:

Network Model	Relational Model
1. Network model is a collection of records connected to each other through links, i.e., it is based on graph structure.	1. Relational model stores records in the form of tables.
2. Many–to–many relationship can be expressed in this model.	2. Many–to–many relationship can be easily expressed in this model.

Network Model	Relational Model
3. Relationship between records is in the form of links or pointers.	3. Relationship between records is represented by a relation which have a key field from each record involved in the relationship.
4. General purpose Query facility is not available.	4. General purpose Query facility is available.

Q7. Explain the following terms:

(i) Domain

(ii) Attribute

(iii) Entity

(iv) Entity set

(v) Primary key

(vi) Candidate key

(vii) Foreign key

(viii) Alternate key

Ans. (i) Refer to Q1.69

(ii) Refer to Q1.97

(iii) Refer to Q1.45

(iv) Refer to Q1.46

(v) Refer to Q1.61

(vi) Refer to Q1.62

(vii) Refer to Q1.64

(viii) Refer to Q1.63

UNIT - IV

Q8. What are the problems of bad database design? Write the procedure of normalizing database while discussing various normal forms.

Ans. Refer to Q18.(a)

Q9.(a) Write the syntax of the following SQL commands and give an example of each:

(i) Alter
(ii) Insert
(iii) Delete
(iv) Update

Ans. (i) Alter Command: Refer to Q18.(c)

(ii) Insert Command

This command inserts rows in a table. Values can be inserted for all the columns or for the selected columns.

The syntax of this command is given below:

```
INSERT INTO <table_name>
    [(column1_name, ……, column_name)]
        VALUES (value,……,value);
```

Only one row is inserted at a time using this command.

The column names may be c ed if all the values of corresponding columns are to be entered. Here the values listed in the VALUES clause should be according to the order and data type of columns in the table. A value must be provided for each column in the table.

e.g.

```
SQL> INSERT INTO DEPT
        VALUES (1000, 'ACCOUNTING', 'ROHTAK');
```

DEPT table

DEPTNO	DNAME	LOC
1000	ACCOUNTING	ROHTAK

The column names are not omitted if the values of all the columns are not entered.

e.g.

```
SQL> INSERT INTO DEPT( DNAME, LOC )
        VALUES ('ACCOUNTING', 'ROHTAK');
```

DEPT table

DEPTNO	DNAME	LOC
	ACCOUNTING	ROHTAK

(iii) Delete Command

This command deletes specified rows from a table. The syntax of this command is given below:

DELETE FROM <table_name> [WHERE condition];

e.g. Consider the given table employee

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT

Suppose MOHAN quits. To remove it from the table employee give the following command:-

```
SQL > DELETE FROM employee
            WHERE Emp_no = 102;
```

Once the above command is obeyed, the relation will be:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT

If the WHERE clause is not given, all the rows will be deleted.

(iv) Update Command

UPDATE command is used to change values in rows of a specified table.

The syntax of this command is given below:

```
UPDATE <table_name> SET <column_name> = expression
        [,<column_name> = expression .....]
         [WHERE condition];
```

Here

- ***The WHERE clause to used to specify one or more affected rows. Omitting the WHERE clause updates all rows.***
- ***SET clause is used to specify the new value that will replace the old value in specified column.***

- *UPDATE can be used to change values of a single or multiple columns. This is done respectively, by specifying a single column_name = expression in the SET clause or by giving a comma list of multiple column_name = expression.*

Updating Fields

e.g Consider the given below table employee:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

To promote ASHU as MANAGER use the command:

```
SQL > UPDATE employee
        SET Design = 'MANAGER'
          WHERE Name = 'ASHU';
```

Once the above command is obeyed, the table will be:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	MANAGER	6400	ROHTAK

Updating multiple columns and rows

e.g. Consider the given below table employee

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	CLERK	5850	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	CLERK	5850	PANIPAT
106	RAJBIR	CLERK	5850	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

To promote all CLERK to ASSTT and change their Basic 6200 use the command:

```
SQL > UPDATE employee
        SET  Design = 'ASSTT ', Basic = 6200
             WHERE  Design = 'CLERK';
```

Once the above command is obeyed, the table will be:

employee

Emp_no	Name	Design	Basic	Address
101	RAJIV	ASSTT	6200	ROHTAK
102	MOHAN	SALESMAN	6400	ROHTAK
103	RAVINDER	MANAGER	9000	KARNAL
105	BALVINDER	ASSTT	6200	PANIPAT
106	RAJBIR	ASSTT	6200	ROHTAK
108	ASHU	SALESMAN	6400	ROHTAK

Q9.(b) Write short notes on the following:

(i) Recovery

(ii) Concurrency

Ans. Refer to Q21.(b) and Q21.(a)

B.C.A. 3rd Semester (MDU) Examination – Feb., 2022

Introduction to Database System

Paper : BCA – 203

Time allowed: 3 hours **Maximum marks: 80**

Note: Attempt **five** questions in all. **Question No.1 is compulsory.** In addition to compulsory question, attempt **four** more questions, selecting **one** question from each unit.

Q1.(a) What is the difference between data and information?

Ans. Refer to Q1.3

Q1.(b) Name different type of database user.

Ans. Refer to Q1.11

Q1.(c) Define Schema and sub schema.

Ans. Refer to Q1.28 and Q1.29

Q1.(d) What is instance?

Ans. Refer to Q1.30

Q1.(e) Define Domain.

Ans. Refer to Q1.69

Q1.(f) Define Foreign key.

Ans. Refer to Q1.64

Q1.(g) What is functional dependency?

Ans. Refer to Q1.85

Q1.(h) How to update data in table?

Ans. To update data in a table, you need to:

- First, specify the table name that you want to change data in the UPDATE clause.
- Second, assign a new value for the column that you want to update. In case you want to update data in multiple columns, each column = value pair is separated by a comma (,).
- Third, specify which rows you want to update in the WHERE clause. The WHERE clause is optional. If you omit the WHERE clause, all rows in the table will be updated.

UNIT - I

Q2.(a) What is database? What are the advantages of database over traditional file-based system?

Ans. Refer to Q2.(b)

Q2.(b) Explain the role of DBA.

Ans. Refer to Q5.(a)

Q3.(a) Differentiate DDL, DML and DCL.

Ans. Refer to Q5.(c)

Q3.(b) How DBMS works? Explain.

Ans. DBMS is complex software which provides interface for each category of the user. DBMS interprets user

commands so that computer system can operate on that command to perform the desired task.

A database management system works as follows: It organizes database files and provides end users more access and control over their data. To accomplish this, a DBMS allows users to manipulate the data in their database files, including creating, editing and updating it when needed.

Thus, DBMS works as an interface between the user and the centralized database. First, a request or query is forwarded to a DBMS which works (i.e., a searching process is started on the centralized database) on the received query with the available data and if the result is obtained, is forwarded to the user. If the output does not completely fulfill the requirements of the user then a rollback (again search) is done and again search process is performed until the desired output is obtained.

UNIT - II

Q4. Define the term data model. Describe record based data model with example.

Ans. Refer to Q10.(a)

Q5.(a) Explain the three-level architecture of DBMS.

Ans. Refer to Q7.(a)

Q5.(b) What is data independence? Differentiate logical and physical data independence.

Ans. Refer to Q8.(a) and Q8.(b)

UNIT - III

Q6.(a) Explain integrity rule. Describe their importance.

Ans. Refer to Q16.(a)

Q6.(b) What is E-R Diagram? Explain various components of E-R diagram.

Ans. **E-R Diagram:** Refer to Q13.(a)

Component of E-R diagram: Refer to Q1.50

Q7.(a) Differentiate Hierarchical and Network data model.

Ans. Refer to Q14.(c)

Q7.(b) Differentiate Primary, Candidate and Unique key.

Ans: Following are the differences between Primary, Candidate and Unique key:

Primary Key	Candidate Key	Unique Key
1. A table can have only a single primary key.	1. A table can have multiple candidate keys.	1. A table can have multiple unique keys.
2. A primary key cannot be defined on columns that allow nulls. Primary Key = Unique Key + Not Null Constraint	2. Candidate key is a set of single or multiple columns within a table that can uniquely identify each record of the table. It also has UNIQUE and NOT NULL constraints.	2. A unique key can be defined on columns that allow nulls but it can accept only one NULL value.

UNIT - IV

Q8. Explain by giving examples, the conditions that are necessary for a relation to be in 1NF, 2NF, 3NF, BCNF and 4NF.

Ans. Refer to Q18.(a)

Q9.(a) What are the various set operational in relational algebra? Explain with example.

Ans. Refer to Q17.(a)

Q9.(b) What is query optimization? Explain.

Ans. Refer to Q20.(b)