INTRODUCTION TO DATABASE SYSTEM

Unit 7

SLOs

- Define terms flat file system and database system
- Differentiate between flat file system and database system
- Discuss the advantages of database system over flat file system
- Differentiate between database and database management system (DBMS)

7.1 DATABASE

A database stores data in organized form. A database is composed of tables which contain rows and columns. These rows and columns are called records and fields respectively. Most databases contain multiple tables. For example, a general store database may include tables for purchase, sales and stock records. Each of these tables has different fields that are relevant to the information stored in the table. Generally, a database is an electronic system that facilitates easy access, manipulation and updating of data.

Use of Database

Nowadays, everyone is familiar with term database, it is mathematically developed data structure which converts raw input data into meaningful information for a particular organization. These days, database can be seen in every field of life, for example in industries, health, agriculture, schooling, business and banking.

The databases can be developed according to the size of its records for a particular organization. Databases can be small in size with a few records or very large like NADRA (National Database Registration Authority) databases which keep the multi millions of records.

A database is playing a leading role to enhance the efficiency and performance of any organization. The goal of database is to minimize the loss and increase the productivity and efficiency of any organization in the age of information technology.

7.1.1 Database Management System (DBMS)

Databases are usually developed, maintained and controlled by the Database Management System (DBMS). The DBMS essentially serves as an interface between databases and end users or application programs, ensuring that data is consistently organized and remains easily accessible.

Here are some examples of popular DBMSs used these days:

- MySql
- Oracle
- Microsoft SQL Server
- MongoDB
- Visual Foxpro
- IBM Db2
- PostgreSQL

Fig: 7.1 Popular DBMS

7.1.2 Flat File System

Early databases were relatively "flat", which means they were limited to simple rows and columns, like a spreadsheet. A flat file is the older version of database. It stores data in a single table structure. Flat file databases are usually in plain text format, with only one record per line. The fields included in the record are separated using delimiters such as tabs or commas.

7.1.3 Advantages of Database Management System over the Flat File System:

DBMS	Flat File System
Multiple users can access data simultaneously	Only one user can access at a time
Capable of handling huge sets of data	Suitable only for smaller sets of data
Allows non-duplication and integrity	Increases duplicate and redundant data
Supports online access	Does not support remote connections
Good for small, medium and large businesses	Limited only to smaller data management needs

Characteristics of Database Management System

A DBMS is modern version of database designing, organization and manipulation. This mainly offers the solutions which a flat file system could not provide. The DBMS has many characteristics. Some of them are:

- Multiple users can access DBMS and can view, add, edit and delete records.
- A DBMS offers tools like Queries, Views and Forms which help users to manipulate data easily and more efficiently.
- A DBMS is more secure and reliable.
- DBMS allows distribution of data in multiple tables by making use of features like keys and relationships between fields of those tables. This allows lesser duplication of data and results in lesser redundancy.
- Preparing backups and providing limited permissions to the users are features of DBMS.
- DBMS can handle large and complex data more conveniently. Therefore, it is preferred by the medium and large organizations.

SLO

- Define basic database terms like table, field, record, data type, etc.

7.2 BASIC COMPONENTS OF DBMS

The basic components of DBMS are discussed below:

(i) Table

It is a collection of data elements organized in shape of rows and columns. A contact list may be one of the simplest examples of a table. The marks record prepared by a class teacher is also an example of a table.

(ii) Field

It is the smallest component in a database. It is where the actual data is stored during data entry. All data fields in the same table, have unique names. Fields are also called attributes or columns. Multiple fields make up a data record, several data records make up a data table, and several data tables make up a database.

Table — Field — Record

Id	Name	Fathername	Class
1	Rameez	Tariq	IX
2	Anam	Sohail	IX
3	Sheldon	David	IX
4	Nawal	Tufail	IX

Fig: 7.2 Components of a Table

(iii) Record

A single entry in a table is called a record. Records are also referred as tuples or rows. A record is made up of two or several data items which are also called tuples in a table representing a set of related data. For example, the illustrated Student table (Fig: 7.2) has 4 tuples /records/rows.

(iv) Data Types

All fields in a table must have some data type. Data type is a data storage format that can contain a specific type or range of values. The data type of a field is a property that tells what kind of data that field can hold. Here are some basic data types.

Data Type	Description	Examples
Integer	Holds only whole numbers.	145, -35, 74586
Floating Point	Holds numbers with decimal points.	5.6, 3.14, 554.9
Character	Stores only one character.	A, B, c, d
String	Can store a combination of numbers, letters and special characters.	Pakistan, Computer, @admin
Boolean	Can hold only Boolean values i.e. true or false.	1,0
Date & Time	Stores date and time in specified format.	01-01-2020 11:30

Different DBMSs offer different range of data types to be stored. For example, MS Access allows a range of whole numbers from -32768 to 32767 for an "Integer". In modern DBMS, choosing proper data type is important to make sure that database runs faster.

Teacher Note	Teachers are advised to explain the concepts of data types and components of DBMS by demonstrating MS Access Components.

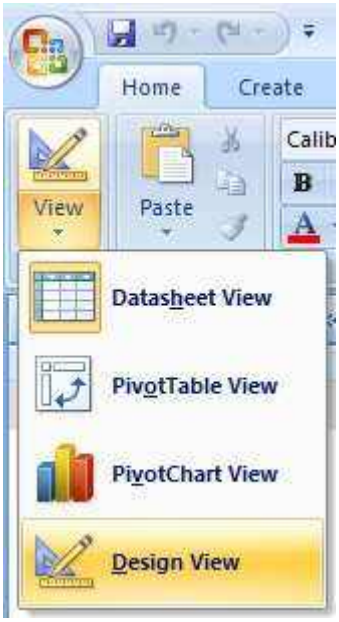
(v) Views

In a database the data is stored in tables. However, we can see that data through views. Views do not store data and just show the information virtually. They have the ability to fetch data from different tables. Views maintain the security of data and ensure that no changes occur in the original data.

Now we will learn how can we create Tables and Views in MS Access.

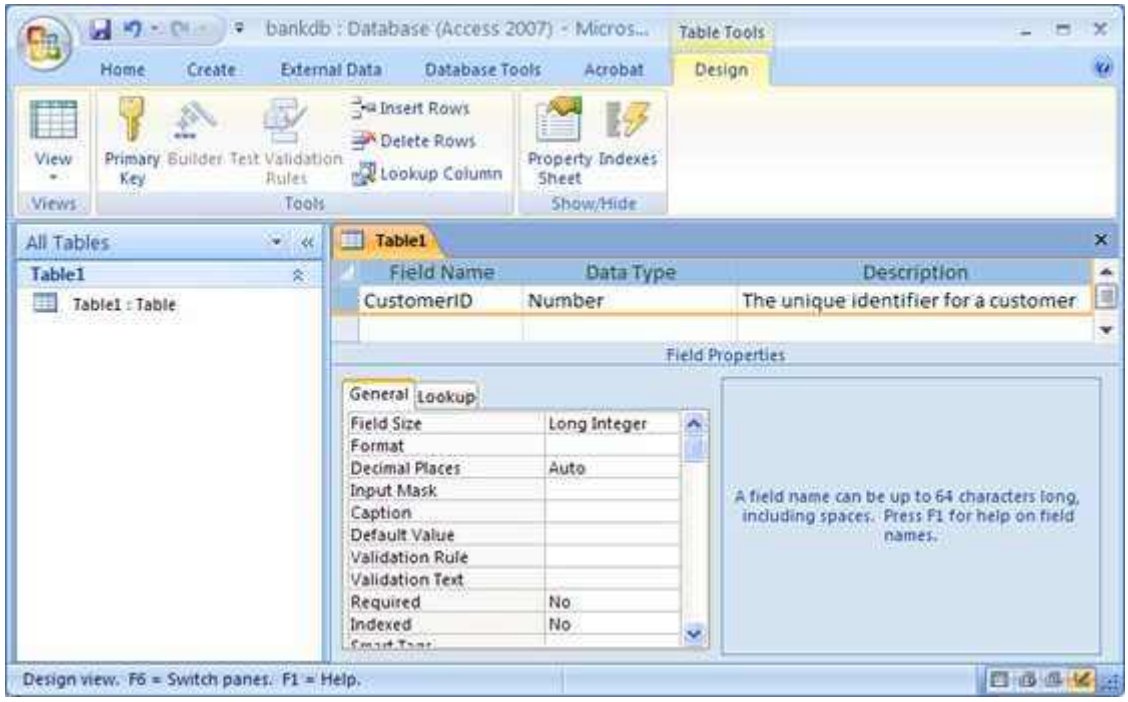
(i) Steps for creating a table using Design View:

1. To create tables in Access using "Design View," click on the Create tab and click on the Table icon. Then pull down the View menu and choose Design View.



2. A new table then appears in the Table Design View. Note that the default name assigned to the table is Table1.
3. Type the name of a field into the "Field Name" column.
4. Then use the drop-down menu in the "Data Type" column to assign the field a data type.

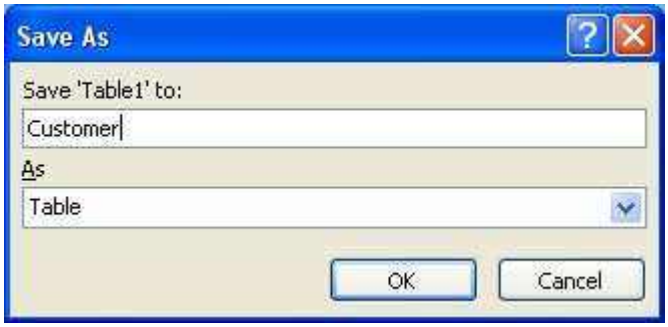
5. If desired, type a description of the data stored in this field.



6. Repeat steps 4 and 5 until you have created all of the necessary table fields. An example of a Table may be customer Table that has following entries.

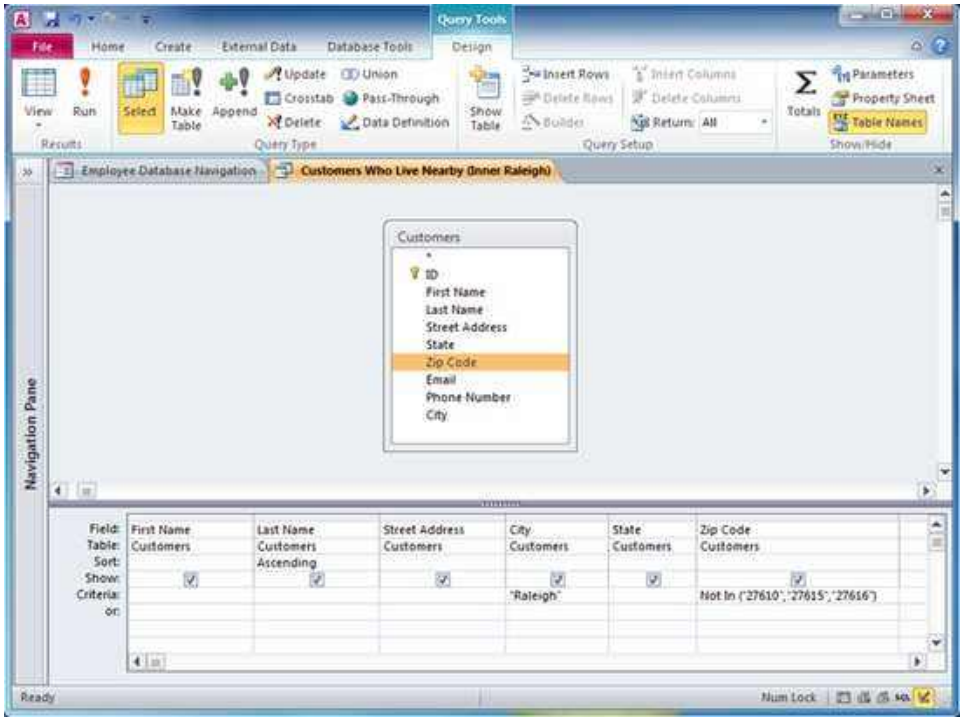
Field Name	Data Type	Description
Customer ID	Number	The Unique Identifier for a customer
First Name	Text	The First Name of the customer
Last Name	Text	The Last Name of the customer
Address	Text	The Address of the customer

7. Click the "Save" button in the Quick Access toolbar.
8. Then type a name for the newly created table and click "OK".



(ii) Steps for creating a query or view using Design View:

1. To make a query in design view, click on the "Create" tab in the Ribbon and pull down the "Queries" group and click on "Query Design" button.
2. In the "Show Table" dialog box, add the table or tables that you want to add to query design view.
3. Next, add the fields from these tables that you want to view in your query results or view. If you want to add all of the fields of a table into your result set, you can click and drag the first field in the table, shown as an asterisk.
4. Once you have added all the necessary tables and fields to the query or view, click the "Close" button in the "Show Table" dialog box to close it and display the query design view.
5. To run a query and view the result set, you can click the "Run" button in the "Results" group of the "Design" tab in the "Query Tools" contextual tab on the office Ribbon.
6. The result set looks like a table. This result set is a reflection of data from the selected fields of the tables. It is also known as a view.
7. Click the "Save" button in the Quick Access toolbar. Type a name for your view and click "OK" to save the query.



SLOs

- Define entity
- Discuss about the term relationship, in the context of database
- Distinguish among primary, foreign and referential keys

7.3 Data Modeling

Data modeling is a process of developing conceptual representation of data objects and their relations. Data models are used to express how the information will be stored in database. This helps to identify the most important fields and remove the irrelevant data. Data models can be used by database developers to create a physical database. This saves a lot of time and efforts of developers. There are three most important components of data models.

(i) Entity

(ii) Relationship

(iii) Referential Keys

7.3.1 Entity

In literal sense, an entity is any individual object which has its own qualities and properties. In database terms, an entity is an independent table and its fields are known as attributes. As an example, a Payroll database will contain an entity named Employees. The Employees entity will contain various attributes like EmployeeID, Name, Designation, Salary, etc.

7.3.2 Relationship

When the database structures grew and became more complex, a lot of data started to become redundant which means that data was being unnecessarily duplicated. This created a need to connect data entities instead of repeating same data in multiple tables. This resulted in the creation of relationships and Relational Database Management Systems (RDBMS).

A relationship defines the connection between two tables. It creates a connection from an attribute of one entity with an attribute of another entity. Three types of relationships can be defined between entities.

(i) One to One Relationship

This type of relationship defines that a record in one entity can be connected to only one record in another entity. This is not a very common type of relationship because the data from related entities can directly be placed in a single entity. However, this type of relationship is used to divide larger entities into smaller ones.

(ii) One to Many Relationship

This type of relationship defines that a record in one entity can be connected to many records in another entity. This is the most common type of relationship used in relational databases. This relationship can also be seen as *Many to One Relationship*.

(iii) Many to Many Relationship

In this type of relationship, one or more records of one entity are connected to one or more records of another entity. Usually, a third entity known as "junction table" is used to create the many-to-many relationship between two related entities.

7.3.3 Referential Keys

The relationships are configured by using referential keys on entities. The keys determine a certain set of rules that must be followed by the data stored in a field of an entity. In larger databases, keys are very important to uniquely identify a specific record. Two types of keys are most commonly used in RDBMSs:

(i) Primary Key

A primary key is used to uniquely identify a record in an entity. When a primary key is applied to any attribute in an entity, it forces the rules of Primary Key onto that attribute. These rules are:

- The attribute (field) must contain a unique value to identify a record. A unique value means that two records in the same entity cannot have the same value stored in this attribute where Primary Key is applied.
- The value of the attribute where Primary Key is applied, cannot be null.

(ii) Foreign Key

A foreign key is used to define the connection or relation between two entities. The foreign key of one entity is configured to be connected to the primary key of another entity. When a foreign key is applied on an attribute, it enforces that the value for that attribute should match any record in the related entity having a primary key.

Understanding relationship and referential keys:

The figure 7.3 shows four tables and their fields.

Students table is used to store personal information of individual student. It has an Id field set as a Primary Key. It also has a ClassId field to setup a One-to-One foreign key relationship with the Class table.

Class table is used to store information about classrooms in a school. It has an Id field set as a Primary Key. A student can be enrolled in only one class; hence, Students table has a One-to-One relationship with Class table. However, many teachers can be associated with many classes. This requires a Many-to-Many relationship between Class and Teachers tables.

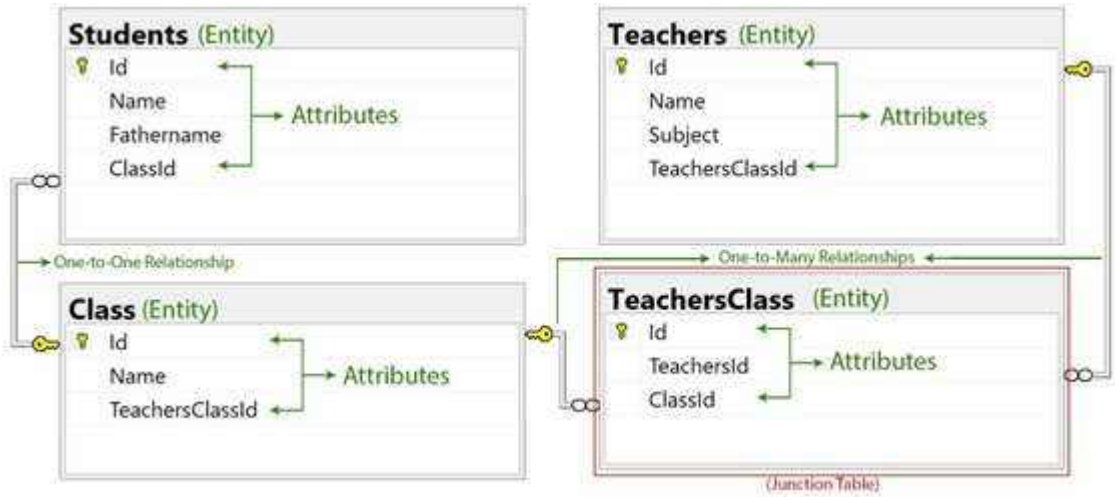


Fig: 7.3 Entity Relationship Diagram

Teachers table is used to store personal information about a teacher. It has an Id field set as a Primary Key. Many classes can be taught by many teachers. This requires a Many-to-Many relationship between Teachers and Class tables.

TeachersClass table is used as a junction table to facilitate the Many-to-Many relationship between Teacher and Class tables. It also contains an Id field set as Primary Key. The other two fields are used to define which teachers are associated with which classes. It creates a One-to-Many relationship with each of the two connected tables. Teachers and Class tables use their TeachersClassId field's foreign key relationship to fetch the related information from this table.

SLOs

- Define term ER model
- Design ER model for a database in M.S Access

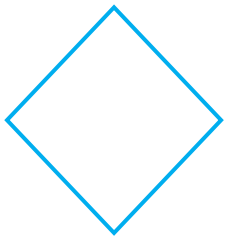
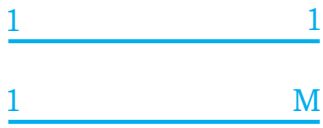
7.3.4 Entity Relationship or ER Model

Entity Relationship Model (ERM) or Entity Relationship Diagram (ERD) describes the entities, attributes and relationships with their types in a simplified diagram. This model or diagram can itself be used as the reference for designing an actual database. It can even be used as a backup for the structure of a database. The ERD can be used in two ways:

- When the database has not been created yet. The ERD helps in creating a clear representation of the entire database based on user requirements.
- When an existing database needs to be documented. The Database development tool features automatic creation of ERD based on existing database which facilitates documentation.

(i) Components of ER Diagram

ER Design is made up of different components like Attributes, Relationships, etc. There are defined symbols and shapes to represent each one of them. Some of the shapes used to define these components are:

	A rectangle is used to define an **entity**. This can be any real-world object like Student, Teacher, Class, etc.
	An ellipse defines an **attribute** of an entity. One entity may contain multiple attributes and are defined by multiple ellipses.
	**Relationships** are symbolically represented by diamond shape. It simply states the type of relationship between two entities.
	Connecting lines show the **type of relationship** between two entities. These lines are annotated by 1 or M (stands for Many) at their ends to describe the type of relationship.

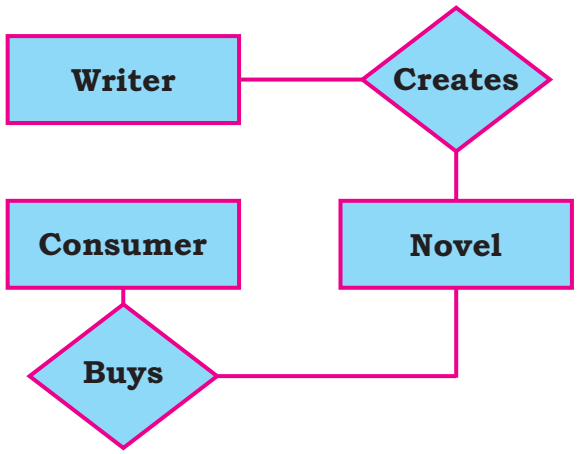
(ii) Steps to design ER Model

1. Identify and design the entities based on the requirements of its users.
2. Identify and design the attributes within the required entities.
3. Identify the relationships required between entities.
4. Define Primary Keys in interrelated entities.
5. Design Foreign Key relationships based on requirements and bind them to previously created Primary Keys.
6. Generate an automated Entity Relationship Diagram

For example a sample ERD for the statement "A writer creates a novel and consumer buys novel" is discussed below.

Here in this example, diagram shows that:

- Entities are in rectangular Box
  1. Writer
  2. Consumer
  3. Novel
- Relationships are in Diamond Shape
  1. Create
  2. Buys



Teacher Note	Teachers are expected to help students in designing an ER Model as given in the Activity section.

SUMMARY

- A database stores data in an organized form.
- Databases are used in many different organizations and various industries.
- A Database Management System (DBMS) software allows convenient creation, modification and display of data in a database.
- There are many popular DBMS programs such as Microsoft SQL, MySQL, Oracle, etc.
- The data in a flat file database is limited to rows and columns in a table.
- Flat file databases usually store data as plain text.
- A DBMS can handle huge sets of data and has multi-user support.
- The fields in a table can be defined as one of the supported data types which best suits the type of data it holds.
- A Relational DBMS introduces concepts of entities, attributes, relationships and keys.
- A table is also called an entity, a record is also called row or tuple and a field is also called an attribute or column.
- There are essentially two types of relationships: One-to-One relationship and One-to-Many relationship.
- One-to-One relationship relates a record from one entity to only one record of another entity.
- One-to-Many relationship relates a record from one entity to one or more records of another entity.
- Many-to-Many relationship is a combination of two One-to-Many relationships with the help of a junction table.
- Relationships make use of Keys.
- Two common types of keys are Primary Keys and Foreign Keys.
- Primary key uniquely identifies records in an entity.
- Foreign key defines a relationship between two entities.
- Entity Relationship Model (ERM) or Entity Relationship Diagram (ERD) graphically displays the structure of a database.
- The components of ERD include Entities, Attributes and Relationships.
- ERDs are used to either design a new database or document an existing one.

EXERCISE

A. Choose the right answer.

1. Which of the following Microsoft Office packages is a DBMS?
   a) MS- Word b) MS- Excel
   c) MS- Power Point d) MS- Access

2. The basic limitation of a flat file database is that:
   a) It is complicated b) It stores data in a single file
   c) It is very heavy d) It is not supported on internet

3. In a database table of "Students", the address of the student will be a:
   a) Record b) Field
   c) Entity d) Data type

4. In a database table of "Students", the particulars of a single student will be a:
   a) Record b) Field
   c) Entity d) Data type

5. In a relational database, keys are used to create a:
   a) Table b) Fields
   c) Records d) Relationship

6. A field that stores the names of students should be defined as:
   a) Integer b) Float
   c) String d) Boolean

7. A key that allows only unique entries in a field is called:
   a) Primary Key b) Secondary Key
   c) Foreign Key d) Super Key

8. Data Redundancy means:
   a) Duplication of Data b) Variety of Data
   c) Size of Data d) Data Type

9. The relationship that matches one record of an entity with only one record of another entity is called:

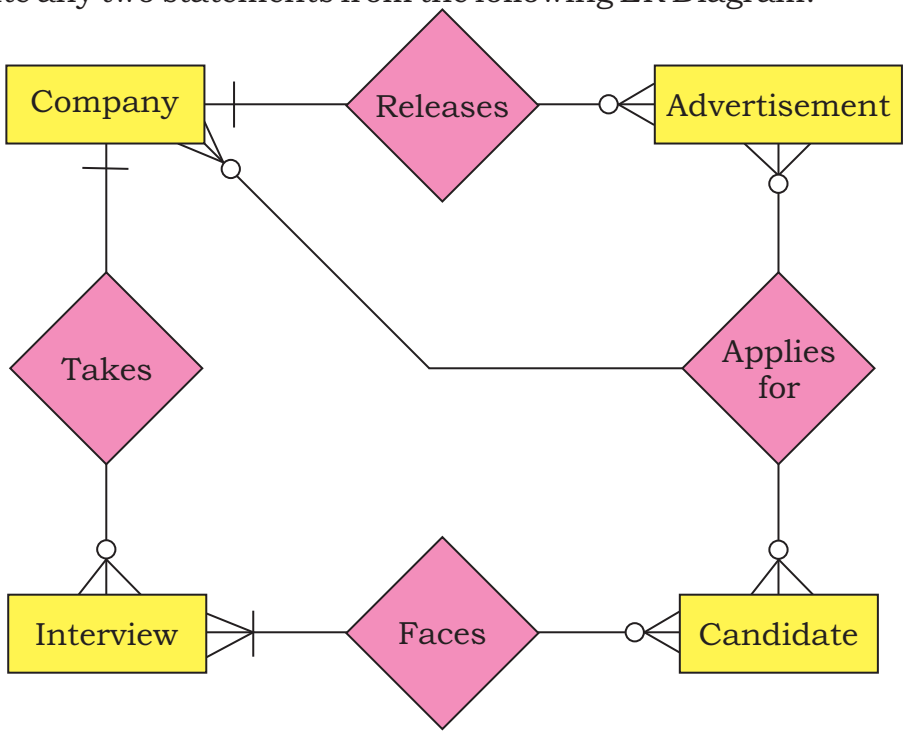
a) One-to-One relationship b) One-to-Many relationship
c) Many-to-One relationship d) Many-to-Many relationship

10. The shape that is used to represent an attribute in an ERD is:

a) A diamond b) An octagon
c) A rectangle d) An ellipse

B. Respond the following:

1. Why Database Management System is preferred over Flat File System?
2. Discuss the use of databases in business with example.
3. What is the difference between Design View and Datasheet View?
4. Why is it important to carefully decide the data type for each field?
5. What is the difference between table and view?
6. Explain entities, attributes and relationships with one example of each.
7. List the major characteristics of primary and foreign keys.
8. Write three benefits of using relationships in the database.
9. Discuss the importance of ERD in business
10. Write any two statements from the following ER Diagram.



C. Match the columns:

S.NO.	A	S.NO.	B	C
(i)	Primary Key	(a)	Attributes	
(ii)	Integer data	(b)	Always unique value in field	
(iii)	Relationship	(c)	Data in plain text form	
(iv)	Field	(d)	Number without decimal point	
(v)	View	(e)	Connection between two tables	
(vi)	Flat file system	(f)	Shows virtual data	
(vii)	Entity	(g)	Table with its own attributes	

ACTIVITIES

1. Create few tables and practice; adding, updating and deleting records in MS Access.

2. Create a table in MS Access by importing Excel Sheet. Examine the data type of each field after importing. Make changes in data types where it is required.

3. Create different views to show data from two tables.

4. In supervision of your teacher, draw a simple ERD on paper and implement that in MS Access. Your ERD should include at least three entities, list of attributes of each table, proper data type assignment for each field, implementation of primary and foreign keys and simple relationships between entities.

WEBLINKS/ WEBSITES

Dear learners!
Internet is full of resources and it is ever growing at very fast speed. Here are some links of website and videos which may help to improve your understanding regarding the concepts that you learn in this book. Remember, these are just few examples. You and your teachers can find many other resources on web.

Fundamental of Computers	➢ https://www.javatpoint.com/history-of-computer ➢ https://www.edureka.co/blog/types-of-artificial-intelligence/ ➢ https://www.tutorialandexample.com/computer-fundamentals-tutorial/
Fundamental of Operating Systems	➢ https://edu.gcfglobal.org/en/computerbasics/understanding-operating-systems/1/ ➢ https://www.dell.com/support/article/en-pk/sln288177/how-to-install-windows-8-or-windows-10-on-a-system-that-was-factory-downgraded-to-windows-7?lang=en
Office Automation	➢ https://www.youtube.com/watch?v=fUkh3yWm3d4 ➢ https://edu.gcfglobal.org/en/excel2010/
Data Communication and Computer Networks	➢ https://www.studytonight.com/computer-networks/ ➢ https://www.ece.uvic.ca/~itraore/elec567-13/notes/dist-03-4.pdf ➢ https://www.youtube.com/watch?v=gFTyL4ZvS5s
Computer Security and Ethics	➢ https://www.reveantivirus.com/en/computer-security-threats/computer-hacking ➢ https://copyrightalliance.org/ca_faq_post/difference-copyright-patent-trademark/ ➢ http://www.nr3c.gov.pk/rescue9911.html ➢ http://web.cs.unlv.edu/harkanso/cs115/files/14%20-%20Computer%20Security.pdf

Web Development	➢ https://www.w3schools.com/html/html_intro.asp ➢ https://www.youtube.com/watch?v=ABFi5V7AiXQ
Introduction of Database System	➢ https://www.studytonight.com/dbms ➢ https://www.tutorialspoint.com/dbms/er_model_basic_concepts.htm
General Websites	➢ https://www.webopedia.com ➢ https://www.unm.edu/~tbeach/terms/index.html ➢ https://www.edureka.co ➢ https://www.britannica.com/ ➢ https://edu.gcfglobal.org/en/computerbasics/ ➢ https://www.homeandlearn.co.uk/BC/BeginnersComputing.html

List of lab activities for grade 9
(Practical)
As given in curriculum

1. Operating System

- Installation of O.S. (MS Windows latest version)
- Manage files and folders
- Customize desktop
- Installation of MS Office latest version
- Installation of Antivirus Software

2. MS Word

- Write different applications / letters
- Design class time table
- Design greeting / invitation cards
- Design certificates

3. Spread Sheet

- Create a marksheet
- Create a utility bill
- Monthly attendance record
- Create a Stock Control list for a grocery shop

4. Create a webpage / website involving

- Lists
- Images and backgrounds
- Hyperlinks
- Tables
- Frames