## Q3. Give detailed answers to the following questions.

i. What are computing devices? Explain early and modern computing devices.

ii. Explain different classifications of computers.

iii. What is software? Explain its two main types with examples.

iv. Explain different types of General Purpose Application Software.

v. Write short note on any five input devices.

vi. What is output? Briefly explain softcopy output devices.

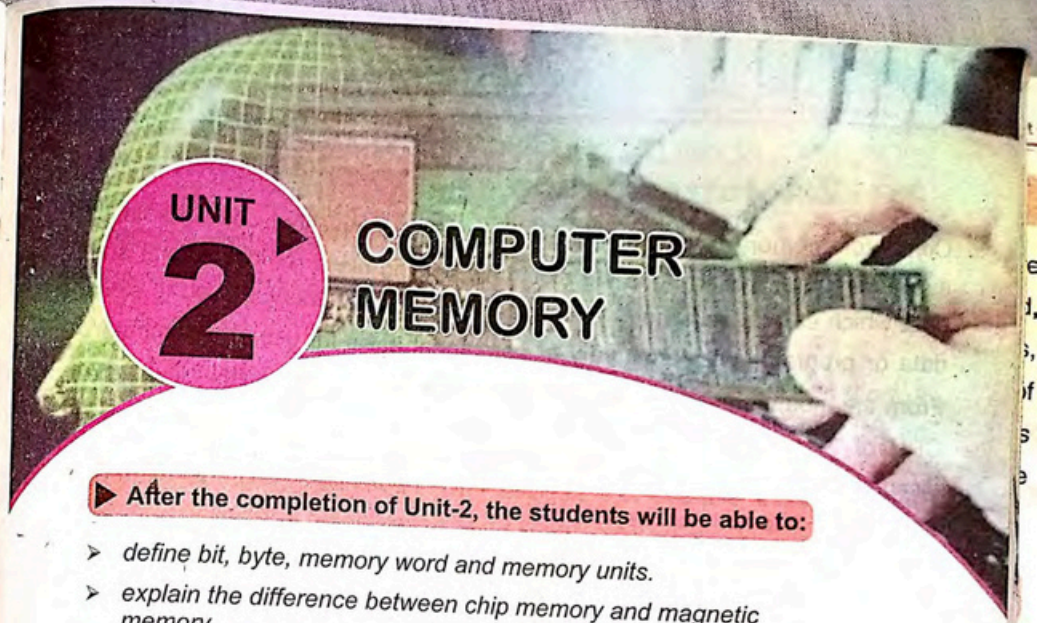
vii. What is the importance of magnetic cards/devices based systems? Explain different types of magnetic cards.

viii. What are impact and non-impact printers? Explain any two types of printers in each category.

ix. How a plotter is different from a printer? Explain different types of plotters.







# UNIT 2 COMPUTER MEMORY

**After the completion of Unit-2, the students will be able to:**

- *define bit, byte, memory word and memory units.*
- *explain the difference between chip memory and magnetic memory.*
- *differentiate between volatile and non-volatile memory.*
- *explain internal processor memory, ram and rom, and their types.*
- *explain secondary storage devices.*
- *explain the difference between sequential access and direct access.*
- *describe magnetic tapes, magnetic disks and optical disks (CD, DVD, Blue Ray).*
- *describe flash memory and memory cards with advantages and disadvantages.*

## 2.1 Introduction

Computer memory is one of the important and compulsory components of every computer system. It is the electronic holding place for instructions and data which can be accessed by computer. Computer memory is used to store data or programs on a temporary or permanent basis for use in a computer. From the moment user turn the computer on until the time it is shut down, the CPU of the computer is constantly using memory. Memory is sometimes distinguished from storage, or the physical medium that holds the much larger amounts of data for later use.

Computer memory is divided into two main types.

- Primary or Main or Internal Memory
- Secondary or Auxiliary or Backing Storage Memory.

Primary or Main memory holds instructions and data when a program is executed, while secondary memory (also called auxiliary memory) holds data and programs not currently in use and provides long-term storage.

### 2.1.1 Units of Memory

The following are basic memory measurement units.

a. Bit
b. Byte
c. Memory Word

#### a. Bit

A **bit** or **binary digit** is the basic unit of information in computing. A **bit** is the smallest amount of memory a computer can recognize. A bit can hold only one of two values, either '0' or '1'. It is also applied to a unit of computer memory corresponding to the ability to store the result of a choice between two alternatives. Computers represent information in binary code, written as






sequences of 0s and 1s. Each binary digit (or "bit") may be stored by any physical system that can be in either of two stable states, to represent 0 and 1. Such a system is called bi-stable. In computers many bits are combined together to hold more information. For example, eight bits make up a byte, which can hold up to 256 characters.

#### b. Byte

In most computer systems, a **byte** is a unit of data that is eight bits long. A byte is the unit most computers use to represent a character such as an alphabet, a number, or a special symbol. For example A, h, 6, 4, #, @, *, etc. Computer storage is measured in byte multiples. For example, a 500 Gigabyte (GB) hard drive holds 500 billion bytes of data.

#### Higher units of memory

The following are higher units of memory. These are the multiple of the unit byte for digital information storage.

**Kilobyte:** Kilo means one thousand (1000) but in digital computer as information is stored in binary digits (0, 1) and its units are power of 2 and the most nearest number near thousand is $2^{10} = 1024$. It is commonly abbreviated as KB (for Kilo Bytes).

**Megabyte:** Mega means one Million ($2^{20} = 1048576$). It is commonly abbreviated as MB. 1MB = 1024 KB

**Gigabyte:** The prefix Giga means $2^{30}$. The unit symbol for the Gigabyte is GB. 1GB = 1024 MB

**Terabyte:** The prefix Tera means $2^{40}$. The unit symbol for the Terabyte is TB. 1TB = 1024 GB

#### c. Memory Word

A **word** is a term for the natural unit of data used by a particular computer design. A word is simply a fixed sized group of bits that are handled together by the system. The number of bits in a word (the word size or word length) is

an important characteristic of computer architecture. Modern computers usually have a word size of 16, 32 or 64 bits. A computer that has a bigger word size can transfer more bits into the microprocessor at a time for processing and this improves the processing speed of the computer.

## 2.2 PRIMARY MEMORY

**Main memory** or Primary memory is the part of the computer that holds data and instructions for processing. Computer internal memory is used to store data that is used by the system at startup and to run various types of programs such as the operating system. Typically, internal memory is contained on small microchips that are either attached or connected to the computer's motherboard. Computer memory can range from a couple of megabytes to several gigabytes. Although it is closely associated with the CPU, in fact it is separate from it. When users load software from a storage medium, it is stored in the main memory first and then it is executed. CPU gets programs from the main memory for processing.

### 2.2.1 Chip memory and Magnetic memory

Computer memory, as for as its manufacturing is concerned, is divided into two types, i.e. Chip memory and Magnetic memory.

#### a. Chip memory

**Chip** or **microchip** is a small piece of semi-conducting material (usually silicon). A small circuit called IC (Integrated Circuit) is embedded in it. A typical chip contains millions of electronic components (transistors). It is extremely complex and small module used as computer memory or provides logic circuitry for microprocessors.

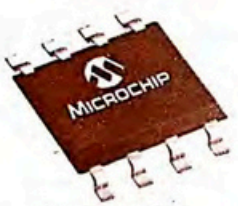


Figure 2.1 A Chip






A chip is manufactured from a silicon (or, in some special cases, a sapphire) wafer, which is first cut to size and then etched with circuits and electronic devices. It uses metal-oxide semiconductor technology. The current stage of microchip is known as Very Large-Scale Integration (VLSI).

Chip memories are very fast as compared to other memories as there are no mechanical moving parts in them but on the other hand chips rely on electric currents.

Examples of chip memory are main memory (RAM, ROM and Cache), Flash memory drives, memory cards and registers. Many special-purpose chips, known as application-specific integrated circuits, are also being made today for automobiles, home appliances, telephones, and other devices. Figure 2.1 shows a chip memory.

#### b. Magnetic memory

Magnetic core memory was the most widely used form of digital computer memory from its birth in the early 1950s until the era of Chip memory began in the early 1970s. Aside from being extremely reliable, magnetic core memory is an appealing technology because it is based on a very simple idea. A core is a ring of magnetic material, stores one bit by the direction of its magnetization. A magnetic core is a ring of ferrite material. It can be permanently magnetized either clockwise or anti-clockwise about its axis just as a vertical bar magnet can be magnetized. We can then turn a magnetic core into a bit of digital memory by letting these two magnetization states correspond to 0 and 1. It provides non-volatile storage. The core needs no continuous power to retain its data.

It is a system of storing information through the alignment of small grains in a magnetic material. Once the grains have been aligned by an external magnetic field, the information remains stored for long periods of time. This type of memory is used in the hard drives of computers as well as in magnetic tape.

Figure 2.2 shows how data is stored on the surface of magnetic storage medium.

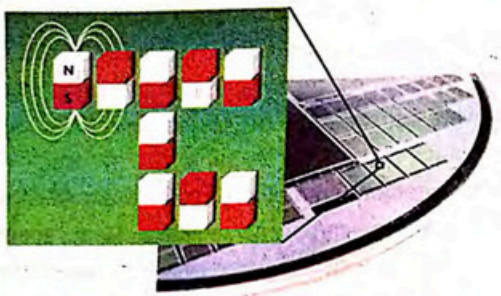



Figure 2.2 Magnetic memory storage mechanism

## 2.2.2 Volatile and Non-Volatile memory

Memory, on the basis of retention of data, can be divided into two types i.e. volatile and non-volatile memory.

### a. Volatile memory

**Volatile memory** is computer memory that requires power (electricity) to maintain the stored information. Volatile memory retains the information as long as power supply remains on, but when power supply goes off or interrupted, the stored data is lost. It is also known as temporary memory. Examples of such memory are RAM (Random access memory) and Registers.

### b. Non-Volatile memory

**Non-volatile memory** is a permanent memory that can retain the stored information even if power supply is off. Examples of non-volatile memory include ROM (Read-only memory), flash memory, magnetic storage devices (e.g. hard disks and magnetic tape), optical disks, and blue-ray disk. Non-volatile memory is typically used for secondary storage, or long-term storage for future use.






## 2.2.3 Fundamental types of Main Memory

Fundamentally Main or Primary memory is classified into three types.

a. Internal processor memory
b. RAM
c. ROM

### a. Internal processor memory

These are directly accessible to the CPU and are extremely fast. The following are the two main types of Internal processor memories.

i. Cache memory
ii. Registers

Cache lies in between the CPU and main memory while registers are associated with the arithmetic logic units.

#### i. Cache Memory

**Cache** (pronounced as cash) memory is extremely fast Static RAM (SRAM) that is built into a computer's central processing unit (CPU), or located next to it on a separate chip. The CPU uses cache memory to store instructions that are repeatedly required to run programs, improving overall system speed. This memory is mainly used to store some active portion of main memory (RAM). When any information is required by the processor, first it will look up in the cache memory, and if it is not available in the cache then it will fetch it from the RAM. Figure 2.3 shows cache memory interface in the computer. There are three levels of cache memory.

- L1 (Level 1) Cache
- L2 (Level 2) Cache
- L3 (Level 3) Cache

**cache**

evel 1 cache is built into the actual processor core. It is a piece of high speed emory, which operates at the same speed as the CPU. It is directly accessed y the computer's processor and holds data that the processor needs to xecute instructions. It is the fastest memory and closest to the CPU but very xpensive and small in size (typically 8, 16, 20, 32, 64 or 128 Kbytes).

**L2 cache**

Level 2 cache pulls information from the system's main memory (RAM), which is then accessed by the L1 cache. It is reasonably fast memory, bigger in size and less expensive than L1 cache. It is normally 64 KB to 16 MB. The purpose of the L2 cache is to constantly read in slightly larger quantities of data from RAM, so that these are available to the L1 cache.

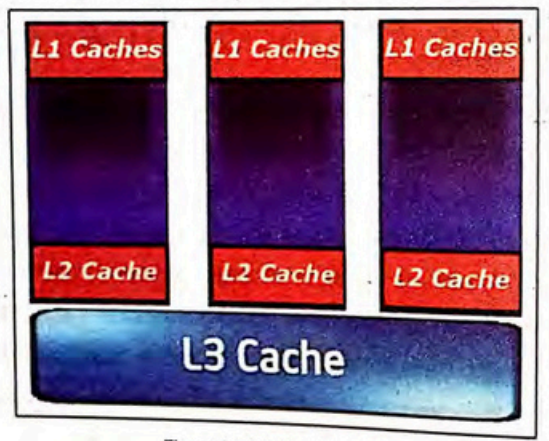



Figure 2.3 Cache memory interface

**L3 cache**

Level 3 cache is specialized memory that works hand-in-hand with L1 and L2 cache to improve computer performance. L3 cache is the biggest cache






memory that caters to the needs of the microprocessor by anticipating data requests so that processing instructions are provided without delay. L3 cache is faster than random access memory (RAM), and is designed to prevent bottlenecks in performance.

CPU first looks for the instructions in L1 cache, then it checks L2 and L3 cache respectively. L3 cache can be far larger than L1 and L2, and even though it is slower, it is still faster than RAM.

The architecture for multi-level cache continues to evolve. L1 and L2 caches are commonly incorporated into the CPU while L3 cache has typically been built into the motherboard.

Fetching instructions from cache is faster than calling upon system RAM and a good cache design greatly improves system performance.

### ii. Registers

Registers are small memory units. There are a large number of registers inside the processor. There function is to temporarily store binary information and pass it to the other parts of the processor or main memory during the execution of program instructions. Some commonly used registers inside the microprocessors are accumulator, instruction register, program counter and memory address registers. They store the operands and the result of an operation. The number of registers varies from processor to processor. The more is the number the faster is the instruction execution.

The main registers are:

- **Accumulator register (AC)**, stores the results of arithmetic and logical operations.
- **Status register (also called PSW, Processor Status Word)**, holds system status indicators (carry digits, overflow).
- **Instruction register (IR)**, contains the current instruction being processed.

- **Program counter (PC)**, contains the address of the next instruction to process.
- **Buffer register**, temporarily stores data from the memory.

## b. RAM (Random Access Memory)

Random Access Memory (RAM) is the common type of computer memory. It is the Read and Write (R/W) memory of a computer. The User can write information to it and read information from it. RAM is a volatile memory; it means information written to it can be accessed as long as power is on and when the power is off, it cannot be accessed. RAM holds data and processing instructions temporarily until the CPU needs them.

In RAM, transistors make up the individual storage cells which can each "remember" an amount of data. Physically, RAM consists of small electronic chips which are mounted in modules (small printed circuit boards). These modules are installed in the Computer's motherboard using sockets. Different types of RAM modules are shown in Figure 2.4.

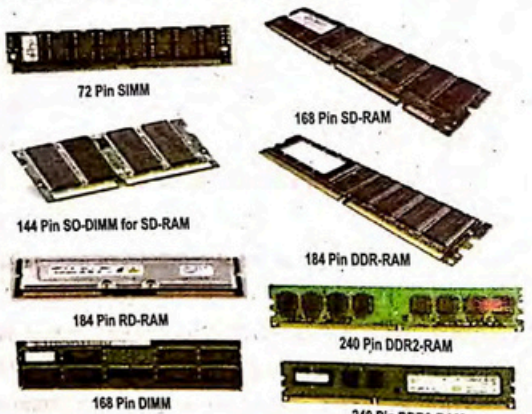



Figure 2.4 Different types of RAM Modules






## Types of RAM

There are two basic types of RAM.

i. Static RAM (SRAM)
ii. Dynamic RAM (DRAM)

### i. Static RAM (SRAM)

(SRAM) is a type of semiconductor memory where the word "Static" indicates that it does not need to be periodically refreshed to retain its data. SRAM is more expensive, but faster and significantly less power hungry than DRAM. Due to a more complex internal structure, SRAM is less dense than DRAM and is therefore not used for high-capacity, low-cost applications such as the main memory in personal computers. Static RAM is mainly used to make the CPU's cache.

### ii. Dynamic RAM

DRAM is a type of semiconductor memory where the word "Dynamic" indicates that it needs to be periodically refreshed to retain its data. It stores each bit of data in a separate capacitor within an integrated circuit. The capacitor can be either charged or discharged; these two states are taken to represent the two values of a bit, conventionally called 0 and 1. In personal computers DRAMs are used as internal memory because of their simple structure that allows high storage and low cost as compared to SRAM. There are two main types of DRAM.

- SDRAM
- DDR SDRAM

Figure 2.5 SDRAM

**SDRAM** stands for Synchronous Dynamic Random Access Memory. SDRAM is a high speed semiconductor memory. It is an improved form of the older DRAM (Dynamic Random Access Memory). SDRAM operates synchronously, which means that it operates in sync with the

ystem data bus. Therefore, it can operate at much greater speeds than non-synchronous RAM.

Figure 2.6 DDR3 SDRAM

**DDR SDRAM** (Double Data Rate SDRAM) is an improved SDRAM which allows a computer to transfer data at twice the speed. It has improved memory clock speed as compared to simple SDRAM. It reads or writes two consecutive words per clock cycle.

There are many types of DDR SDRAMs used for computers today, including **DDR1** RAM (Double Data Rate), **DDR2** RAM and **DDR3** RAM ranging in speed from 100 MHz to 2000 MHz. SDRAM comes in sizes of 512 MB to 4GB for use in today's computers. Figure 2.5 shows SDRAM.

DDR2 and DDR3 RAMs are used in today's computers. DDR2 reads or writes 4 words of data per clock cycle whereas DDR3 reads or writes 8 data words per clock cycle. Figure 2.6 shows DDR3 SDRAM.

### c. ROM (Read Only Memory)

ROM (Read only memory) is non volatile memory, i.e., the information stored in it, is not lost even if the power supply goes off. It is used for the permanent storage of information. It also possesses random access property. Information cannot be written into a ROM by the users/programmers. In other words the contents of ROMs are decided by the manufactures. Figure 2.7 shows different types of ROM chips.


Figure 2.7 Different types of ROM Chips






### Types of ROM

The ROM is classified into the following types.

i. Programmable Read Only Memory (PROM)
ii. Erasable Programmable Read Only Memory (EPROM)
iii. Electrically Erasable Programmable Read Only Memory EEPROM

#### i. PROM

It is a type of ROM which can be programmed once and then can never be changed. PROM is manufactured blank and then it is programmed just once by "blowing" its fuses. This process is irreversible. Once a bit position is blown, it can never be un-blown. The data is fed into it using a PROM programs.

#### ii. EPROM

EPROM is an erasable PROM. The stored data in EPROM can be erased by exposing it to Ultra Violet (UV) light for about 20 minutes. When it is exposed to UV light, the entire data is erased.

#### iii. EEPROM

EEPROM (Electrically Erasable PROM) is a chip that can be erased and reprogrammed on the board. It can be erased within a few milliseconds. There is a limit on the number of times the EEPROM can be reprogrammed, i.e.; usually around 10,000 times. Flash drive is a special type of EEPROM.

## 2.3 SECONDARY STORAGE

Secondary storage is used to hold data or information permanently. It is also called auxiliary storage, external storage or backing storage. It lies outside the CPU. The computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary storage. Secondary storage does not lose the data when the device is powered off and it is non-volatile. Some examples of secondary storage

devices are Hard Disk drive, CD, DVD, Blue Ray Disk, Flash memory and Memory cards.

## 2.3.1 Secondary Storage Devices

Secondary storage devices are used for storing the data permanently. These devices have the following characteristics.

- They are non-volatile as the data is not lost when power goes off.
- The capacity of these devices is very high. It goes to terabytes.
- They are cost effective as compared to the main memory.
- They are reusable as data can be erased and stored any time the user requires.
- Depending on their characteristics, these are sequential and random or direct access.

Various types of Secondary Storage Devices are Magnetic tapes, Magnetic disks, Optical disks, Flash memory and Memory cards.

## 2.3.2 Sequential Access and Direct Access Storage

Secondary storage can be divided into two main categories as for as its storing or accessing the data mechanism is concerned. These are Sequential Access and Direct or Random Access.

### a. Sequential Access Storage

Sequential access is a storage system where the data is stored and read in a fixed or linear order. This order is pre-determined and follows a logical progression. Some types of sequential access are unavoidable, such as when playing back a cassette. Common example of this type of device is an audio or video cassette.

The main advantage of sequential, as compared to random access memory, is that it is usually much cheaper to produce.






The main drawback of this type of memory is that it usually takes longer to physically access particular piece of data. This is because the computer either has to run through all the data in sequential order until it find the correct piece, like looking for information in a book with no index. Magnetic Tape is an example of sequential memory device.

### b. Direct Access Storage

Direct access, also called Random access is a storage system where the data is stored and read directly from storage devices. In this system all data items are addressed independently. In direct access storage devices, such as a magnetic disk, bits of data are stored at precise locations, enabling the computer to retrieve information directly without having to scan a series of records. Magnetic disks, Compact disks and all latest memory devices have direct storage access mechanism. Direct access is efficient as compared to sequential access. The only drawback is that these devices are costly as compared to sequential access devices.

## 2.3.3 Types of Secondary Storage Devices

Secondary storage devices are classified into the following types.

a. Magnetic Tapes
b. Magnetic Disks
c. Optical Disks
d. Chip Memory

### a. Magnetic Tapes

**Magnetic tape** has been used for **data storage** for over 50 years. Magnetic Tape is a sequential access storage device used for data collection, backup and archiving. It consists of a thin tape with a coating of a fine magnetic material, used for recording analog or digital data. A device that stores computer data on magnetic tape is a tape drive. Magnetic Tapes generally

transfer data a bit slower than hard drives; however magnetic tapes are cheaper and are more durable. These devices are usually used for taking backup of data. The major drawback of tape is its sequential format. Locating a specific record requires reading every record before it or searching for markers that identify predefined partitions. Also updating requires copying files from the original tape to a blank tape and adding the new data in between while copying. Tapes are used for storing large amount of data. Modern tapes can store data up to 5 Terabytes. It is used with minicomputers and mainframes for backups and archives.

Figure 2.8 Magnetic Tape with cartridge

## b. Magnetic Disks

The most common type of secondary storage devices are **magnetic disks**. These are made of either flexible plastic material (Old Floppy disks) or rigid metal (Hard Disks). Magnetic disks are coated with a magnetic substance. Each surface of the disk is subdivided into concentric rings called **tracks**. Disks with bigger capacity have more tracks. In larger computers, one stores the same amount of data in each track and keeps several disks mounted on a shaft on top of each other as a **disk pack**. At least one read-write head is assigned for each surface. The read-write heads are mounted on a device






called the **access mechanism**, which positions them on the cylinder in which the appropriate data item is to be located. Some common types of magnetic disks are Floppy disks, Zip disks and Hard disks.

### i. Floppy disks and Zip disks

**Floppy disks** are old type of magnetic storages. These disks were very popular during the 1980 and early 1990s as portable storage device. Floppy disks are flexible plastic disks coated with magnetic material on both sides. They are packed inside a plastic jacket for protection. Digital information is stored in floppy disks in the form of small magnetized spots. Floppy disks are inserted in floppy disk drive for reading and writing information. Due to their limited storage size these have been obsolete now days. Maximum storage capacity of a floppy disk was 1.44 MB. Floppy disks in different sizes are shown in Figure 2.9.

Figure 2.9 (a) Floppy Disks


Figure 2.9 (b) Zip disk

**Zip disks** are also old type of removable storage devices. A zip disk is somewhat like floppy disk, only the size and capacity of disks are different. A zip disk can hold around 100 MB to 250 MB of data. Zip and Floppy disks are almost obsolete now a days because other storage media like Flash memory and CDs are becoming more popular due to their large storage capacity and low cost.

### ii. Hard disks

A **hard disk drive** (HDD) is a non-volatile, random access storage device for digital data. It contains rotating platters on a motor-driven spindle within a protective enclosure. Data is magnetically read from and written to the platter by read/write heads that float on a film of air above the platters. Hard disk drives have been the dominant devices for secondary storage of data in general purpose computers since the early 1960s. They have maintained this position because advances in their real recording density have kept pace with the requirements for secondary storage. Today's HDDs operate on high-speed serial interfaces; i.e. Serial ATA (SATA) or serial attached SCSI (SAS).

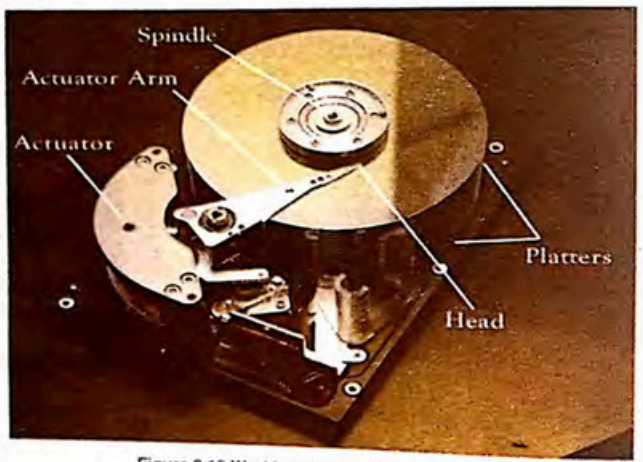



Figure 2.10 Working of Hard disk drive (HDD)

A typical HDD design consists of a spindle that holds flat circular disks, also called platters, which hold the recorded data. The platters in HDDs are spun at speeds varying from 4,200 rpm to 15,000 rpm for high performance servers. Today, most HDDs operate at a speed of 7,200 rpm.






Information is written to and read from a platter as it rotates. The read-and-write head is used to detect and modify the magnetization of the material immediately under it. An actuator arm (or access arm) moves the heads on an arc across the platters as they spin, allowing each head to access almost the entire surface of the platter as it spins. A typical HDD has two electric motors; a disk motor that spins the disks and an actuator (motor) that positions the read/write head assembly across the spinning disks.

The surface of the disk is divided into tracks and sectors before writing data, as shown in Figure 2.11.

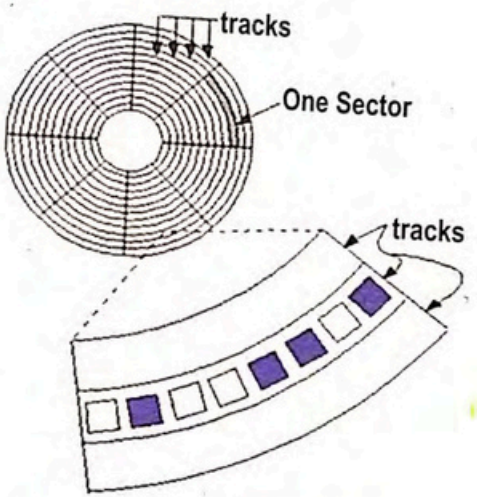



Figure 2.11 Tracks and Sectors in Hard disk

**Tracks** are concentric circles (circles within circles). The data bits are recorded as tiny magnetic spots on the tracks.

**Sectors** are the further divisions of tracks, which hold a block of data that is read or written at one time. Modern disks have more sectors in the outer tracks

than the inner ones because the outer radius of the platter is greater than the inner radius.

## c. Optical disk

It is a flat, usually circular disk which encodes binary data in the form of pits (binary value of 0 or off, due to lack of reflection when read) and lands (binary value of 1 or on, due to a reflection when read) on a special material (often aluminum) on one of its flat surfaces. The encoding pattern follows a continuous, spiral path covering the entire disc surface and extending from the innermost track to the outermost track. The data is stored on the disc with a laser or stamping machine, and can be accessed when the data path is illuminated with a laser diode in an optical disc drive which spins the disc at speeds of about 200 rpm up to 4000 rpm or more depending on the drive type, disc format, and the distance of the read head from the center of the disc (inner tracks are read at a faster disc speed). The one side of an optical disc usually has a printed label, generally made of paper but sometimes printed or stamped onto the disc itself. The other side of the disc contains the actual data and is typically coated with a transparent material, usually lacquer. Unlike the 3½-inch floppy disk, most optical discs do not have an integrated protective casing and are therefore susceptible to data transfer problems due to scratches, fingerprints, and other environmental problems. Optical discs are usually between 7.6 and 30 cm (3 to 12 in) in diameter, with 12 cm (4.75 in) being the most common size. A typical disc is about 1.2 mm (0.05 in) thick, while the track pitch (distance from the center of one track to the center of the next) is typically 1.6 micro meters (µm)

The following are different types of optical disks.

i. CD (Compact Disk)
ii. DVD (Digital Versatile Disk)
iii. Blue Ray Disk (BD)






### i. CD (Compact Disk)

A compact disk (CD) is a plastic-fabricated, circular medium for recording, storing, and playing back audio, video, and computer data. Compact disk is an optical disk designed to support one of three recording types: read-only (e.g. CD-ROM), recordable (write-once, e.g. CD-R), and re-recordable (re-writable, e.g. CD-RW). Write-once optical disks commonly have an organic dye recording layer. Rewritable disks typically contain an alloy recording layer. CDs are used for storing music, video, data and programs. A CD can hold about 700 megabyte of data.

A CD drive/player is used for reading/recording the data on the CD as shown in Figure 2.12. The job of CD player is to focus the laser on the track of bumps (also called pits). The laser beam passes through the layer, reflects off the layer and hits the censor that detects changes in light. The bump (pits) scatters the light and the land reflects it into the censor. The change in reflection is transmitted as 0s and 1s into the memory of the computer.

Figure 2.12 CD and CD drive

### ii. DVD (Digital Versatile Disk)

DVD is an optical disk technology with a 4 to 16 gigabyte storage for video, audio, or other information. DVDs can be single- or double-sided, and can have two layers on each side. DVD is very similar to CD but has larger data storage capacity. Its data storage capacity is about ten times more than a CD. It has replaced the video tapes that were used in the past for storing movies. A DVD writer or player is used to read the data stored on a DVD. DVD players are compatible with CD which means they can play CDs also. DVDs have the same diameter and thickness as CDs and are made of the same material and manufacturing methods. Data is also stored just like a CD on a spiral track in the form of lands and bumps. Like CDs, DVDs are available as DVD-R and DVD-RW.

DVDs are easy to carry and can store more data in less space compared to CDs. Disadvantage is that DVDs require special drives to read/write data. DVD does not provide enough data storage compared to other latest storage devices used today.


Figure 2.13 DVDs

### iii. Blu-Ray Disk (BD)

Blu-ray is an optical disk format designed to store large amount of data. Blu-ray is the successor to DVD. Blu-ray disk drive uses blue laser to read from and write to the disk rather than the red laser of DVD players. Its main






advantage over CD and DVD is that it has storage capacity of 50 GB to 100 GB. It is also faster than CDs and DVDs. The bumps (pits) on the surface of blu-ray that represent digital information are much smaller and very densely packed. This increases the storage capacity of blu-ray. Blu-ray disks are better storage devices for storing movies because they require a lot more storage. Another advantage of blu-ray disk is their durability. They have a special coating that helps to prevent scratches and marks that degrade performance. A blu-ray disk is shown in Figure 2.14.

Blu-ray disks cannot be used on the current CD and DVD players, because those players lack the blue-violet laser required to read the disks. However, Blu-ray players can run CDs and DVDs. Nowadays. most of the motion pictures industry is supporting blu-ray disk. It requires a special blue-ray drive for reading and writing.


Figure 2.14 Blue Ray disk

## 2.3.4 Chip Memory as Secondary storage

Chip or microchip is a small piece of semi-conducting material (usually silicon). A small circuit called IC (Integrated Circuit) is embedded on it. A typical chip contains millions of electronic components (transistors). Flash memory and memory cards are the two common types of chip memories which are used as portable secondary storage in computers.

## a. Flash Memory

It is a non-volatile computer storage chip that can be electrically erased and reprogrammed. It is primarily used in memory cards, USB flash drives, MP3 players and solid-state drives for general storage and transfer of data between computers and other digital products. It is a specific type of EEPROM (electrically erasable programmable read-only memory) that is erased and programmed in large blocks. In early flash the entire chip had to be erased at once. Flash memory has become the dominant technology wherever a significant amount of non-volatile, solid state storage is needed. Example applications include PDAs (personal digital assistants), laptop computers, digital audio players, digital cameras and mobile phones.

**Flash Memory Drive** (also known as USB flash drive) is a data storage device that includes flash memory with an integrated Universal Serial Bus (USB) interface. USB flash drives are typically removable and re-writable, and physically much smaller than other storage media. Documents, presentations and any other form of data can be stored on a Flash Drive, and has proved a far more effective way of transferring data than burning CD's, and even DVDs. Flash Drives are also known as USB Memory Pens, USB Pen Drives, and USB Memory Sticks.


Figure 2.15 Flash Memory drives

### Advantages of Flash Memory

- The obvious initial appeal and great advantage of Flash Memory is its portability. Users can place a number of files and applications in Flash memory.







- It is faster in read and write compared to traditional hard disk drives.
- Its physical size is smaller as compared to other portable devices.
- It is less prone to damage.
- It is cheaper than traditional drives in small storage capacities.
- It uses less power than traditional hard disk drives.
- Flash Memory is much more durable than other forms of computer memory.
- Extremes in pressure or temperature change would not normally affect Flash Memory.
- Adding or deleting files in Flash Memory is quick and tidy.

### Disadvantages of Flash Memory

- Flash Memory has a limited number of write and erase cycles.
- Most flash drives do not have a write-protection mechanism.
- Due to small in size, these devices can easily be lost.
- Currently costs a lot more per gigabyte as compared to traditional hard drives for large storage capacities.

## b. Flash Memory Cards

A Flash Memory Card is an electronic flash memory data storage device used for storing data such as text, pictures, audio, and video. They are commonly used in many electronic devices, including digital cameras, mobile phones, laptops, MP3 players and video game consoles. They are small, re-recordable, and able to retain data without power. They come in various sizes and with


Figure 2.16 Flash Memory Cards

different storage capacity.

### Advantages of Memory Cards

- Memory cards have non-volatile memory, which keeps data stable on the card. Data on them are not threatened by loss of power, and need not be periodically refreshed.
- They are solid state media hence free from mechanical difficulties or damages.
- The new generation memory cards are smaller, lighter and compact with higher storage capacity.
- They require less amount of power.
- They are highly portable. They can be easily used in number of small, lightweight and low-power devices.
- They do not produce any noise while reading/writing.
- They have relatively large storage space compared to old backup devices.
- They can easily fit in memory card slot in different devices and are easily removable.
- They can be used in different devices such as cameras, computers or mobile phones.

### Disadvantages of Memory Cards

- They can break easily.
- They can be lost, misplaced or smashed.
- Memory cards may be affected by electronic corruption and make entire card unreadable.
- Sometimes work slow.
- Cannot be attached or read by the computer /devices without proper hardware.
- Can get corrupted if not handled carefully.






# SUMMARY

- Computer memory is one of the important and compulsory components of every computer system.
- Secondary memory (also called auxiliary memory) holds data and programs not currently in use and provides long-term storage.
- Primary or Main memory holds instructions and data when a program is being executed.
- Bit or binary digit is the basic unit of information in computing. A bit is the smallest amount of memory a computer can recognize. A bit can hold only one of two values, either '0' or '1'.
- Byte is a unit of data that is eight bits long. A byte is the unit most computers use to represent a character such as an alphabet, a number, or a special symbol.
- Main memory or Primary memory is the part of the computer that holds data and instructions for processing.
- Magnetic core memory was the most widely used form of digital computer memory based on a very simple idea. A core, a ring of magnetic material, stores one bit by the direction of its magnetization. A magnetic core is a ring of ferrite material.
- Volatile memory is computer memory that requires power (electricity) to maintain the stored information.
- Non-volatile memory is a permanent memory that can retain the stored information even if the power supply in off.
- Cache (pronounced as cash) memory is extremely fast Static RAM (SRAM) that is built into a computer's central processing unit (CPU), or located next to it on a separate chip.
- Registers are small memory units. There are a number of registers inside the processor.

Random Access Memory (RAM) is the common type of computer memory. It is the Read and Write (R/W) memory of a computer.

ROM (Read only memory) is non volatile memory, i.e., the information stored in it, is not lost even if the power supply goes off.

- Secondary storage is used to hold data/information, to be transferred for use during processing as and when required, and for storing data/programs permanently for future use.
- Sequential access is a storage system where the data is stored and read in a fixed or linear order.
- Direct access, also called Random access is a storage system where the data is stored and read directly from storage devices.
- Magnetic Tape is a sequential access storage device used for data collection, backup and archiving.
- Magnetic storage refers to the storage of data on a magnetized medium.
- A hard disk drive (HDD) is a non-volatile, random access storage device for digital data. It contains rotating platters on a motor-driven spindle within a protective enclosure.
- Optical disk is a flat, usually circular disc which encodes binary data in the form of and lands on a special material on one of its flat surfaces.
- A compact disk (CD) is a plastic-fabricated, circular medium for recording, storing, and playing back audio, video, and computer data.
- Blu-ray is an optical disk format designed to store large amount of data.
- Flash Memory is a non-volatile computer storage chip that can be electrically erased and reprogrammed. It is primarily used in memory cards and USB flash drives.






# EXERCISE

## Q1. Select the best choice for the following MCQs.

i. _____ memory holds data and programs not currently in use and provides long-term storage.
A. Primary B. Secondary
C. Main C. Internal

ii. _____ is the smallest amount of memory a computer can hold?
A. Byte B. KB
C. Bit C. MB

iii. Which of the following is the fastest memory?
A. RAM B.ROM
C. Cache memory D. PROM

iv. How much is 1 Mega Byte memory equal to?
A. 1024 K Bytes B. 1000 K Bytes
C. 1024 K Bits D.1024 G Bytes

v. Which material is used to make memory chips?
A. Iron B. Gold
C. Silver D. Silicon

vi. Which of the following is volatile memory?
A. RAM B. ROM
C. PROM D. EEPROM

vii. Which of the following is called internal processor memory?
A. RAM B. ROM
C. Cache D. DRAM

viii. _____ has the highest storage capacity.

A. DVD B. Blu-ray Disk

C. CD D. Zip disk

ix. _____ is a type of optical storage?

A. Hard disk B. Blu-ray Disk

C. Floppy disk D. Zip disk

x. Which of the following is a sequential access storage device?

A. Magnetic disk B. Blu-Ray disk

C. Magnetic tape D. Zip disk

## Q2. Give short answers to the following questions.

i. What is computer memory?

ii. Define bit, byte and memory word.

iii. What is the importance of cache memory in a computer?

iv. Give some uses of secondary memory.

v. What is the role of registers in computer?

vi. Differentiate between DRAM and SRAM.

vii. Give few characteristics of secondary storage devices.

viii. Differentiate between the following.

a) Chip memory and Magnetic memory

b) Cache and Register

c) Volatile and non-volatile memory

d) Magnetic tapes and Magnetic disks

e) EPROM and EEPROM







## Q3. Give detailed answers to the following questions.

i. Briefly explain the processor internal memory and its types.

ii. Explain RAM and ROM along with their types in detail.

iii. What is meant by secondary storage devices also explain the difference between Sequential access and Random access.

iv. Describe the following along with their advantages and disadvantages:

a) Magnetic tapes

b) Magnetic disks

c) Optical disks( CD, DVD, Blue Ray)

v. Describe the following chip Memories with their advantages and disadvantages.

a) Flash Memory

b) Memory Cards