

output devices which are used to produce output on physical media such as paper. Plotters have drawing pins to generate the print while the printers don't have any such drawing pins. Plotters are more expensive than printers.

i. Drum Plotter

In the drum plotter the paper, on which the design has to be made is placed over the drum, which can rotate in both clockwise and anti-clockwise direction. The drawing pens are mounted on the drum. During rotation of the drum the pens move left and right and create the desired image on the paper. The advantage of drum plotter is that the length of the plot is almost unlimited and the width of the image depends on the width of the drum.

ii. Flatbed Plotter

A flatbed plotter plots a design on a sheet in such a way that the sheet is spread and fixed over a rectangular flatbed table. In such plotters the pen holding mechanism is designed to provide all types of motions under the computer control, necessary to draw a design or graph. Most flatbed plotters have one or more pens of different colors and width.

Unit # 2

Computer Memory 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
- D. Internal

ii. _____ is the smallest amount of memory a computer can hold?

- A. Byte
- B. KB
- C. Bit
- D. 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. _____ has the highest storage capacity.
A. DVD
B. Blu-ray Disk
C. CD
D. Zip disk
- viii. _____ is a type of optical storage?
A. Hard disk
B. Blu-ray Disk

- C. Floppy disk
D. Zip disk
- ix. Which of the following is a sequential access storage device?
A. Magnetic disk
B. Blu-Ray disk
C. Magnetic tape
D. Zip disk
- x. What does SIMM stand for?
A. System in-line memory module
B. Synchronous in-line memory module
C. Single In-Line Memory Module
D. Serial in-line memory module

Q2. Give short answers to the following questions.

i. What is computer memory?

Ans. Computer memory:

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 temporary or permanent basis for use in a computer. 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.

ii. **Define bit, byte and memory word.**

Ans. 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'.

Byte:

Byte is a unit of data that is eight bits long. Byte is a unit that most computers use to represent a character such as an alphabet, a digit or a special symbol. For example A, h, 6, 4, #, @, *, etc.

Memory Word:

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.

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

Ans. Importance of cache memory:

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.

iv. **Give some uses of secondary memory.**

Ans. Uses of secondary memory:

Secondary memory is used to hold data or information permanently. 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.

v. **What is the role of registers in computer?**

Ans. Role of registers:

Registers are small tinny but fastest memory locations insided the CPU. Register is used to temporarily store small binary information and pass it to the other parts of the processor or main memory during the execution of program instructions. They store the operands and the result of an operation.

vi. **Differentiate between DRAM and SRAM.**

Ans. Static RAM (SRAM):

It is a type of semiconductor memory. 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.

Dynamic RAM (DRAM):

It is a type of semiconductor memory. It stores each bit of data in a separate capacitor within an integrated circuit. It requires continuous refreshing of capacitors to retain data that's why it is named as "Dynamic" RAM. The capacitor has two states 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.

vii. Give few characteristics of secondary storage devices.

Ans. Some characteristics of secondary storage devices are following.

- They are non-volatile as the data is not lost when power goes off.
- The capacity of these devices is very high. It goes up 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.

viii. Differentiate between the following.

1. Chip memory and Magnetic memory
2. Volatile and Non-Volatile memory
3. Differentiate between SIMM and DIMM.

Ans. 1. Differentiate between Chip memory and Magnetic memory

Chip Memory	Magnetic Memory
It is made of silicon a semi-conducting material.	It is composed of circular metallic plates.
Integrated Circuits (ICs) are embedded in it.	Ferric Oxide is coated on metallic plates to store the data in magnetic form.
There are millions of transistors on this chip.	Ferric oxide is magnetized to store the data in the forms of bits.
It is of very small size.	It is of a larger size as compared to a chip.

2. Volatile and Non-Volatile memory

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.

Non-volatile memory:

Non-volatile memory is a permanent memory that can retain the stored information even if power is off.

Non-volatile memory is typically used for secondary storage or long-term storage.

3. Differentiate between SIMM and DIMM.

SIMM	DIMM
SIMM stands for Single In-line Memory Module	DIMM stands for Dual In-line Memory Module.
SIMM can have 30 pin or 72 pins.	DIMM have 168 pin connector.
30 pins transfers 9 bits of data and 72 pins transfers 32 bits of data.	It can transfer data at a rate of 64 bits.
Its storage capacity ranges from 56KB to 32MB.	Its storage capacity ranges from 64MB to 512MB.

Q3. Give detailed answers to the following questions.

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

Ans. 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.

- Cache memory
- Registers

Cache lies in between the CPU and Main Memory while registers are associated with the ALU.

• Cache Memory

Cache memory is extremely fast Static RAM (SRAM) that is built into the 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, hence 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 CPU will fetch it from the RAM. There are three levels of cache memory.

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

L1 cache

Level 1 cache is built into the actual processor core. It is a piece of high speed memory, which operates at the same speed as the CPU. It is the fastest memory and closest to the CPU but very expensive and small in size.

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.

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 RAM.

- **Registers**

Registers are small memory units. There are a large number of registers inside the processor. Their 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. The number of registers varies from processor to processor. The more is the number, the faster is the instruction execution. 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 main registers are:

- **Accumulator register (AC)**, stores the results of arithmetic and logical operations.
- **Status Register**, 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.

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

Ans. 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 if the power goes off, information will be lost. RAM holds data and processing instructions temporarily until the CPU needs them. That's why it is also named as temporary memory.

Types of RAM

There are two basic types of RAM.

- i. Static RAM (SRAM)
 - ii. Dynamic RAM (DRAM)
- i. **Static RAM (SRAM):**

It is a type of semiconductor memory. 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):**

It is a type of semiconductor memory. It stores each bit of data in a separate capacitor within an integrated circuit. It requires continuous refreshing of capacitors to retain data that's why it is named as "Dynamic" RAM. The capacitors have two states charged or discharged. These two states are used 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 types of DRAM.

- SDRAM
- DDR 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. SDRAM operates synchronously, which means that it operates in sync with the system data bus. Therefore, it can operate at much greater speeds than non-synchronous RAM.

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.

b) **ROM (Read Only Memory)**

ROM is non volatile memory, i.e., the information stored in it, is not lost even if the power goes off. It is

used for the permanent storage of information. It also possesses random access property. Information in the ROMs are written by the manufacturers and programmers cannot change it.

Types of ROM

The ROM is classified into the following types.

- Programmable Read Only Memory (PROM)
- Erasable Programmable Read Only Memory (EPROM)
- Electrically Erasable Programmable Read Only Memory EEPROM
- **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 program.

- **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.

- **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.

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

Ans. Secondary Storage Device

Secondary storage devices are used for storing the data permanently. It lies outside the CPU. It is non-volatile memory that doesn't require power to retain its data. The computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary storage. Some examples of secondary storage devices are Hard Disk drive, CD, DVD, Blue Ray Disk, Flash memory and Memory cards.

Sequential Access and Random Access Storage

On the basis of storage or accessing mechanism of data secondary storage can be divided into two main categories. 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 linear sequential order. We have to traverse all the intermediate records to reach the desired record. For example, if we want to access the record no 7 and we are currently at the record no 2 then we have to traverse all the intermediate records for reaching the record no 7. The best example of sequential storage is audio 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 data transfer rate is very low in sequential access device. Also searching of a record will take too much time because of traversing of intermediate records.

b. Random Access Storage

Direct access, also called Random access is a storage system where the data is stored and read randomly and directly from storage devices. In this system all data items are addressed independently. The computer can retrieve information by using the address of data, without having to scan a series of record. 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.

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

- (a) Magnetic tapes
- (b) Magnetic Disks
- (c) Optical disk (CD, DVD, Blu-ray)

Ans. (a) Magnetic Tapes

Magnetic tape is the first and the oldest secondary storage device. Magnetic Tape is a sequential access storage device. 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. Updating requires copying files from the original tape to a blank tape and adding the new data in between while copying.

a. Advantages

- Magnetic tapes are cheaper and are more durable.
- Tapes are used for storing large amount of data. Modern tapes can store data up to 5 Terabytes.
- Magnetic tape can be recorded over and reused repeatedly.
- Large amount of information is stored.

b. Disadvantages

- Magnetic Tapes generally transfer data a bit slower than hard drives.
- The major drawback of tape is its sequential format.
- Magnetic tape has a lifespan of 15 years. Data quality gradually erodes over time.

(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 disk 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.

a. Advantages

- Provides very fast access to data.
- Data can be read directly from any part of the hard disk.
- Some of the magnetic storage devices are very cheap for example floppy disks.
- Most of the magnetic storage devices store very large amount of data.

b. Disadvantages

- Gradually lose their charge over time - data lost.
- Regular crashes can damage the surface of the disk, leading to loss of data in that sector.

(c) Optical disk (CD, DVD, Blu-ray)

It is a flat circular disk which encodes binary data in the form of pits and lands. Pit represents 0 or off and lands represents 1 or on. Laser light is used to read or write the data. Aluminium foil is pressed in between two transparent plastic plates to store the data. While reading data if the laser light is reflected from the surface then it means there is land or 1 and if the light does not reflect from the surface then it means there is Pit or 0.

The encoding pattern follows a continuous, spiral path covering the entire disk surface and extending from the innermost track to the outermost track. An optical disk drive, containing the laser beam mechanism, is used

to read the disk. The one side of an optical disk usually has a printed label. The other side of the disk contains the actual data and is typically coated with a transparent material. The scratches, fingerprints and other environmental problems can cause problems in data reading. Commonly used Optical disks have a diameter of 4.75 inches and a thickness of 0.05 inches. The distance between track is 1.6 micro meters (μm).

The following are different types of optical disks.

a) CD (Compact Disk)

A compact disk (CD) is a plastic-fabricated, circular medium for recording, storing and playing back audio, video and computer data. CD 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). A CD can hold about 700 megabyte of data.

b) DVD (Digital Versatile Disk)

Just like CD, DVD is also an optical disk technology. It can store 4 to 16 gigabyte of video, audio or other information. DVDs can be single- or double-sided and can have two layers on each side. Its data storage capacity is about ten times more than a CD. Video tapes have been replaced by DVDs. A DVD writer or player is used to read the data from a DVD. DVD players can read CD but a CD player cannot read DVD.

c) Blu-Ray Disk (BD)

Blu-ray is an optical disk format designed to store very 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. DVD can store 50 GB to 100 GB of data. It is also faster than CDs and DVDs.

Advantages

- The cost-per-bit of storage for optical disks is very low, because of their low cost and enormous storage density.
- Since data once stored on an optical disk becomes permanent, there is no danger for the loss of data.
- Due to their compact size and lightweight, optical disks are easy to handle, store and easily portable.

Disadvantages

- It is a read-only (permanent) storage medium. Data once recorded, cannot be erased and hence, the optical disks cannot be reused.
- The data access speed for optical disks is slower than magnetic disks.
- Optical disks require a more complicated drive mechanism than magnetic disks.

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

(a) Flash Memory

(b) Memory Cards

Ans. (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.

Advantages

- It is faster in read and write as 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

- 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 or stolen.

(b) 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 come in various sizes and with different storage capacity.

Advantages

- Data on these cards are not threatened by loss of power and need not be periodically refreshed.
- They involve no mechanical difficulties or damages.
- They require less amount of power.
- 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

- 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 works slow.
- Cannot be attached or read by the computer /devices without proper hardware.
- Can get corrupted if not handled carefully.

vi. Write note on SDRAM and DDR SDRAM.

Ans. 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 system's data bus. Therefore, it can operate at much greater speed than non-synchronous RAM.

DDR 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.

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.

Unit # 3

Central Processing Unit EXERCISE

Q1. Select the best choice for the following MCQs.

i. Which of the following performs the arithmetic and logic operations on data?

A. ALU

B. Control unit

C. Bus

D. Memory unit

ii. _____ coordinates and controls the computer system, just like the brain controls the human body.

A. Bus

B. Control Unit

C. Output Unit

D. Register

iii. Where are the logical operations performed in the CPU?

A. CU

B. Register

C. ALU

D. Memory