Module 1: Understanding of Hardware and its Components

Section 1: Multiple Choice Question

1. Which of the following is NOT a component of the CPU?
    1. ALU
    2. RAM
    3. CU
    4. 1 and 3 both
Ans: 2.RAM

2. What is the function of RAM in a computer?
Ans: RAM is a temporary, volatile storage area that holds data and instructions that the computer is actively using, allowing for quick access by the processor.

3. Which of the following is a primary storage device?
    1. HDD
    2. SSD
    3. SD card
    4. 1 and 2 both
Ans: HDD and SD card

4. What is the purpose of a GPU?
Ans: A Graphics Processing Unit (GPU) is an advanced and specialized processor which makes computing possibilities for machine learning, deep learning, gaming, content creation, and many more related technologies.
    A GPU accelerates computer graphics and image processing. It is also useful for non-graphic computations such as neural networks and cryptocurrency.

Section 2: True or false

5. True or False: The motherboard is the main circuit board of a computer where other components are attached.
Ans: True

6. True or False: A UPS (Uninterruptible Power Supply) is a hardware device that provides emergency power to a load when the input power source fails.
Ans: True

7. True or False: An expansion card is a circuit board that enhances the functionality of a component.
Ans: True

## 8. Explain the difference between HDD and SSD.

	HDD	SSD
1.	Use spinning disks to store data.	Use flash memory with no moving parts.
2.	Slower data access and boot time	Very fast data access and quick boot time.
3.	Can break if dropped	More durable and shock-resistant
4.	Consumes more power	Use less power, more efficient
5.	It has mechanical/moving parts	It has no mechanical/moving parts.
6.	Random access time 5 - 10ms	Random access time 0.1ms
7.	Good for bulk storage and backups.	Best for Speed and high-performance tasks.
8.	Con break if dropped	More durable and shock-resistant
9.	Makes noise while spinning	Completely silent in operation

9. Describe the function of BIOS in a computer system.

Ans: BIOS, which stands for Basic Output System, is a small memory chip on the motherboard. BIOS is a set of computer instructions in firmware which control input and output operation. It provides the initial instructions your computer needs to start up, perform hardware checks, and eventually load the OS.

Key Functions of BIOS
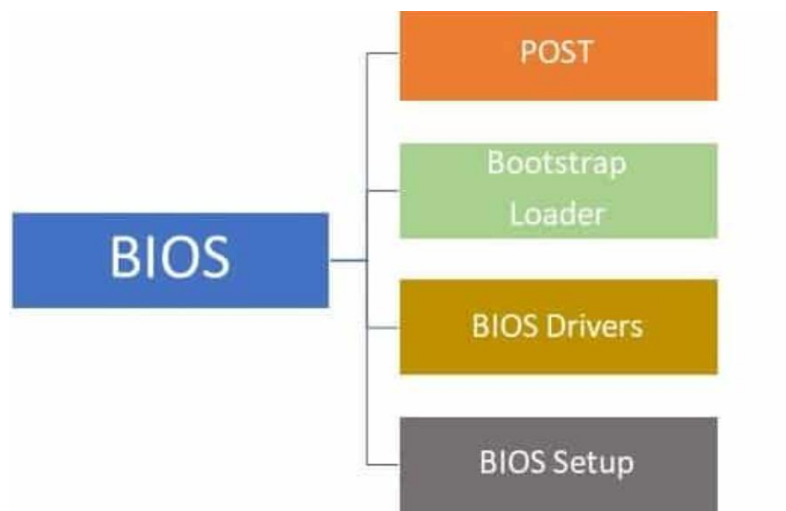
The BIOS's primary function is to handle the system setup process including driver loading and operating system booting.

1.POST (Power-On-Self-Test) : The BIOS performs a Power-On Self-Test (POST) during startup to check key hardware like the CPU, RAM, hard drives, and graphics card. If issues are found, it either shows an error message or uses beep codes to signal the problem.

2. Bootstrap Loader: Once POST is successful, the BIOS uses the bootstrap loader to locate the operating system. It identifies the boot device (usually a hard drive or SSD) and launches the OS bootloader to begin system startup.

3. BIOS Setup Utility: Users can access this utility during boot (typically by pressing F2, Delete, or Esc) to configure hardware settings such as:

- Boot device priority
- CPU and memory clock speeds
- Voltage settings
- Enabling/disabling peripherals

4. CMOS Settings: BIOS settings are stored in CMOS memory, which is powered by a small battery. If the battery fails, settings like date/time and boot order may reset to defaults.

5. Hardware and Driver Management: The BIOS provides basic drivers and enables low-level communication between the CPU and devices like the keyboard, mouse, and storage drives—ensuring they function before the operating system loads.

10. List and briefly explain three input devices commonly used with computers.
Ans:

Input Devices:
1. Keyboard
2. Mouse
3. Touchscreen
4. JoyStick
5. Light pen
6. Trackball
7. Microphone
8. Digital Camera

1. Keyboard: A keyboard is a common input device. It has keys for letters, numbers, and special functions. When a user presses a key, the keyboard sends a signal to the computer. The computer then processes this input and displays the correct character or performs the assigned action.

Most keyboards have between 84 and 110 keys. Some keyboards also include extra buttons for volume control, shortcuts, and multimedia functions. Keyboards connect to computers using wires (USB) or wirelessly (Bluetooth).

2. Mouse: A mouse is a handheld input device. It controls the movement of the cursor on the screen. When the user moves the mouse, sensors inside detect the motion and send signals to the computer. The computer then moves the cursor accordingly.

A mouse usually has two or three buttons. The left button selects items, while the right button opens menus. Some mice also have a scroll wheel for easy navigation.

3. Touch Screen: A touch screen is both an input and output devices. Users interact with it by touching the display directly. The screen detects the touch and sends the input to the computer.
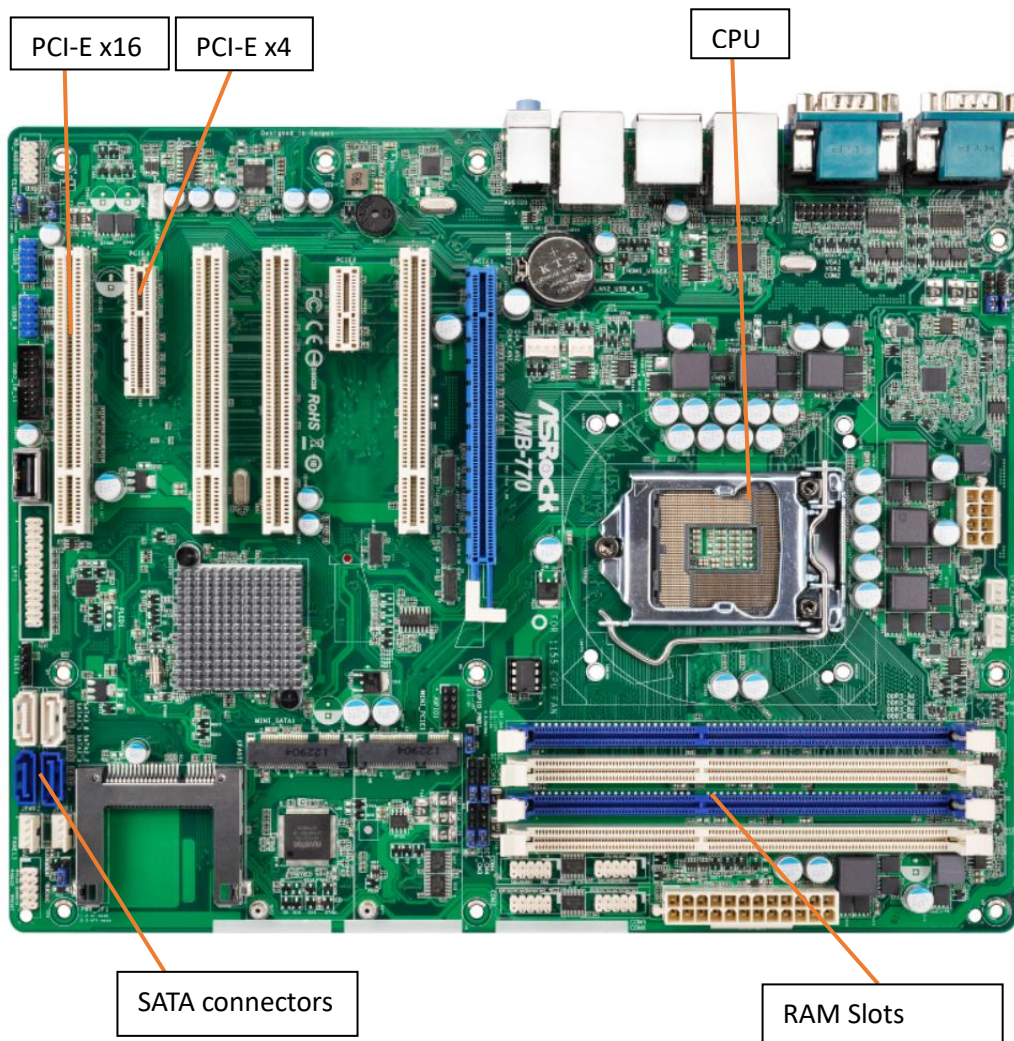
Touch screens are used in smartphones, tablets, ATMs, and kiosks. Modern touch screens support multi-touch, allowing multiple fingers to be used at the same time.

Section 4: Practical Application

11. Identify and label the following components on a diagram of a motherboard:
- CPU
- RAM slots
- SATA connectors
- PCI-E slot

Ans:

12. Demonstrate how to install a RAM module into a computer.

Section 5: Essay

13. Discuss the importance of proper cooling mechanisms in a computer system. Include examples of cooling methods and their effectiveness.

Ans: Proper cooling mechanisms are critical to the performance, reliability, and longevity of a computer system. As components like CPUs, GPUs, and power supplies operate, they generate heat. Without effective cooling, this heat can lead to thermal throttling, hardware damage, or even system failure.

Importance of Proper Cooling System :

- **Performance Stability**: High temperatures can cause CPUs and GPUs to reduce their clock speeds to prevent overheating, leading to slower performance.
- **Hardware Longevity**: Excessive heat accelerates wear and tear on components, shortening their lifespan.
- **System Reliability**: Overheating can cause crashes, data corruption, or permanent damage to sensitive electronics.
- **Energy Efficiency**: Cooler systems often operate more efficiently, reducing power consumption and noise.

Types of Cooling Methods and their effectiveness:

- **Air Cooling:** It is the most common method, using fans and heatsinks to move heat away from components. It is affordable, reliable, and common in desktops, though its effectiveness is moderate.
- **Liquid Cooling:** It circulates coolant through a loop to absorb and transfer heat, offering high effectiveness and quieter operation. It is ideal for gaming PCs, workstations, and servers but comes with higher cost and maintenance needs.
- **Passive Cooling:** It relies on natural airflow and large heatsinks without fans. It is silent and used in low-power devices like Raspberry Pi, but its cooling capability is limited.
- **Thermoelectric (Peltier) Cooling:** It uses electric current to create a temperature difference, drawing heat away from components. It is mostly used in experimental setups due to niche effectiveness.
- **Phase Change Cooling:** It works like a refrigerator with compressed gas, achieving very high cooling performance. It is mainly used for extreme overclocking because of its expense and complexity.
- **Immersion Cooling:** It submerges components in a thermally conductive liquid, offering extremely high effectiveness. It is used primarily in data centres and high-performance computing environments.

Each method balances cost, complexity, and performance, with the choice depending on the system's needs and intended use.

14. Explain the concept of bus width and its significance in computer architecture.

Ans: In computer architecture, **bus width** refers to the number of bits that can be transmitted simultaneously across a bus. A **bus** is a communication pathway that transfers data between components—such as the CPU, memory, and peripherals.

If a bus has a width of **32 bits**, it can carry 32 bits of data at once. A **64-bit bus** can carry twice as much data in the same cycle.

There are different types of buses:
- **Data bus**: Carries actual data.
- **Address bus**: Carries memory addresses.
- **Control bus**: Carries control signals.

Bus width directly impacts a system's **performance**, **speed**, and **data handling capacity**:

1. Data Throughput

- Wider buses can transfer more data per clock cycle.
- For example, a 64-bit data bus can move 64 bits of data in one cycle, doubling the throughput compared to a 32-bit bus.

2. Memory Addressing

- The width of the address bus determines how much memory the system can address.
- A 32-bit address bus can access up to **4 GB** of memory (2^{32} addresses).
- A 64-bit address bus can theoretically access **16 exabytes** (2^{64} addresses), though actual limits depend on the system.

3. System Compatibility

- Bus width affects compatibility with software and hardware.
- A 64-bit processor requires a 64-bit operating system to fully utilize its capabilities.

A **64-bit data bus** allows faster data transfer between the CPU and RAM by moving 64 bits of data in a single clock cycle.

An **address bus with 32-bit width** limits the system's ability to access memory to a maximum of 4 GB. In contrast, a **64-bit address bus** enables the system to access a vastly larger memory space, supporting up to 2^{64} unique memory addresses.