UNIVERSITY OF BARISHAL

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

3rd Year 2nd Semester Final Examination 2021

Course Title: Peripherals and Interfacing
Course Code: CSE-3207

Time: 3 hours **Marks:** 60

Answer any five Questions from the followings.

1. a) What is Interface? Briefly explain different types of Interface [5]
   b) What do you mean by Computer peripheral? List down the input and output Peripherals. [2]
   c) Differentiate between off-line and on-line peripherals [2]
   d) Write short note on Universal Serial Bus [3]
2. a) What is the Aspect ratio and Viewable area? [2]
   b) Why LCD is called liquid crystal? Draw and define the cutaway rendering of a color CRT [6]
   c) Describe the working procedure of a CRT monitor and provide a simplified diagram illustrating the key components and electron beam's path within the monitor? [4]
3. a) What do you mean by the accuracy of an optical mouse? Describe the factors that affect the quality of an optical mouse. [5]
   b) Write short notes on: [4]
      i. Polling rate
      ii. Refresh rate
   c) Can a mouse's sensitivity (DPI) be adjusted, and why might someone want to change it? [3]
4. a) If the 3rd bit of port C has to be "RESET", then what is the control word of 82C55? [4]
   b) What is bar code? Describe the principle of barcode reading. [4]
   c) Discuss the role of input /output derivers for UNIX / LINUX operating system. [4]
5. a) Explain various storage interfaces. [3]
   b) What is sound card? Describe the major components of a sound card. [4]
   c) Describe the functions of the signals BUSY. PAPER, #ERROR, #INI and #STR of the parallel printer. [5]
6. a) Define digital camera scanner .Write down the advantages and disadvantages of digital camera scanner over other scanner . [4]
   b) Write down the advantages & disadvantages of Drum scanner over flatbed scanner . [4]
   c) Define check digit. Using the following code determines the check digit. [4]
      "93000283936"
7. a) Define printer. What are the basic technologies of Printer? [4]
   b) Briefly explain the inkjet printer printing process. [4]
   c) Why Laser printer is so popular over other printers? [4]
8. a) Write short notes on the Hall effect keyboard. [4]
   b) Write down the difference between laser keyboard and dome switch keyboard [4]
   c) What is hall effect keyboard? Write down the working principle of these keyboard. [4]

1.a)(5)

Let's answer this clearly 👇

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a) What is an Interface?

An **Interface** is a shared boundary or point of interaction between **two systems, devices, or components** through which information or signals are exchanged.

In simple terms, an interface defines **how two different entities communicate or interact** with each other — it could be between **hardware and hardware**, **hardware and software**, or **software and user**.

Types of Interfaces:

There are **several types** of interfaces depending on the context. The main categories are:

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1. Hardware Interface

- It defines how **hardware components** communicate with each other.
- Includes physical and electrical connections between devices.

Examples:

- USB ports, HDMI, Serial ports, Parallel ports, SATA, etc.
- CPU–I/O device interface using control and status registers.

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2. Software Interface

- It defines how **software programs or modules** interact and share data.
- Describes the **functions, protocols, and data formats** used for communication.

Examples:

- **API (Application Programming Interface)** — allows programs to interact.
- **Operating system interfaces** — like system calls that connect apps to hardware.

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3. User Interface (UI)

- It is the interaction between **user and computer system**.
- It determines how easily a user can control or operate a system.

Types of User Interfaces:

- **Command-Line Interface (CLI):** User types text commands (e.g., MS-DOS).
- **Graphical User Interface (GUI):** Uses icons, windows, and menus (e.g., Windows OS).
- **Menu-Driven Interface:** User selects from a list of options.
- **Touch or Voice Interface:** Used in smartphones and voice assistants.

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4. Network Interface

- It defines how devices connect and communicate over a network.
- Usually involves **network interface cards (NICs)** and communication protocols.

Example: Ethernet interface, Wi-Fi interface.

Summary Table:

Type of Interface	Description	Example
Hardware Interface	Communication between hardware devices	USB, HDMI, CPU–I/O
Software Interface	Communication between software components	APIs, OS system calls
User Interface	Communication between user and system	GUI, CLI

Network Interface	Communication between devices over a network	Ethernet, Wi-Fi

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Would you like me to give this answer in **microprocessor context** (e.g., how CPU interacts with I/O devices via interfaces)?

b)b) What do you mean by **Computer peripheral**? List down the **input and output Peripherals**. (2)

Let's answer this one clearly 👇

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b) What do you mean by Computer Peripheral?

A **computer peripheral** is an **external device** that is **connected to a computer** to either provide input, output, or additional functionality.

In simple terms, peripherals are **hardware devices** that help the computer **communicate with the external world** — they are **not part of the main CPU or memory**, but they work with it to perform tasks.

Types of Computer Peripherals:

Peripherals are generally classified into **three main types**:

1. **Input Peripherals** – Used to give data or commands **to the computer**.
2. **Output Peripherals** – Used to **display or send out** information from the computer.
3. **Storage/Communication Peripherals** – Used to **store** or **transfer** data (sometimes treated as a third category).

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1. Input Peripherals:

Devices that **send data to the computer** for processing.

Examples:

- Keyboard

- Mouse
- Scanner
- Microphone
- Webcam
- Joystick
- Barcode Reader
- Touch Screen
- Light Pen

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2. Output Peripherals:

Devices that **present processed data** from the computer to the user.

Examples:

- Monitor (Display Screen)
- Printer
- Speaker
- Projector
- Plotter
- Headphones

(Optional) 3. Storage/Communication Peripherals:

Devices that **store** or **transfer** data between systems.

Examples:

- External Hard Drive

- USB Flash Drive
- CD/DVD Drive
- Network Interface Card (NIC)
- Modem

Summary Table:

Type	Purpose	Examples
Input Peripherals	To send data to computer	Keyboard, Mouse, Scanner
Output Peripherals	To display/produce output	Monitor, Printer, Speaker
Storage/Communication Peripherals	To store/transfer data	USB, Hard Drive, NIC

✅ **In short:**
Computer peripherals are the devices that **expand the computer's capabilities** by allowing **input, output, storage, or communication** with the external environment.

c) Differentiate between **off-line and on-line peripherals**. (2)

Here's a clear and concise explanation 👇

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c) Difference between Off-line and On-line Peripherals

Peripherals can be classified based on how they interact with the computer system — either **directly (on-line)** or **indirectly (off-line)**.

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1. Off-line Peripherals

- These devices are **not directly connected** to the computer during normal operation.

- Data is **transferred manually** (using storage media like USB drives, CDs, etc.).
- They **do not communicate in real-time** with the CPU.
- Usually used for **data preparation or backup** tasks.

Examples:

- Punched card reader
- Magnetic tape unit (used offline)
- External hard drive used for backup
- Printer (if data is transferred manually)

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2. On-line Peripherals

- These devices are **directly connected** to the computer and **communicate in real time**.
- Data is **transferred automatically** as part of the computer's normal operation.
- Used for **interactive or continuous data processing**.

Examples:

- Keyboard
- Mouse
- Monitor
- Hard Disk Drive
- Printer (if connected and printing directly from PC)

Comparison Table:

Feature	Off-line Peripherals	On-line Peripherals

Connection	Not directly connected to CPU	Directly connected to CPU
Operation Mode	Operate independently	Operate in real time
Data Transfer	Manual or delayed	Automatic and continuous
Speed	Slower interaction	Faster, real-time interaction
Examples	Card reader, tape drive, external backup	Keyboard, mouse, monitor, printer

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✅ **In short:**

- **Off-line peripherals** work **independently and indirectly**, often for batch or backup tasks.
- **On-line peripherals** are **actively connected** and exchange data **instantly** with the computer system.

d) Write short note on Universal Serial Bus. 3

Here's a clear and concise short note 👇

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d) Short Note on Universal Serial Bus (USB)

Universal Serial Bus (USB) is a **standard interface** used for **connecting peripheral devices** to a computer or other host systems.
It allows **data transfer** and **power supply** through a **single cable** and connector.

Key Points:

1. **Purpose:**
   USB was developed to **simplify connections** between computers and external devices like keyboards, mice, printers, cameras, and flash drives.

2. **Plug and Play:**
   Devices connected via USB are **automatically detected** by the operating system — no need for manual configuration or restarting the computer.

3. **Hot Swapping:**
   USB supports **hot plugging**, meaning devices can be **connected or removed** while

the computer is running.

4. **Data Transfer Speeds:**

USB Version	Maximum Speed	Year Introduced
USB 1.0 / 1.1	12 Mbps	1996
USB 2.0	480 Mbps	2000
USB 3.0	5 Gbps	2008
USB 3.1	10 Gbps	2013
USB 3.2 / 4.0	Up to 40 Gbps	2017+

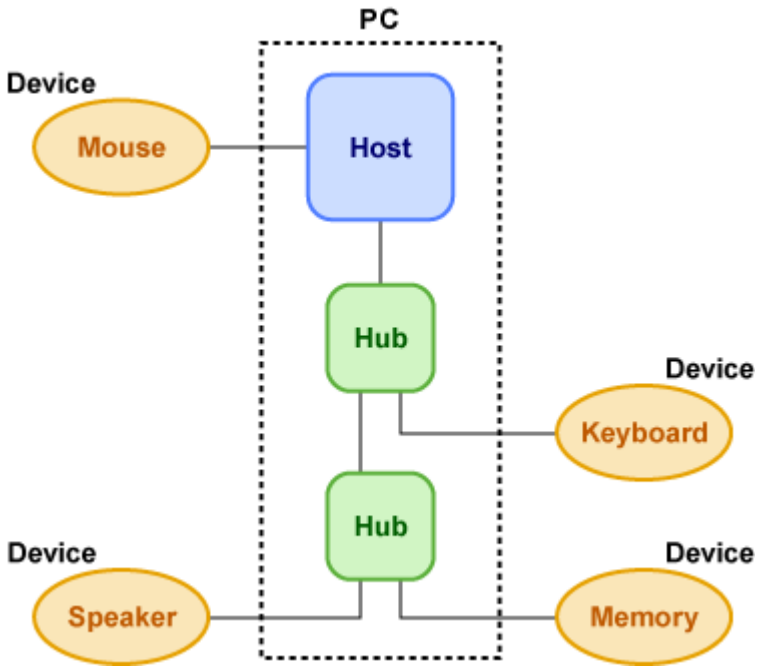
5. **Power Supply:**
   USB can supply **power (typically 5V)** to connected devices, allowing them to **charge** or **operate without a separate power adapter**.

6. **Connector Types:**
   - **Type-A:** Standard rectangular connector (found on PCs).
   - **Type-B:** Square connector (used in printers, older devices).
   - **Mini/Micro USB:** Smaller versions for mobile devices.
   - **USB Type-C:** New reversible connector supporting high speed and power.

Advantages:

- Easy to use and universal standard
- Supports plug and play and hot swapping
- Provides both power and data transfer
- Backward compatible with older versions

✅ **In short:**
USB is a **universal, fast, and convenient interface** that allows computers and devices to **communicate and transfer data**, while also **supplying power** through a single connection.



Question 2

a) What is the **Aspect ratio** and **Viewable area**? [2]

Here's a clear and easy explanation 👇

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a) What is Aspect Ratio and Viewable Area?

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1. Aspect Ratio

Definition:
The **aspect ratio** of a display screen is the **ratio of its width to its height**.
It describes the **shape of the screen** — whether it is more square or more rectangular.

Formula:
[
{Aspect Ratio} =Width/Height
]

Common Aspect Ratios:

Aspect Ratio	Description	Example Use
4 : 3	Standard screen (almost square)	Old monitors, CRT displays
16 : 9	Widescreen format	Modern monitors, TVs, laptops
21 : 9	Ultra-wide screen	Cinematic displays, gaming monitors

Example:
If a monitor has a resolution of **1920 × 1080 pixels**,
then
[
Aspect Ratio ={1920}/{1080} = 16:9
]

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2. Viewable Area

Definition:
The **viewable area** is the **actual visible portion of the display screen** that can be seen by the user.
It is usually measured **diagonally in inches**, or sometimes as **width × height** in millimeters or centimeters.

Formula:
[
Viewable Area = Width \Height
]

Example:
A monitor described as **24 inches** refers to a **24-inch diagonal viewable area** of the screen.

Difference Summary:

Feature	Aspect Ratio	Viewable Area
Definition	Ratio of screen width to height	Actual visible display size
Measurement	Ratio (e.g., 16:9, 4:3)	Area or diagonal (e.g., 24-inch screen)
Purpose	Describes screen shape	Describes screen size

Example	16:9 (widescreen)	24-inch diagonal viewable screen

✅ **In short:**

- **Aspect Ratio** = Shape of the screen (Width : Height)
- **Viewable Area** = Actual visible size of the display screen

b) Why **LCD** is called liquid crystal? Draw and define the **cutaway rendering of a color CRT (2)**

Let's go step by step 👇

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b) Why LCD is called *Liquid Crystal*?

LCD stands for **Liquid Crystal Display**.
It is called *Liquid Crystal* because the **material used inside the display has properties of both a liquid and a solid crystal**.

Explanation:

- The molecules in **liquid crystals** can **flow like a liquid**,
  but they also maintain a certain **order or orientation** like a crystal.
- When **electric voltage** is applied, the **orientation of these molecules changes**, which **controls the amount of light passing through**.
- This property is used to form **images on the screen**.

Thus, the term **"Liquid Crystal"** refers to this **unique state of matter**—neither purely liquid nor solid, but something in between—used in **LCD technology**.

Working Principle of LCD:

1. LCDs do **not produce light** themselves.

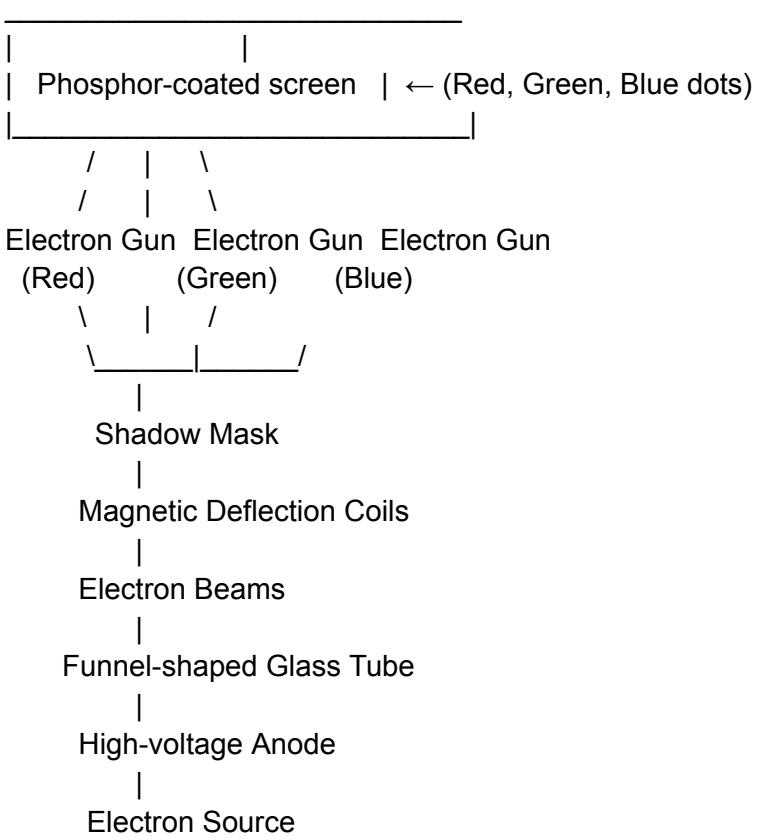
2. They use a **backlight** (or reflective surface) and **liquid crystal layer** that **modulates light**.

3. The **electric field** changes the crystal alignment to **allow or block light** for each pixel.

4. **Color filters (Red, Green, Blue)** combine to produce full-color images.

Now, Cutaway Rendering of a Color CRT

Below is a labeled **diagram (text version)** of a **Color Cathode Ray Tube (CRT)** display:



Definition (Cutaway Rendering of Color CRT):

A **color CRT (Cathode Ray Tube)** consists of:

1. **Three Electron Guns** – One for each primary color: **Red, Green, and Blue (RGB)**.

2. **Shadow Mask** – A thin metal sheet with holes ensuring each electron beam hits its corresponding color phosphor dot on the screen.

3. **Phosphor Screen** – The inner surface of the screen coated with **red, green, and blue phosphor dots** that glow when struck by electrons.

4. **Deflection Coils** – Magnetic coils used to **steer the beams horizontally and vertically**, forming images line by line.

5. **Glass Envelope** – Vacuum-sealed tube housing all components.

How It Works:

- The **three electron beams** (RGB) are fired from the electron guns.
- The **shadow mask** ensures each beam hits only its corresponding color dot.
- The **phosphor coating** emits light when struck by electrons.
- The intensity of each beam controls the **brightness** of that color.
- Combined RGB dots create a **full-color image** on the screen.

✅ **In short:**

- **LCD** is called *Liquid Crystal* because it uses materials that behave like both liquids and crystals.
- **Color CRT** uses **three electron guns, a shadow mask, and phosphor screen** to produce colored images.

C)provide a simplified diagram illustrating the **key components and electron beam's path** within the monitor.

Here's a clear explanation 👇

Working Procedure of CRT Monitor

A **CRT (Cathode Ray Tube)** monitor works by using **electron beams** to create images on a **phosphor-coated screen**. It's based on the principle of converting **electrical signals into visible light**.

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1. Main Components:

1. **Electron Guns:**
    - There are three guns — **Red, Green, and Blue (RGB)** — each producing an electron beam.
    - These beams are emitted from the back of the tube.
2. **Control Grid:**
    - Regulates the **intensity (brightness)** of each beam.
3. **Accelerating Anodes:**
    - Accelerate the electron beams toward the screen.
4. **Deflection Coils:**
    - Located around the neck of the tube.
    - **Magnetic fields** generated by these coils deflect the beams **horizontally and vertically**, scanning the screen.
5. **Shadow Mask:**
    - A thin metal sheet with small holes.
    - Ensures that each beam hits only its **corresponding color phosphor dot** (R, G, or B).
6. **Phosphor-coated Screen:**
    - Inner side of the front glass coated with **red, green, and blue phosphor dots**.
    - When struck by the electron beams, the phosphors **emit light**.

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2. Working Steps:

1. **Electron Generation:**
    - The electron guns emit three electron beams (R, G, B).
2. **Beam Control:**
    - The control grid adjusts beam brightness according to image data.
3. **Beam Acceleration:**
    - The accelerating anode pulls beams toward the screen.
4. **Beam Deflection (Scanning):**
    - Magnetic deflection coils guide the beams in a **raster scan** — line by line across the screen from top to bottom.
5. **Image Formation:**
    - Beams pass through the shadow mask and hit red, green, and blue phosphor dots.
    - The glowing dots blend together to form full-color images.
6. **Persistence of Vision:**
    - The image appears continuous because the phosphor glows briefly after being hit, and the screen is refreshed many times per second (refresh rate).

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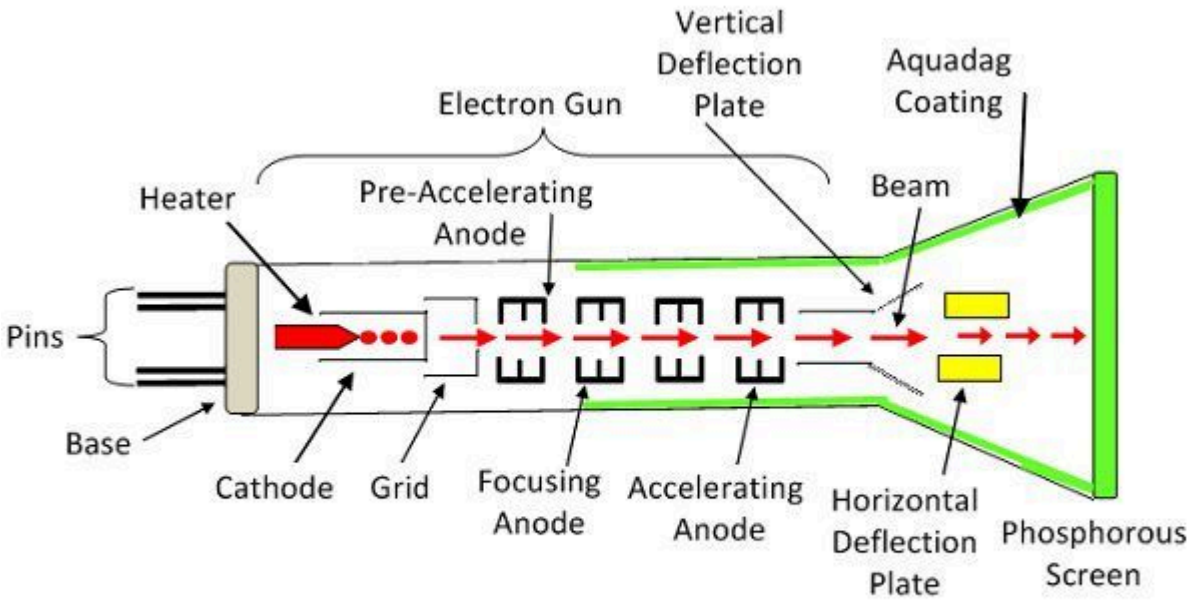
3. Simplified Diagram of CRT Monitor:

Below is a simplified labeled diagram showing the **key components** and **electron beam path** 👇

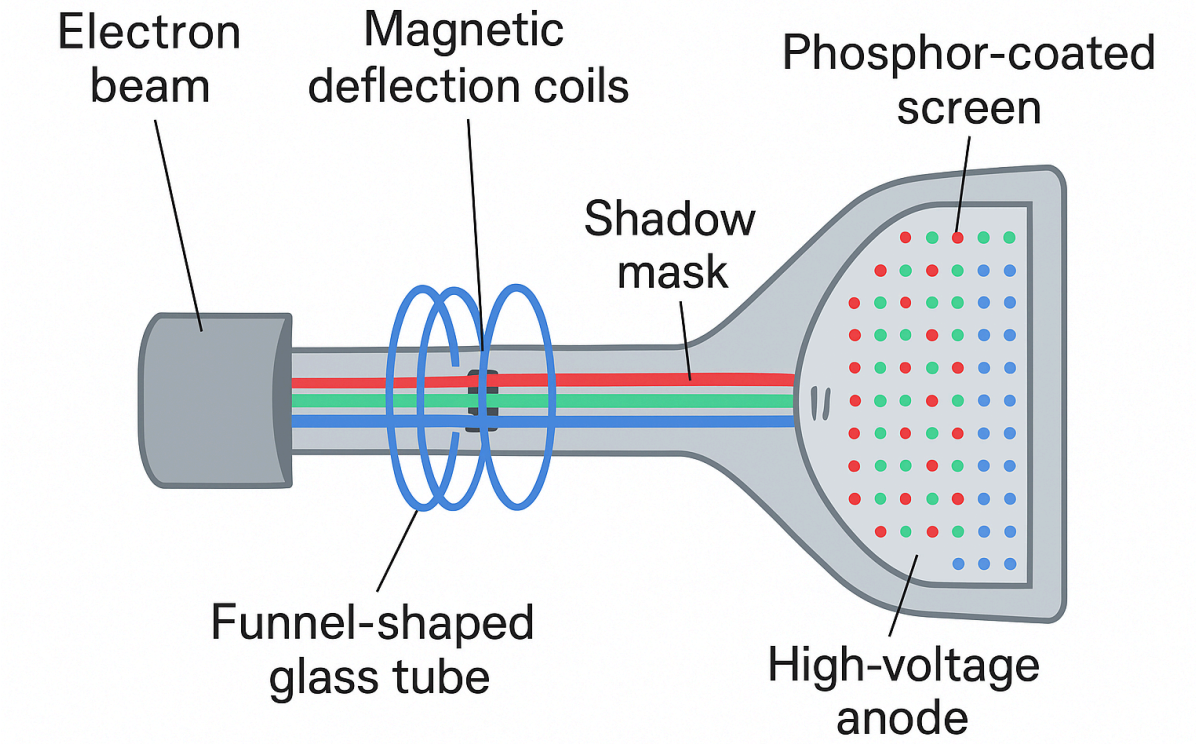
In short:

A **CRT monitor** works by firing **three electron beams (R, G, B)** through a **shadow mask** onto a **phosphor-coated screen**. The beams are **deflected magnetically** to scan the screen, and the **phosphors emit light** to form the image visible to the user.



Cathode Ray Tube

Circuit Globe



Question 3

a) What do you mean by the accuracy of an optical mouse? Describe the factors that affect the quality of an optical mouse. [5]

Here's a clear and well-structured answer 👇

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a) Accuracy of an Optical Mouse

Definition:
The **accuracy of an optical mouse** refers to how precisely the mouse can detect and translate its physical movement on a surface into cursor movement on the screen.

It determines how well the cursor follows the user's hand motion — without lag, skips, or drift.

Measurement of Accuracy

Accuracy is generally measured in **DPI (Dots Per Inch)** or **CPI (Counts Per Inch)**.

- **DPI / CPI:** Indicates how many points (pixels) the cursor moves on the screen for every inch the mouse is moved physically.
    - Higher DPI → More sensitive and accurate.
    - Lower DPI → Slower or less sensitive.

Example:

- A mouse with **800 DPI** moves the cursor 800 pixels for every inch of movement.
- A **3200 DPI** mouse can detect smaller movements more precisely (used in gaming or design work).

Factors Affecting the Quality and Accuracy of an Optical Mouse

1. **Sensor Resolution (DPI/CPI):**

- Determines how finely the mouse can detect movement.
- Higher resolution = greater accuracy.

2. **Surface Quality:**
    - Optical sensors work by capturing images of the surface.
    - Smooth, shiny, or glass surfaces can cause inaccurate tracking.
    - Textured or matte mousepads improve performance.
3. **Sensor Type:**
    - **LED-based sensors** are common and work well on most surfaces.
    - **Laser sensors** are more sensitive and can track on glossy or uneven surfaces.
4. **Polling Rate (Hz):**
    - The number of times per second the mouse sends position data to the computer.
    - Common values: 125 Hz, 500 Hz, 1000 Hz.
    - Higher polling rate → smoother and more responsive cursor movement.
5. **Lighting Conditions:**
    - Strong external light or reflections can interfere with optical sensors, reducing accuracy.
6. **Firmware and Driver Quality:**
    - Proper drivers ensure correct communication between the sensor and computer, improving precision.
7. **Build Quality and Shape:**
    - Good design ensures comfort and consistent hand positioning, reducing tracking errors.
8. **Debounce and Filtering Algorithms:**
    - Software inside the mouse filters out noise and false signals, affecting precision and responsiveness.

Summary Table

Factor	Effect on Accuracy
Sensor Resolution (DPI)	Higher DPI gives finer control
Surface Texture	Textured surfaces improve tracking
Sensor Type	Laser sensors provide higher precision
Polling Rate	Higher rate = smoother movement
Lighting	Bright reflections reduce accuracy
Firmware/Drivers	Affects responsiveness and consistency

✅ **In short:**
The **accuracy** of an optical mouse is its ability to **precisely track motion** and **translate it into cursor movement**.
Its quality depends on **sensor resolution, surface texture, polling rate, sensor type, and lighting conditions**.

b) Write short notes on: [4]

i. **Polling rate** ii. **Refresh rate**

Here’s a clear and easy explanation 👇

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b) Short Notes

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i. Polling Rate

Definition:
The **polling rate** is the number of times per second that a device (such as a mouse or keyboard) **reports its position or status** to the computer.

It is measured in **Hertz (Hz)** — meaning how many reports are sent per second.

Formula Example:

- A **500 Hz** polling rate = The device sends data **500 times per second**.
- Time between reports = (\frac{1}{500} = 2 \text{ ms})

Explanation:

- Higher polling rates make cursor movement **smoother and more responsive**.
- Lower polling rates can cause **slight delay (input lag)** between physical movement and cursor movement.

Typical Polling Rates for a Mouse:

Polling Rate (Hz)	Report Interval (ms)	Performance
125 Hz	8 ms	Standard
500 Hz	2 ms	Fast
1000 Hz	1 ms	Very Responsive (used in gaming)

In short:

- **Higher polling rate = smoother, more accurate, faster response.**

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ii. Refresh Rate

Definition:
The **refresh rate** is the number of times per second a **display screen updates its image**. It indicates how often the image on the screen is redrawn.

Measured in **Hertz (Hz)** — meaning how many frames the monitor can display per second.

Example:

- A **60 Hz** monitor refreshes the screen **60 times per second**.
- A **144 Hz** monitor refreshes it **144 times per second** — providing smoother motion.

Effect on Performance:

- Higher refresh rates reduce **screen flicker** and **motion blur**.
- Important for **gaming, animation, and high-speed video**.

Typical Refresh Rates:

Refresh Rate	Application
60 Hz	Normal office use
75–120 Hz	Multimedia and movies
144–240 Hz	Gaming and high-speed visuals

In short:

- **Polling rate** → How often input data is sent **to the computer**.
- **Refresh rate** → How often the screen **updates the display**.

✅ **Summary Difference:**

Feature	Polling Rate	Refresh Rate
Definition	Device reports per second	Screen updates per second
Measured In	Hertz (Hz)	Hertz (Hz)
Applies To	Mouse, keyboard	Monitor/display
Purpose	Improves input responsiveness	Improves visual smoothness

c) Can a mouse's **sensitivity (DPI)** be adjusted, and why might someone want to change it? [3]

Here's a clear and simple answer 👇

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c) Can a mouse's sensitivity (DPI) be adjusted, and why might someone want to change it?

✅ **Yes**, a mouse's **sensitivity (DPI — Dots Per Inch) can be adjusted** on most modern optical or laser mice.

What is DPI?

- **DPI (Dots Per Inch)** measures how far the cursor moves on the screen when the mouse moves physically by one inch.
- **Higher DPI** → cursor moves **faster and more sensitive**.
- **Lower DPI** → cursor moves **slower and more precise**.

How DPI Can Be Adjusted:

1. **Using DPI Buttons on the Mouse:**
   Many mice (especially gaming ones) have **DPI buttons** that let users switch between sensitivity levels instantly (e.g., 800, 1600, 3200 DPI).

2. **Through Software:**
   Mouse manufacturers provide software (like Logitech G Hub, Razer Synapse, etc.) where users can **set custom DPI values** and save profiles.

3. **Operating System Settings:**
   In Windows or macOS, sensitivity can also be changed via **mouse settings**.

Why Someone Might Want to Change DPI:

Reason	Explanation
Precision Tasks	Lower DPI helps in accurate tasks like graphic design, photo editing, or aiming in games.
Fast Movement	Higher DPI allows quicker cursor movement across large screens or multiple monitors.
Gaming Needs	Gamers often switch DPI settings depending on the game — low for aiming, high for fast turning.
Personal Comfort	Users adjust DPI to match their preferred cursor speed and hand movement style.
Display Resolution	Higher screen resolutions (e.g., 4K) often require higher DPI for smooth navigation.

Example:

- A **400 DPI** setting gives **slow, precise movement** — ideal for sniping in FPS games.
- A **3200 DPI** setting gives **fast cursor motion** — useful for quick navigation or real-time strategy games.

✅ **In short:**
Yes, **DPI can be adjusted** to control mouse sensitivity.
People change it to suit their **task type, display size, comfort level, and precision needs**.

Question 4

a) If the third bit of port C has to be "RESET", then, what is the control word of 82C55? [4]

Sure! Let's solve this **step by step**.

We are asked:

> If the 3rd bit of port C has to be "RESET", then what is the control word of 82C55?

Step 1: Recall 82C55 Control Word Format

The 82C55 **Programmable Peripheral Interface (PPI)** has **3 ports**: Port A, Port B, and Port C. Port C is split into **upper (PC7–PC4)** and **lower (PC3–PC0)**.

The **control word (8-bit)** has the following format:

Bit positions:

D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0

- **D7** = 1 → Mode set (control word); 0 → Bit set/reset operation
- **D6** = 0 → N/A in BSR mode
- **D5** = N/A in BSR mode

- **D4** = N/A in BSR mode
- **D3** = 1 → Bit number (PC3–PC0) to set/reset
- **D2** = 1 → 1 = SET, 0 = RESET
- **D1–D0** = N/A in this case

Since we want to **reset the 3rd bit of port C**, this is a **Bit Set/Reset (BSR) operation**.

Step 2: BSR Control Word Format

For **BSR**, the 82C55 uses:

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	C3	S	0	0

Where:

- **D3–D1** → Select bit (PC0 to PC7)
- **D0** → 1 = SET, 0 = RESET

But note: Actually, the standard BSR format is:

D7 = 0 (BSR mode)

D3–D1 = bit number (0–7)

D0 = 1 → SET, 0 → RESET

So for **PC3**:

- **D3–D1 = 011** (binary for 3)
- **D0 = 0** (RESET)
- **D7 = 0**

Thus, control word = `0000 0110`?

Let's check carefully:

Standard BSR format (Intel 82C55 datasheet):

- **D7 = 0** → BSR mode
- **D3–D1** → Bit select (000 → PC0, 001 → PC1, …, 111 → PC7)
- **D0** → 0 = RESET, 1 = SET

For **PC3 reset**:

- D7 = 0
- Bit select for PC3 = 011 (D3–D1)
- RESET → D0 = 0

Remaining bits D6–D4 = 0

So final **control word** in binary:

D7 D6 D5 D4 D3 D2 D1 D0

0 0 0 0 0 1 1 0

✅ Wait, careful: D3–D1 = 011 → bits D3=0, D2=1, D1=1?

Actually, assign:

- D3–D1 = 011 → D3=0, D2=1, D1=1
- D0 = 0 (RESET)
- D7–D4 = 0

Binary = `00001110`

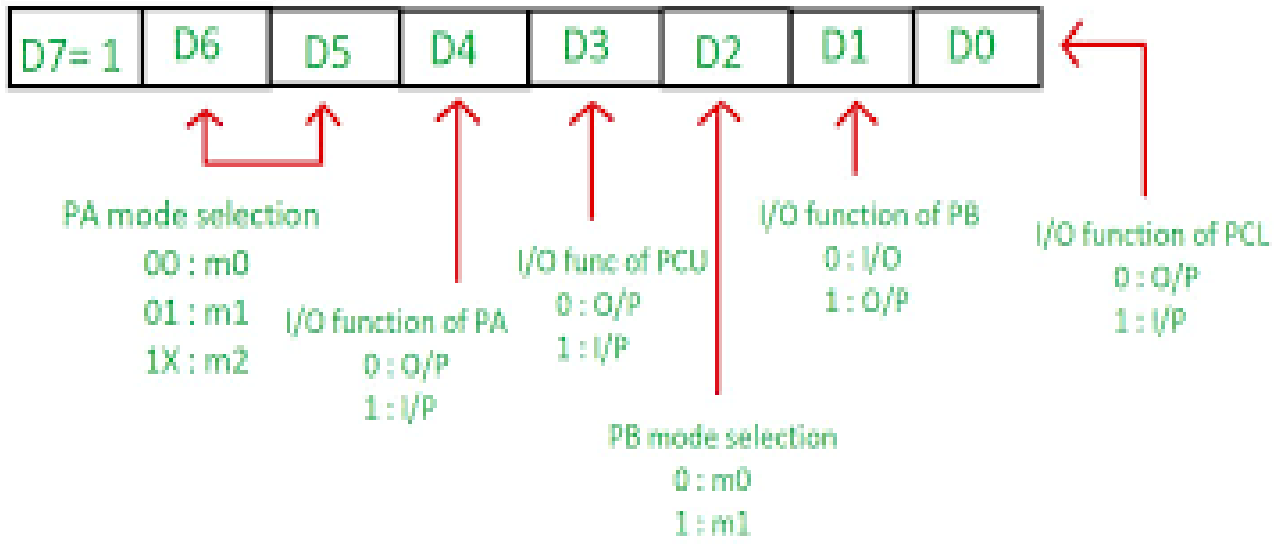
✅ Step 3: Convert to Hex

Binary `0000 1110` → Hex = **0x0E**

Answer:

Control word to RESET PC3 of 82C55:

0x0E



b) What is bar code? Describe the principle of barcode reading. [4]

---

b) What is a Barcode?

A barcode is a machine-readable representation of data in a visual format. It consists of a series of parallel black and white bars of varying widths, which encode information such as product ID, price, or other data.

- Barcodes are widely used in retail, logistics, libraries, healthcare, etc.
- Each barcode has a unique code that can be quickly scanned by a device.

Example:

| ||| | |||| → represents a numeric or alphanumeric code

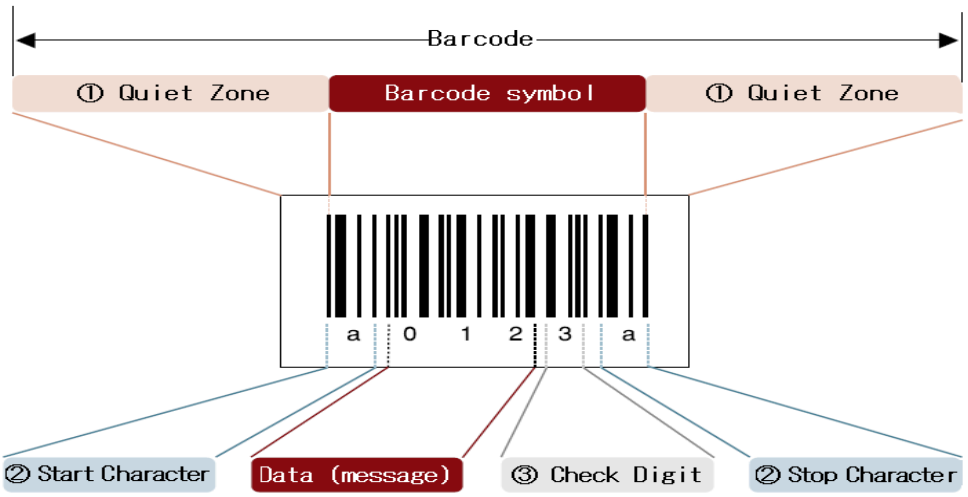
Principle of Barcode Reading

Barcode reading is based on optical scanning. The basic principle is:

1. A barcode reader (scanner) emits a light beam (usually red LED or laser) onto the barcode.
2. The light reflects back differently from the black bars and white spaces:
    - Black bars absorb light → less reflection
    - White spaces reflect light → more reflection
3. A photodiode sensor detects the reflected light intensity.
4. The scanner converts the pattern of light and dark into an electrical signal.
5. This signal is then decoded by the scanner's processor into the original data (numbers, letters, etc.).
6. The data can be sent to a computer or POS system for further processing.

Key Points

- Barcodes are read horizontally across the bars.
- Accuracy depends on scanner resolution and barcode quality.
- There are 1D barcodes (linear) and 2D barcodes (like QR codes).



Here's a clear, structured summary of the **common product codes** and their components based on your notes:

Common Product Codes

Product codes are mainly divided into **two groups**:

1. **UPC (Universal Product Code)**
    - Standardized in the **United States**.
    - Widely used in **retail and supermarkets**.
2. **EAN (European Article Number)**
    - Standardized in **Europe**, based on the UPC system.
    - Used internationally for product identification.

Components of a Product Code

1. **GS1 Company Prefix**
    - Assigned to a manufacturer by **GS1 organization** (e.g., GS1 Japan).
    - Obtained via the **local Chamber of Commerce**.
    - Uniquely identifies the **manufacturer or company**.

2. **Product Item Code**
    - Assigned by the **manufacturer**.
    - Identifies a **specific product or item**.
    - Works together with the **GS1 Company Prefix** to uniquely identify a product.
3. **Check Digit**
    - **Calculated value** based on the **GS1 Company Prefix** and **Product Item Code**.
    - Ensures **accuracy and reliability** of the scanned code.

---

c) Discuss the role of **input/output derivers for UNIX/LINUX operating system**. [4]

Sure! Let's explain this **clearly and concisely**.

---

c) Role of Input/Output (I/O) Drivers in UNIX/Linux

I/O drivers (also called **device drivers**) are **special programs** that allow the operating system to **communicate with hardware devices** such as keyboards, mice, disks, printers, and network cards.

In **UNIX/Linux**, I/O drivers play a critical role because **the OS treats almost everything as a file**, including devices.

Roles of I/O Drivers

1. **Hardware Abstraction**
    - Provide a **standard interface** between the OS and hardware devices.
    - Applications **don't need to know hardware details**; they can just perform read/write operations.
2. **Device Control**
    - Handle **commands sent to devices** (e.g., read, write, seek, control).

- Ensure that **devices operate correctly and efficiently**.

3. **Data Transfer Management**
    - Manage **input from devices** (keyboard, mouse) and **output to devices** (monitor, printer).
    - Can use **polling, interrupts, or DMA** for efficient data transfer.
4. **Error Handling**
    - Detect and report **hardware errors** to the OS.
    - Ensures **reliable operation** and may allow recovery from errors.
5. **Resource Sharing**
    - Allow **multiple processes** to use the same device safely.
    - Handle **synchronization and access control**.

Summary

- I/O drivers are **essential for bridging the gap between hardware and software**.
- In UNIX/Linux, they make devices appear like **files**, enabling **consistent and simple I/O operations** for programs.

---

a) Explain **various storage interfaces**. [3]

Sure! Let's explain **various storage interfaces** in a clear and structured way.

---

a) Storage Interfaces

A **storage interface** is a standard **connection between a computer system and a storage device** (like HDD, SSD, CD/DVD, or external drives). It defines **how data is transmitted**, the **speed**, and the **protocol used**.

Here are the **common types of storage interfaces**:

---

1. Parallel ATA (PATA) / IDE

- **Full name:** Parallel Advanced Technology Attachment (also called IDE).
- **Data Transfer:** Parallel (multiple bits at a time, typically 16-bit).
- **Speed:** Up to 133 MB/s (ATA-7).
- **Use:** Older HDDs and optical drives.
- **Connection:** 40-pin ribbon cable, bulky.

---

2. Serial ATA (SATA)

- **Full name:** Serial Advanced Technology Attachment.
- **Data Transfer:** Serial (one bit at a time).
- **Speed:** SATA I = 1.5 Gb/s, SATA II = 3 Gb/s, SATA III = 6 Gb/s.
- **Use:** Modern HDDs, SSDs, optical drives.
- **Advantages:** Faster, thinner cables, hot-swappable.

---

3. SCSI (Small Computer System Interface)

- **Data Transfer:** Parallel (older) or Serial (SAS – Serial Attached SCSI).
- **Use:** High-performance servers, storage arrays, enterprise drives.
- **Advantages:** Supports multiple devices per bus, faster and reliable.

---

4. USB (Universal Serial Bus)

- **Data Transfer:** Serial.
- **Use:** External storage devices, flash drives, external HDDs/SSDs.
- **Advantages:** Plug-and-play, hot-swappable, widely supported.

---

5. Fibre Channel (FC)

- **Use:** High-speed storage area networks (SANs).
- **Speed:** 16–128 Gbps.
- **Advantages:** Very fast, reliable, used in enterprise storage systems.

---

6. NVMe / PCIe

- **Full name:** Non-Volatile Memory Express over PCI Express.
- **Use:** Modern SSDs (especially M.2 drives).
- **Advantages:** Extremely fast, low latency, high IOPS.

Summary Table

Interface	Type	Speed / Use	Notes
PATA	Parallel	Up to 133 MB/s	Old HDDs, ribbon cable
SATA	Serial	1.5–6 Gb/s	Modern HDD/SSD, thin cable
SCSI/SAS	Parallel/Serial	Fast, multiple devices	Servers, enterprise storage
USB	Serial	12–40 Gb/s (USB 3.2)	External storage
Fibre Channel	Serial	16–128 Gbps	SAN, enterprise storage

NVMe/PCIe	Serial	Very high (GB/s range)	Modern SSDs, low latency

---

b) What is sound card? Describe the major components of a sound card. [4]

b) What is a Sound Card?

A **sound card** is a **computer expansion card** or **integrated component** that allows a computer to **input, process, and output audio signals**.

- It converts **analog audio signals** from microphones or musical instruments into **digital data** for the computer (**ADC – Analog to Digital Conversion**).
- It also converts **digital audio data** from the computer into **analog signals** that can be played on speakers or headphones (**DAC – Digital to Analog Conversion**).
- Sound cards support **stereo sound, surround sound, MIDI, and audio effects**.

Major Components of a Sound Card

1. **Digital-to-Analog Converter (DAC)**
    - Converts **digital audio data** from the computer into **analog signals** for speakers or headphones.
2. **Analog-to-Digital Converter (ADC)**
    - Converts **analog signals** from a microphone or other input device into **digital data** for processing or recording.
3. **Audio Processor / DSP (Digital Signal Processor)**
    - Processes **audio effects**, mixing, and compression.
    - Handles tasks like **3D audio, echo, equalization**, etc.
4. **Input/Output Ports**
    - **Line-in**: For external audio input (microphones, instruments)
    - **Line-out / Speaker-out**: For connecting headphones or speakers

- **MIDI/Game port**: For musical instruments or legacy devices

5. **Memory (Optional)**
    - Some advanced sound cards include **dedicated memory** to store audio samples for faster processing.
6. **Amplifier / Mixer Circuit**
    - Amplifies audio signals and allows **mixing multiple audio sources** before output.

Summary Diagram (Textual)

[Microphone / Instrument] --> ADC --> Audio Processor/DSP --> DAC --> [Speakers / Headphones]

c) Describe the functions of the signals BUSY, PAPER, #ERROR, #INI and #STR of the parallel printer. [5]

c) Functions of Signals of a Parallel Printer

A parallel printer uses an 8-bit data bus along with control and status lines to communicate with the computer. Important status/control signals include:

---

1. BUSY
    - Type: Status signal from printer to computer
    - Function: Indicates whether the printer is currently printing or not ready.
    - Logic:
        - High (1): Printer is busy → computer must wait
        - Low (0): Printer is ready to receive data

---

2. PAPER (sometimes called PAPER END or PAPER OUT)
    - Type: Status signal
    - Function: Indicates whether the printer has paper loaded.
    - Logic:
        - High (1): Paper is out → printing cannot continue
        - Low (0): Paper is available → printing can continue

---

3. #ERROR (Error or Fault signal)
    - Type: Status signal
    - Function: Indicates printer malfunctions such as paper jam, open cover, or hardware error.
    - Logic:
        - Active low (#): 0 → Error present
        - 1 → No error

---

4. #INI (Initialize)
    - Type: Control signal from computer to printer
    - Function: Resets or initializes the printer to its default state.
    - Logic:
        - Active low (#): When 0 → Printer performs reset/initialization

---

5. #STR (Strobe)
    - Type: Control signal from computer to printer

- Function: Tells the printer that valid data is available on the data lines.
- Logic:
  - Active low (#): A falling edge triggers the printer to latch the data

---

Summary Table

Signal	Type	Function	Logic
BUSY	Status	Printer is busy or ready	1 = busy, 0 = ready
PAPER	Status	Paper availability	1 = paper out, 0 = paper present
#ERROR	Status	Printer error (jam, cover open)	0 = error, 1 = no error
#INI	Control	Initialize or reset printer	0 = reset active
#STR	Control	Latch data from computer	Falling edge triggers latch

---

Question 6

a) Define **digital camera scanner** device. Write down the **advantages and disadvantages of digital camera scanner over other scanner**. [4]

Sure! Let's answer this clearly and structured.

---

a) Digital Camera Scanner Device

A **digital camera scanner device** is a type of **image input device** that captures **images, documents, or objects** and converts them into **digital form** for storage, editing, or processing by a computer.

- Essentially, it is a **camera-based scanner** that works like a **flatbed or handheld scanner**, but uses **digital imaging sensors** (like CCD or CMOS) to capture data.
- Often used for **document scanning, photo digitization, or 3D object scanning**.

Advantages of Digital Camera Scanner

1. **High Resolution and Detail**
    - Can capture very detailed images, often **better than simple flatbed scanners**.
2. **Portability**
    - Digital camera scanners can be **handheld or portable**, unlike bulky traditional scanners.
3. **Fast Scanning**
    - Can **capture images quickly**, especially for large or irregular objects.
4. **Versatile**
    - Can scan **3D objects, books, or documents** that cannot be placed on a flatbed scanner.
5. **Direct Digital Storage**
    - Output is directly in **digital form** (JPEG, TIFF, PNG), ready for editing or transmission.

Disadvantages of Digital Camera Scanner

1. **Expensive**
    - High-quality digital camera scanners are **costlier** than conventional scanners.
2. **Lighting Sensitivity**
    - Requires **proper lighting** to avoid shadows or uneven scans.
3. **Distortion**
    - May produce **distorted images** if the object is not flat or the camera angle is wrong.
4. **Lower Accuracy for Text**
    - For OCR (Optical Character Recognition), flatbed scanners may produce **more accurate text scans** than a handheld camera scanner.

Summary Table

Advantages	Disadvantages
High resolution & detail	Expensive
Portable & handheld	Sensitive to lighting
Fast scanning	Possible distortion on non-flat objects
Can scan 3D objects	Lower text accuracy for OCR
Direct digital output	

b) Write down the **advantages & disadvantages of Drum scanner over flatbed scanner**. [4]

Sure! Let's explain this clearly.

---

b) Advantages and Disadvantages of Drum Scanner over Flatbed Scanner

A **drum scanner** is a **high-end optical scanner** that uses a **photomultiplier tube (PMT)** to scan images mounted on a rotating drum. It is mainly used in **professional printing and high-resolution image reproduction**.

A **flatbed scanner** uses a **moving optical sensor** to capture images placed on a flat glass surface.

Advantages of Drum Scanner over Flatbed Scanner

1. **Higher Resolution**

- Drum scanners can achieve **very high resolution** (up to 12,000 dpi or more) compared to flatbed scanners.

2. **Better Color Accuracy and Dynamic Range**
    - Uses **photomultiplier tubes** to capture subtle shades of color, giving **superior color reproduction**.
3. **Excellent Image Quality**
    - Produces **high-quality, detailed images** suitable for professional printing.
4. **Can Scan Large Formats**
    - Can scan **oversized images or film negatives** without losing detail.

Disadvantages of Drum Scanner

1. **Expensive**
    - Much **costlier** than flatbed scanners, suitable mainly for professional use.
2. **Bulky and Non-portable**
    - Large and requires **special setup**, unlike compact flatbed scanners.
3. **Complex Operation**
    - Requires **skilled operators** to handle and calibrate.
4. **Time-consuming**
    - Scanning process can be **slower**, especially for large images.

Summary Table

Advantages	Disadvantages
Extremely high resolution	Very expensive

Superior color accuracy & dynamic range	Bulky and non-portable
Excellent image quality	Complex operation
Can scan large images or film negatives	Slower scanning process

c) Define check digit. Using the following code determines the check digit. [4]

"9300028936"

---

c) Check Digit

Definition:
A **check digit** is an extra **digit added to a numeric code** (like a barcode) to **detect errors** in data entry or transmission. It is **calculated from the other digits** using a standard algorithm.

- Commonly used in **UPC, EAN, ISBN**, etc.
- Helps ensure **accuracy** by verifying the code.

Given Code:

9300028936

We are to **calculate the check digit**.

Step 1: Identify the algorithm

For **EAN-13 / UPC-like codes**, the **check digit calculation** is usually:

1. Sum **odd-positioned digits** (from left, first digit = position 1).
2. Sum **even-positioned digits** and multiply by 3.
3. Add the two sums.
4. The **check digit** = number that makes total a **multiple of 10**.

Step 2: Assign positions

Code (without check digit, assuming last digit is for checking) = `9 3 0 0 0 2 8 9 3 6`

Positions:

Position	Digit
1	9
2	3
3	0
4	0
5	0
6	2
7	8

8	9
9	3
10	6

Step 3: Sum of odd and even positions

- **Odd positions** (1,3,5,7,9): 9 + 0 + 0 + 8 + 3 = **20**
- **Even positions** (2,4,6,8,10): 3 + 0 + 2 + 9 + 6 = **20**

Multiply **even sum by 3**: 20 × 3 = **60**

Step 4: Total sum

Total = Odd sum + (Even sum × 3) = 20 + 60 = **80**

Step 5: Calculate check digit

- Check digit = Number which makes total sum a multiple of 10
- Next multiple of 10 after 80 = 80
- Check digit = 0

✅ Answer

Check Digit = 0

OR,

---

c) Check Digit

A **check digit** is an extra digit **added to a numerical code** (like UPC or EAN) to **verify the accuracy** of the code during data entry or scanning.

- It is **calculated using a specific formula** based on the other digits in the code.
- Helps detect **errors** such as mistyped or misread digits.

Step 1: Given Code

We are given the code:

9300028936

Assuming this is a **10-digit code** (like UPC-10) and we want to calculate the **check digit for UPC/EAN standard**.

Step 2: Standard Check Digit Calculation (UPC/EAN-13 method)

1. **Number the positions from left to right**, starting at 1.
2. **Multiply digits in odd positions by 3** and **digits in even positions by 1**.
3. **Sum all the products**.
4. The **check digit** is the number required to make the sum a **multiple of 10**.

Step 3: Assign positions and multiply

Code digits: `9 3 0 0 0 2 8 9 3 6`

Position	Digit	Multiply by	Product

1	9	3	27
2	3	1	3
3	0	3	0
4	0	1	0
5	0	3	0
6	2	1	2
7	8	3	24
8	9	1	9
9	3	3	9
10	6	1	6

Step 4: Sum the products

27 + 3 + 0 + 0 + 0 + 2 + 24 + 9 + 9 + 6 = 80

Step 5: Calculate the check digit

- **Next multiple of 10 after 80** = 80 (already multiple of 10)
- **Check digit** = 10 - (sum mod 10)

Check digit = 10 - (80 mod 10) = 10 - 0 = 0

✅ So, **check digit = 0**

Answer

- **Original code:** 9300028936
- **Check digit: 0**
- **Complete code with check digit:** `93000289360`

a) Define **printer**. What are the **basic technologies of Printer**? [4]

a) Printer

A **printer** is an **output device** that produces a **hard copy (physical copy)** of data or documents stored in a computer.

- It converts **digital data** into **text or graphics** on paper.
- Printers are widely used in **offices, homes, and industries**.

Basic Technologies of Printers

Printers can be broadly classified based on **printing technology**. The main types are:

1. **Impact Printers**
    - Operate by **physically striking an inked ribbon against the paper**.
    - **Examples:** Dot matrix printer, Daisy wheel printer.

- **Advantages:** Can print multi-part forms (carbon copies).
- **Disadvantages:** Noisy, slower, lower print quality.

2. **Non-Impact Printers**
   - Print **without physically striking** the paper.
   - **Examples:**
     - **Inkjet printer:** Sprays tiny droplets of ink on paper.
     - **Laser printer:** Uses a **laser beam and toner** to produce images.
     - **Thermal printer:** Uses **heat-sensitive paper** to produce images.
   - **Advantages:** Quiet, faster, high-quality output.
   - **Disadvantages:** Usually more expensive, limited paper types for some printers.

Summary Table

Technology	How it works	Examples	Key Feature
Impact Printer	Physically strikes ribbon/paper	Dot matrix, Daisy wheel	Can print carbon copies
Non-Impact Printer	No striking; sprays ink or uses laser	Inkjet, Laser, Thermal	Quiet, fast, high-quality

b) Briefly explain the **inkjet printer printing process**. [4]

An **inkjet printer** is a **non-impact printer** that sprays **tiny droplets of liquid ink** directly onto the paper to form an image or text.

Printing Process Steps

1. **Data Processing**
    - The computer sends the **digital image or text** to the printer.
    - The printer's **controller converts the data** into instructions for the inkjet nozzles.
2. **Ink Droplet Formation**
    - Tiny droplets of ink are generated using one of two methods:
        - **Thermal Bubble Method:** Heats the ink to create a bubble, which forces a droplet out of the nozzle.
        - **Piezoelectric Method:** Uses a piezoelectric crystal to create pressure, pushing the ink droplet.
3. **Droplet Ejection onto Paper**
    - The **print head moves across the paper** (or the paper moves under the stationary head).
    - Drops of ink are precisely **placed on the paper** to form characters or images.
4. **Paper Feed and Alignment**
    - The paper moves incrementally to **allow the next line of ink droplets** to be printed.
    - Ensures **accurate positioning** and avoids smudging.
5. **Drying**
    - Ink dries quickly on the paper, forming a **permanent image or text**.

Key Features of Inkjet Printing

- High-quality printing with **fine resolution** (up to 1200 dpi or more).
- Quiet and **suitable for home or office use**.
- Can print on **various types of paper**, including photo paper.

Summary Diagram (Textual)

Computer → Printer Controller → Ink Droplet Formation → Print Head Ejects Ink → Paper Feed → Drying

c) Why **Laser printer** is so popular over other printers? [4]

Sure! Let's explain this clearly.

---

c) Why Laser Printers Are Popular Over Other Printers

A **laser printer** is a **non-impact printer** that uses **laser beams, toner, and electrostatic charges** to produce high-quality prints. It is **very popular** because of several advantages over other types of printers like inkjet or dot matrix.

Reasons for Popularity

1. **High Printing Speed**
    - Can print **dozens of pages per minute**, much faster than inkjet printers.
    - Suitable for **offices and high-volume printing**.
2. **High Print Quality**
    - Produces **sharp text and clear graphics** due to precise laser technology.
    - Consistent quality on **every page**.
3. **Low Cost per Page**
    - Toner cartridges last **much longer** than ink cartridges.
    - Economical for **bulk printing**.
4. **Reliability and Durability**

- Fewer moving parts compared to impact printers.
- Less prone to **mechanical wear and tear**.

5. **Quiet Operation**
    - Unlike dot matrix or impact printers, laser printers are **virtually silent**.
6. **Supports Large Volume and Complex Jobs**
    - Can handle **large documents, multiple copies, and network printing** efficiently.

Summary Table

Feature	Laser Printer Advantage
Speed	High-speed printing
Print Quality	Sharp text and clear graphics
Cost per Page	Low (long-lasting toner)
Reliability	Durable and fewer moving parts
Noise	Quiet operation
Volume & Complexity	Handles large, complex print jobs easily

Question 8

a) Write short notes on the **Hall effect keyboard**. [4]

a) Hall Effect Keyboard

A **Hall Effect keyboard** is a type of **electronic keyboard** that uses the **Hall effect** to detect key presses.

Hall Effect Principle

- The **Hall effect** occurs when a **magnetic field** is applied perpendicular to a **current-carrying conductor**, producing a **voltage (Hall voltage) perpendicular to both**.
- In a keyboard, **each key has a small magnet or metal element**.
- Pressing a key **changes the magnetic field** detected by a Hall sensor, which generates a corresponding **electrical signal**.

Features of Hall Effect Keyboards

1. **Non-contact operation**
    - Keys do **not need to physically touch the circuit**, reducing wear and tear.
2. **Durable and Long-lasting**
    - Can withstand **millions of key presses** without failure.
3. **Reliable**
    - Less prone to **dust, moisture, or dirt**, since there is no direct electrical contact.
4. **Smooth and Quiet Operation**

- Keys can be pressed **softly**, ideal for industrial or professional use.

Advantages

- Very **durable and reliable**.
- Can be used in **harsh environments** (industrial, medical, military).
- Minimal maintenance required.

Disadvantages

- **More expensive** than ordinary membrane or mechanical keyboards.
- Slightly **larger and heavier** due to sensors and magnets.

b) Write down the **difference between laser keyboard and dome switch keyboard**. [4]

Sure! Let's compare the **Laser Keyboard** and **Dome Switch Keyboard** clearly.

---

b) Difference Between Laser Keyboard and Dome Switch Keyboard

Feature	Laser Keyboard	Dome Switch Keyboard
Working Principle	Uses **laser beams or infrared sensors** to detect key presses.	Uses **pressure on a rubber/silicone dome** to close a circuit and register a key press.
Contact Type	**Non-contact** – no physical contact needed.	**Contact-based** – pressing the dome makes electrical contact.

Durability	High durability, no wear from key presses.	Less durable; domes may wear out after prolonged use.
Typing Feel	Usually **light and smooth**, no tactile resistance.	**Tactile feedback** – softer or bouncy feel when pressed.
Cost	Expensive due to laser/infrared sensors.	Cheaper and widely used.
Maintenance	Low maintenance; less affected by dust or spills.	Moderate maintenance; dust or dirt can affect key operation.
Applications	Advanced, futuristic, or touchless interfaces.	Common desktop keyboards, laptops, and low-cost devices.

Summary

- **Laser Keyboard** → Non-contact, durable, expensive, futuristic.
- **Dome Switch Keyboard** → Contact-based, affordable, tactile, common in everyday devices.

c) What is **hall effect keyboard**? Write down the **working principle of these keyboard**. [5]

c) Hall Effect Keyboard

A **Hall Effect keyboard** is an **electronic keyboard** that uses the **Hall effect** to detect key presses.

- Unlike mechanical or membrane keyboards, it is a **non-contact type**, meaning the key **does not need to physically touch a circuit**.

- It is **durable, reliable**, and can withstand harsh environments, making it ideal for **industrial, medical, or military applications**.

Working Principle of Hall Effect Keyboard

1. **Hall Effect Principle**
    - When a **current-carrying conductor** is placed in a **magnetic field perpendicular** to the current, a **voltage (Hall voltage)** is generated **perpendicular to both** the current and the magnetic field.
    - This voltage is used to **detect the presence or absence of a magnetic field**.
2. **Keyboard Construction**
    - Each key has a **small magnet or metal component** underneath.
    - A **Hall sensor** is placed beneath the key.
3. **Key Press Detection**
    - When a key is pressed, the **magnet moves closer to the Hall sensor**.
    - The Hall sensor **detects the change in the magnetic field** and generates a **corresponding electrical signal**.
4. **Signal Processing**
    - The keyboard's **controller receives the signal** and converts it into a **digital code** corresponding to the pressed key.
    - This digital code is sent to the **computer**.
5. **Non-contact Operation**
    - Since there is **no physical contact** between the key and the circuit, the keyboard is **highly durable and reliable**.

Advantages

- Extremely **durable**; can last for **millions of key presses**.
- Works well in **dusty, wet, or harsh environments**.
- Provides **quiet and smooth keypress operation**.

Summary Diagram (Textual)

[Key + Magnet] → [Hall Sensor detects magnetic change] → [Controller processes signal] → [Computer receives key code]

If you want, I can **draw a labeled diagram showing a Hall effect keyboard key, magnet, sensor, and signal flow** for easier understanding.

Do you want me to do that?