

Comprehensive Notes On Fundamentals of Computer (Unit 1)

Class XI - Information Technology

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1 Session 1: Fundamentals of Computer

1.1 Evolution and Concept of Computers

The word **Computer** is derived from the Latin word '*compute*', which means to calculate. Historically, calculations were performed manually, which was slow and highly error-prone. The invention of calculating devices progressed from the ancient **Abacus** to modern supercomputers capable of performing trillions of calculations per second.

Definition of a Computer

A computer is an electronic device that accepts raw data and instructions as **Input**, processes the data according to specified programs in the **Processing Unit**, and produces meaningful results as **Output**.

1.2 Binary Language and High-Level Programming Languages

- **Binary / Machine Language:** Computers operate using electronic signals representing two states: ON (1) and OFF (0). Data and instructions in machine language consist solely of binary digits (0s and 1s).
- **High-Level Languages (HLL):** Human-readable programming languages using English-like syntax (e.g., C, C++, Java, Python, JavaScript). HLL code must be converted into machine language using software translators (**Compilers** or **Interpreters**).
- **Hardware vs. Software:**
 - *Hardware:* Tangible physical components of a computer (keyboard, monitor, CPU, hard disk).
 - *Software:* Intangible programs, routines, and operational instructions that direct hardware execution (Operating Systems, web browsers, spreadsheets).

1.3 Characteristics of a Computer

Computers possess seven fundamental characteristics that distinguish them from manual processing:

Characteristic	Core Concept / Definition	Measurement / Significance
Speed	Ability to process data and execute instructions rapidly.	Measured in MIPS (Million Instructions Per Second). Communication speed is measured in Baud .
Versatility	Capability to perform completely different tasks simultaneously or sequentially.	Switching effortlessly from typing word documents to executing payroll calculations.
Accuracy	Executes calculations with high precision without internal errors.	Errors occur due to bad input data or faulty logic, known as GIGO (Garbage In, Garbage Out).
Diligence	Untiring nature; executes millions of repetitive tasks without fatigue or boredom.	Repeats complex additions 10,000 times with identical precision.
Memory	Stores programs and data in primary memory during execution.	Primary RAM is volatile (lost when powered off).
Storage	Retains massive volumes of data for long-term retrieval.	Stored in non-volatile secondary storage (Hard Disks, SSDs, Pen Drives).
Intelligence	Evolving capability from dumb instruction followers to AI systems.	Modern Artificial Intelligence enables self-driving vehicles and autonomous chess engines.

1.4 Functional Components of a Computer (The IPO Cycle)

Every computer operation follows the **Input-Process-Output (IPO) Cycle**:

⚙️ Functional Units of Computer Architecture

- Input Unit:** Captures data and programs from external devices (Keyboard, Mouse, Scanner).
- Central Processing Unit (CPU):** The brain of the computer, comprising:
 - Arithmetic Logic Unit (ALU):* Performs arithmetic operations (+, −, ×, /) and logical comparisons (<, >, =, ≠).
 - Control Unit (CU):* Acts as the central manager, coordinating data flow between memory, ALU, and peripheral I/O devices.
- Memory / Storage Unit:** Holds data, programs, and intermediate computation results.
 - Primary Memory (RAM & ROM):* Directly accessed by CPU for current working tasks.
 - Secondary Storage:* High-capacity permanent storage (HDD, SSD).
 - Cache Memory:* High-speed buffer memory placed between CPU and RAM to reduce data access time.
- Output Unit:** Converts internal digital results into human-readable form (Monitor, Printer, Speakers).

1.5 Comparison of Primary Memory Types

Primary memory is broadly classified into RAM (volatile) and ROM (non-volatile):

Parameter	Dynamic RAM (DRAM)	Static RAM (SRAM)
Primary Application	Used as system Main Memory (RAM).	Used as CPU Cache Memory.
Speed & Cost	Slower access speed; relatively inexpensive.	Extremely fast access speed; expensive.
Power Consumption	Consumes less power; requires periodic refresh cycles.	Consumes more power; no refresh cycle needed.

Types of Read Only Memory (ROM)

ROM contains permanent startup instructions (**BIOS / Bootstrapping**). Varieties include:

- **PROM:** Programmable ROM (written once by user).
- **EPROM:** Erasable Programmable ROM (erased using Ultraviolet light).
- **EEPROM:** Electrically Erasable Programmable ROM (erased electrically; used in modern flash memory).

2 Session 2: Components of Computer

2.1 The Motherboard and Internal Bus Architecture

The **Motherboard** is the primary printed circuit board (PCB) inside a computer cabinet. It interconnects the CPU, RAM modules, expansion cards (video/sound), power supply connectors, hard drive interfaces, and external peripheral ports (USB, HDMI, Ethernet).

2.2 Detailed Input and Output Peripherals

Device Name	Type (Input / Output)	Operational Function
Keyboard	Input	Standard alphanumeric text and command entry device.
Mouse	Input	Graphical pointing device for selecting screen objects.
Webcam	Input	Captures real-time video feeds and digital images.
Scanner	Input	Digitizes physical paper documents into digital graphics/PDFs.
Microphone	Input	Converts acoustic voice signals into digital audio data.
Digitizer Tablet	Input	Captures freehand handwriting and graphical pen strokes.
Monitor (VDU)	Output	Standard Visual Display Unit (LCD, LED) showing soft copies.
Printer	Output	Produces permanent physical text and graphic hard copies.
Plotter	Output	High-precision vector printer for large architectural maps and blueprints.
Projector	Output	Projects enlarged screen displays onto large screens for audiences.

2.3 Processor Speed and Power Supply Unit (PSU)

- **Processor Technology:** Processors utilize multi-core architecture (Dual-core, Quad-core, Octa-core) from major manufacturers such as Intel and AMD.
- **Clock Speed Measurement:** Processor speed is measured in **Megahertz (MHz)**—millions of cycles per second, or **Gigahertz (GHz)**—billions of cycles per second.
- **Power Supply Unit (PSU / SMPS):** Converts high-voltage AC grid power (230 V) into regulated low-voltage DC power required by internal electronic microchips.

2.4 Digital Storage Measurement Hierarchy

Computer memory is structured in binary units base-2 ($2^{10} = 1024$):

Data Unit	Equivalent Value	Relative Size Scale
1 Bit (b)	Binary Digit (0 or 1)	Smallest unit of data.
1 Nibble	4 Bits	Half a byte.
1 Byte (B)	8 Bits	Stores a single ASCII character.
1 Kilobyte (KB)	1024 Bytes = 2^{10} Bytes	Small text file.
1 Megabyte (MB)	1024 KB = 2^{20} Bytes	High-resolution photo / MP3 audio.
1 Gigabyte (GB)	1024 MB = 2^{30} Bytes	HD movie file / RAM capacity.
1 Terabyte (TB)	1024 GB = 2^{40} Bytes	Standard Hard Disk capacity.
1 Petabyte (PB)	1024 TB = 2^{50} Bytes	Data center storage pool.
1 Exabyte (EB)	1024 PB = 2^{60} Bytes	Global enterprise cloud server.
1 Zettabyte (ZB)	1024 EB = 2^{70} Bytes	Global annual internet traffic scale.
1 Yottabyte (YB)	1024 ZB = 2^{80} Bytes	Maximum standardized unit.

3 Session 3: Operating System

3.1 Definition and Core Role

An **Operating System (OS)** is system software that acts as an intermediary interface between the user/application software and computer hardware components.

Historical Note & Examples

Gary Arlen Kildall is widely recognized as a pioneer of microcomputer operating systems (creator of CP/M). Popular OS examples include Windows, Linux, Unix, macOS, MS-DOS, Android, and Solaris.

3.2 Five Core Functions of an Operating System

1. **Communication Manager:** Manages hardware peripheral recognition using specialized programs called **Device Drivers**.
2. **Resource Manager:** Allocates CPU time, RAM space, I/O devices, and file access to competing programs based on priority.
3. **Process Manager:** Schedules, executes, and terminates active processes, determining processor time allocation via CPU scheduling algorithms.
4. **Memory Manager:** Dynamically allocates RAM blocks to active applications and reclaims memory upon process completion.
5. **File Manager:** Controls file creation, directory structures, access rights, renaming, deletion, and physical disk tracking using File Systems.

3.3 File Allocation Systems: FAT vs. NTFS

- **FAT (File Allocation Table):** Legacy file system tracking cluster locations on disk. Formats include **FAT16** (16-bit addressing) and **FAT32** (32-bit addressing).

- **NTFS (New Technology File System):** Modern Windows file system offering file encryption, journaling, large file support, and security permissions.

3.4 Classification of Operating Systems

OS Type	Core Mechanism	Example
Single-Tasking	Allows execution of only one program at a time.	MS-DOS.
Multi-Tasking	Executes multiple programs simultaneously via CPU time-sharing.	Windows 11, Linux, macOS.
Single-User	Supports only one user session at a time.	Desktop PCs, Smartphones.
Multi-User	Maintains multiple concurrent user accounts and sessions.	Unix / Linux Servers.
Real-Time (RTOS)	Guarantees deterministic, strict response times for critical events.	Anti-aircraft missile guidance, medical life support systems.
Batch Processing	Clubs similar jobs into batches and executes them sequentially without user intervention.	Punch-card billing systems, payroll batch runs.

4 Session 4: Troubleshooting and Utilities

4.1 Fundamentals of Computer Troubleshooting

Troubleshooting is a systematic trial-and-error process of elimination used to diagnose and resolve hardware, software, and network failures.

⚠ Essential Data Safety Rule

Always perform a complete data backup to an external drive (Pen Drive, External HDD, Cloud) before starting hardware repairs or system reformatting to prevent permanent data loss.

4.2 Common Hardware Troubleshooting Procedures

- **Blank Screen / No Display:**

- (1) Check if system is in *Sleep Mode* (press any key or move mouse).
- (2) Verify VGA/HDMI cable and power cord connections between monitor and cabinet.
- (3) Check if laptop battery is depleted; plug into AC power socket.

- **Keyboard Unresponsive:**

- (1) Verify USB cable connection or replace wireless batteries.
- (2) Inspect cord for physical cuts.

- (3) If keys are stuck, power off computer and clean keyboard with a soft brush and slightly damp cloth.

- **Mouse Unresponsive:**

- (1) Re-seat USB connector or restart wireless mouse power switch.
- (2) Clean optical sensor lens on underside of mouse with a lint-free cloth.

- **Printer Troubleshooting:**

- (1) Check power connection, paper tray jams, and ink/toner levels.
- (2) *Network Printer IP Mismatch:* Access **HP Print Assistant** → **Utilities** → **Update IP Address**. Verify printer's IP (e.g., 192.168.1.5) matches PC configuration (192.168.1.11).
- (3) *Wrong Default Printer:* Open Control Panel → **Devices and Printers** → Right-click target printer → Select **'Set as Default Printer'** (marked with green checkmark).
- (4) *Slow Printing Speed:* Open Printing Preferences → Select **'Fast Draft'** / **'Economical Printing'** mode.

- **No Audio / Sound Failure:**

- (1) Check taskbar master volume slider and application volume controls.
- (2) Ensure external speakers are plugged into green audio output jack.
- (3) Test audio output with headphones to isolate whether speakers or audio drivers are faulty.

4.3 Software Troubleshooting and System Recovery

- **Frozen Application:** Press Ctrl + Alt + Delete to open **Windows Task Manager**. Select non-responsive program marked *'Not Responding'* under Applications tab, and click **'End Task'**.
- **System Frozen / Completely Unresponsive:** Perform a **Hard Reboot** by holding the physical Power button down for 5–10 seconds until power cuts off. Switch on again and run a virus scan.

4.4 System Utilities and Disk Optimization

System utilities are specialized maintenance tools designed to optimize system performance, security, and storage space:

Utility Software	Primary Operational Function	Execution Steps
Antivirus Scanner	Scans memory and disk for background malware/viruses slowing down CPU.	Run full system scan via installed Security Software.
Disk Cleanup	Removes unnecessary system temp files, error logs, and update caches.	My Computer → Right-click C: → Properties → General → Click Disk Cleanup .
Recycle Bin Emptying	Reclaims disk space occupied by deleted files.	Right-click Recycle Bin on Desktop → Click Empty Recycle Bin .
Browsing History Clear	Deletes temporary internet files and browser cache.	Control Panel → Internet Options → General tab → Click Delete Browsing History .
Disk Defragmentation	Rearranges fragmented file blocks contiguously on magnetic hard drive.	Local Disk (C:) Properties → Tools tab → Click Defragment Now .
Startup Service Manager	Disables non-essential background startup services.	Control Panel → Administrative Tools → Services → Stop & Disable service.

4.5 Network Troubleshooting Framework

1. **Taskbar Connectivity Check:** Inspect network tray icon. An orange star or red 'X' indicates disconnected network state.
2. **Checking IP Address Validity via Command Prompt:**
 - Open Command Prompt: Press **Start** → Type cmd → Press Enter.
 - Type ipconfig and press Enter.
 - Verify IPv4 Address, Subnet Mask, and Default Gateway. If disconnected, output displays '*Media disconnected*'.
3. **Checking Network Fly Lead (Ethernet Cable):** Inspect physical RJ-45 cable connected between PC network card and wall ethernet socket. Test with a known working spare cable.
4. **Testing Network Interface Card (NIC) via Loopback Ping:**
 - In Command Prompt, type ping 127.0.0.1 and press Enter.
 - A successful reply confirms that the local Network Card hardware and TCP/IP stack are functioning properly.

5 Comprehensive Question Bank

5.1 Multiple Choice Questions (MCQs)

1. What is the smallest unit of digital information in a computer?

- (A) Byte
- (B) Bit
- (C) Nibble
- (D) Kilobyte

Answer: (B)

Explanation: A Bit (Binary Digit) representing 0 or 1 is the fundamental atomic unit of digital storage.

2. How many bits constitute one Nibble?

- (A) 2 Bits
- (B) 4 Bits
- (C) 8 Bits
- (D) 16 Bits

Answer: (B)

Explanation: 1 Nibble is equal to exactly 4 bits (half of a byte).

3. Which component of the CPU acts as the central manager, coordinating data flow between memory and peripherals?

- (A) Arithmetic Logic Unit
- (B) Control Unit
- (C) Primary RAM
- (D) Hard Disk

Answer: (B)

Explanation: The Control Unit (CU) coordinates all computer hardware operations and instruction execution.

4. Which memory type is volatile, losing all stored data when power is switched off?

- (A) ROM
- (B) EEPROM
- (C) RAM
- (D) Hard Disk

Answer: (C)

Explanation: Random Access Memory (RAM) is volatile working memory; its contents clear when power is disconnected.

5. What phenomenon describes computer errors caused by wrong input data or incorrect user instructions?

- (A) MIPS
- (B) GIGO
- (C) Baud
- (D) RTOS

Answer: (B)

Explanation: GIGO stands for Garbage In, Garbage Out—incorrect input yields incorrect output.

6. Which operating system type guarantees fixed, deterministic response times for critical applications?

- (A) Single-User OS
- (B) Batch Processing OS
- (C) Real-Time Operating System (RTOS)
- (D) Multi-Tasking OS

Answer: (C)

Explanation: RTOS is designed for time-critical systems like missile guidance and medical monitors.

7. Which command-line utility tests whether a Network Interface Card (NIC) hardware is functional using a loopback address?

- (A) ipconfig
- (B) ping 127.0.0.1
- (C) defrag
- (D) cls

Answer: (B)

Explanation: ping 127.0.0.1 sends loopback ICMP packets to test internal NIC hardware functionality.

8. What key combination opens the Windows Task Manager to forcefully end frozen applications?

- (A) Alt + F4
- (B) Ctrl + Alt + Delete
- (C) Ctrl + Shift + Esc
- (D) Windows + R

Answer: (B)

Explanation: Ctrl + Alt + Delete accesses security options and Task Manager to terminate unresponsive tasks.

9. Which utility program rearranges fragmented file blocks contiguously on a magnetic hard drive?

- (A) Disk Cleanup
- (B) Antivirus Scanner
- (C) Disk Defragmentation
- (D) IPConfig

Answer: (C)

Explanation: Disk Defragmentation consolidates scattered file fragments to accelerate disk read/write speeds.

10. How many Gigabytes (GB) are equivalent to 1 Terabyte (TB)?

- (A) 1000 GB
- (B) 1024 GB
- (C) 512 GB
- (D) 2048 GB

Answer: (B)

Explanation: Digital memory units scale by powers of 2 ($2^{10} = 1024$), making 1 TB = 1024 GB.

5.2 Assertion-Reasoning Questions

- Assertion (A):** Errors produced in computer outputs are primarily caused by hardware failure.
Reason (R): Computers operate under the GIGO principle, where wrong input data or flawed instructions yield incorrect results.
Answer: A is false but R is true.
Explanation: Computers possess high accuracy; processing errors stem from bad user data or faulty software logic (GIGO), not hardware defects.
- Assertion (A):** Cache memory is placed between the CPU and Primary RAM to accelerate data access.
Reason (R): Cache memory is an extremely high-speed, expensive buffer that holds frequently accessed data for the CPU.
Answer: Both A and R are true, and R is the correct explanation of A.
Explanation: Cache memory bridges the operational speed gap between high-speed CPU registers and relatively slower main RAM.
- Assertion (A):** Data stored in RAM is permanently retained when the computer is turned off.
Reason (R): RAM is primary volatile working memory requiring continuous electric current to maintain data state.
Answer: A is false but R is true.
Explanation: RAM is volatile memory; all data clears immediately when system power is disconnected.
- Assertion (A):** Running ipconfig in Command Prompt allows users to verify system IP address settings.
Reason (R): ipconfig displays active network interface settings including IPv4 address, subnet mask, and default gateway.
Answer: Both A and R are true, and R is the correct explanation of A.
Explanation: ipconfig is the standard Windows network configuration diagnostic command.
- Assertion (A):** A hard reboot should be used as the primary method whenever a single program runs slowly.
Reason (R): Hard reboots force sudden power cuts which can cause file corruption and data loss.
Answer: A is false but R is true.
Explanation: Hard reboots should be a last resort for total system freezes due to data loss risks; slow programs should be closed or ended via Task Manager.

5.3 One-Word / Brief Answer Questions

- Name the fundamental operational cycle followed by every computer task.
Answer: Input-Process-Output (IPO) Cycle.
- What is the term for a set of instructions given to a computer to perform a specific task?
Answer: Program (Software).
- Name the high-speed buffer memory placed between CPU and main RAM.
Answer: Cache Memory.

4. What unit measures computer processing speed in terms of millions of instructions per second?
Answer: MIPS (Million Instructions Per Second).
5. Name the primary printed circuit board that connects all internal hardware components.
Answer: Motherboard.
6. What software component translates peripheral hardware properties for the operating system?
Answer: Device Driver.
7. Name the modern Windows file system that supports file encryption and journaling.
Answer: NTFS (New Technology File System).
8. Which command-line tool is used to display current system IP address details?
Answer: ipconfig.
9. What is the exact loopback IP address used to test network card hardware?
Answer: 127.0.0.1.
10. Name the utility used to remove temporary internet files, update caches, and system junk.
Answer: Disk Cleanup.

5.4 Differentiate Between Questions

1. Differentiate between Hardware and Software.

Feature	Hardware	Software
Nature	Tangible physical components.	Intangible set of programs/instructions.
Function	Provides physical execution capability.	Directs hardware actions and logic execution.
Examples	CPU, Motherboard, Keyboard, RAM.	Windows OS, Python, LibreOffice Writer.

2. Differentiate between Dynamic RAM (DRAM) and Static RAM (SRAM).

Feature	Dynamic RAM (DRAM)	Static RAM (SRAM)
Application	Used as main working memory (RAM).	Used as high-speed CPU Cache memory.
Speed & Refresh	Slower; requires continuous refreshing.	Extremely fast; no refresh cycle needed.
Cost & Power	Inexpensive; lower power consumption.	Expensive; higher power consumption.

3. Differentiate between Primary Memory and Secondary Storage.

Feature	Primary Memory	Secondary Storage
CPU Access	Directly accessible by CPU bus.	Indirectly accessed via I/O controllers.
Volatility	Volatile (RAM lost on power off).	Non-volatile (permanent data retention).
Capacity & Speed	High speed; limited capacity (GBs).	Moderate speed; huge capacity (TBs).

4. Differentiate between Control Unit (CU) and Arithmetic Logic Unit (ALU).

Feature	Control Unit (CU)	Arithmetic Logic Unit (ALU)
Role	Manager and central coordinator.	Actual data processor.
Function	Directs instruction fetching, decoding, data flow.	Executes arithmetic (+, −, ×) and logic (<, >) math.
Data Modification	Does not alter data values.	Computes new data results.

5. Differentiate between Single-Tasking OS and Multi-Tasking OS.

Feature	Single-Tasking OS	Multi-Tasking OS
Execution	Runs only one program at any given moment.	Runs multiple programs concurrently via CPU time-sharing.
Resource Sharing	Dedicated allocation to single job.	Time-sliced CPU scheduling and dynamic RAM allocation.
Example	MS-DOS.	Windows 11, Linux, macOS.

5.5 Short Answer Questions

1. Explain the IPO cycle with a suitable real-world example.

Answer: The Input-Process-Output (IPO) cycle describes how computers accept raw data (Input), process it according to program instructions in the CPU (Process), and display the result (Output). For example, entering numbers 15 and 25 via keyboard (Input), adding them in ALU (Process), and displaying sum 40 on the monitor (Output).

2. What is GIGO? How does it relate to computer accuracy?

Answer: GIGO stands for *Garbage In, Garbage Out*. It means that computers perform operations with absolute mathematical accuracy, so any output error is a direct result of incorrect input data or faulty program logic supplied by the user, rather than hardware defect.

3. Describe the role of Cache memory in computer performance.

Answer: Cache memory is an extremely high-speed buffer memory located between the CPU and primary RAM. It holds frequently accessed data and instructions, allowing the CPU to retrieve them rapidly without waiting for slower RAM, thereby reducing access latency and boosting system speed.

4. Explain the difference between a printer and a plotter.

Answer: A printer produces hard copies of text documents and small graphics on standard paper

sizes (A4, Letter). A plotter is a specialized vector output device used by architects and engineers to print high-precision, large-scale technical blueprints, engineering drawings, and maps.

5. **What steps should be taken if a computer application freezes and becomes unresponsive?**

Answer: Press Ctrl + Alt + Delete to open Windows Task Manager, select the frozen application (marked *'Not Responding'*) under the Applications tab, and click *'End Task'* to forcefully terminate the process. If Task Manager fails, perform a system restart.

5.6 Long Answer Questions

1. **Draw and explain the functional block diagram of a computer system in detail.**

Answer: A computer system consists of three primary functional blocks:

(1) Input Unit: Accepts raw data and instructions from input peripherals (Keyboard, Mouse, Scanner) and converts them into digital binary format.

(2) Central Processing Unit (CPU):

- *Arithmetic Logic Unit (ALU):* Carries out mathematical calculations (+, −, ×, /) and relational comparisons (<, >, =, ≠).
- *Control Unit (CU):* Acts as the central manager, controlling data transfer between registers, ALU, RAM, and I/O devices.
- *Registers & Memory Unit:* Stores current working instructions in RAM and high-speed cache.

(3) Output Unit: Converts digital processed data into human-readable text, graphics, or audio (Monitor, Printer, Speakers).

(4) Secondary Storage Unit: Non-volatile storage (HDD, SSD) retaining data permanently for future retrieval.

2. **Detail the five core functions of an Operating System with suitable explanations.**

Answer: An Operating System manages core hardware and software resources:

(1) Communication Manager: Uses specialized software drivers to manage peripheral communication (printers, keyboards, network cards).

(2) Resource Manager: Allocates CPU time, RAM space, file handles, and I/O channels to competing processes to optimize performance.

(3) Process Manager: Schedules executing processes, assigns processor time slots, and handles process creation/termination.

(4) Memory Manager: Dynamically allocates memory blocks in RAM to active applications and reclaims space when programs close.

(5) File Manager: Manages file creation, folder structures, access permissions, and disk tracking using file allocation systems (FAT, NTFS).

3. **Explain the complete troubleshooting procedure for a network printer that is not printing due to an IP address mismatch.**

Answer: When a wireless or networked printer fails to print, the configured IP address on the PC may differ from the printer's current dynamic IP:

(1) Step 1: Open Control Panel → Devices and Printers → Select printer (e.g., HP Deskjet 3540).

(2) Step 2: Launch HP Print Assistant → Click *Utilities* → Run *'Update IP Address'* utility.

(3) Step 3: Check the printer's current IP address by pressing the Wireless/Ethernet icon on the printer display (e.g., 192.168.1.5).

(4) Step 4: Compare the current IP (192.168.1.5) with the previous IP saved on system (192.168.1.11). Enter current IP into utility and click *Test*.

(5) Step 5: Upon receiving a success message, click *Save* to update system settings and send print jobs cleanly.

5.7 Case-Study / Competency-Based Questions

1. Case Study 1: Troubleshooting Storage Capacity and System Slowdown

Scenario: An office desktop running Windows has become extremely sluggish. Applications take several minutes to launch, and downloading email attachments fails. The technician inspects the Local Disk (C:) Properties and finds that out of 500 GB capacity, only 50 MB free space remains.

Sub-Questions:

- (a) What is the minimum recommended free disk space required on a C: drive for smooth OS functioning?
- (b) Outline three specific utility applications/steps the technician should use to free disk space.
- (c) Why does running a Disk Defragmentation program improve system performance after deleting files?

Answers:

- (a) A minimum of 200–500 MB (ideally 10–15% of total drive capacity) is required for virtual memory paging and temporary OS files.
- (b) (1) Run **Disk Cleanup** utility to delete temporary system files; (2) Empty the **Recycle Bin**; (3) Clear browser temporary history via **Internet Options**.
- (c) Defragmentation consolidates scattered file fragments across magnetic hard drive sectors, allowing read/write heads to access files contiguously without excessive physical travel.

2. Case Study 2: Network Connectivity Diagnostics

Scenario: A student is unable to open study portal websites on her computer connected via ethernet. The network tray icon shows a red 'X'. Her teacher asks her to use command-line diagnostics to identify whether the issue lies in the network card or the physical ethernet cable.

Sub-Questions:

- (a) What command should the student run in Command Prompt to check her system's IP configuration, and what will it display if disconnected?
- (b) How can the student test whether her Network Interface Card (NIC) hardware is functional using the ping command?
- (c) What is the ethernet cable connecting a computer to a wall network socket called, and how can cable failure be isolated?

Answers:

- (a) Run `ipconfig`. If disconnected, it displays '*Media disconnected*'.

- (b) Type `ping 127.0.0.1`. Receiving a reply confirms that internal NIC hardware and TCP/IP stack are functional.
- (c) The cable is called a **Network Fly Lead**. Cable failure is isolated by replacing it with a known working spare fly lead.

3. Case Study 3: Print Job Management in Office Environments

Scenario: In a school computer lab with two network printers—*Printer A (HP Deskjet)* and *Printer B (Laserjet 1020)*—students report that clicking 'Print' does not produce output on Printer B. Upon inspection, the green tick icon in Devices and Printers is set on Printer A, while Printer B is currently offline.

Sub-Questions:

- (a) Why were print jobs automatically directed to Printer A instead of Printer B?
- (b) Explain how to permanently set Printer B as the Default Printer on Windows.
- (c) How can a user print a document to Printer B without changing the global default printer setting?

Answers:

- (a) Printer A was configured as the system's **Default Printer** (indicated by the green checkmark).
- (b) Open Control Panel → Devices and Printers → Right-click *HP Laserjet 1020 (Printer B)* → Select '**Set as default printer**'.
- (c) In the application's Print Dialog window, manually select *Printer B* from the drop-down list of available printers before clicking the *Print* button.